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**Teaching and assessment of learning in statistics: the experiences of multipurpose teachers in initial training**

*Enseñanza y evaluación del aprendizaje en estadística: experiencias de profesoras polivalentes en la formación inicial*

*Enseignement et évaluation des apprentissages en statistique : expériences d'enseignantes polyvalentes dans la formation initiale*

*Ensino e avaliação das aprendizagens em estatística: vivências de professoras polivalentes na formação inicial*

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**Abstract**

This article aimed to analyze the experiences of teaching and assessment in Statistics among versatile teachers during their initial training for teaching, considering both pedagogical and emotional dimensions that

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permeate this process. The research question sought to understand how teaching and assessment practices experienced during this period influenced the relationship of these teachers, who worked in the early years of elementary education, with statistical content and with their own professional development. The theoretical framework articulated contributions on the knowledge base for teaching, assessment of learning, and the emotional implications of teaching practice. The study, qualitative in nature and interpretative in approach, involved twelve versatile teachers from public schools in Paraná, Brazil, whose formative trajectories included Teacher Training, Pedagogy, and other undergraduate programs. Data was generated through semi-structured interviews and analyzed using Discursive Textual Analysis, which enabled the construction of categories related to assessment practices, the emotions arising from these practices, and their implications for learning. The results revealed the predominance of summative assessments, focused on exams and tests, which triggered feelings of fear, anxiety, insecurity, and frustration, negatively affecting the teachers' relationship with Statistics and, in some cases, generating aversion to discipline. It is concluded that such experiences reinforce the need to rethink initial teacher education by diversifying assessment strategies capable of promoting statistical literacy, meaningful learning, and greater sensitivity to the emotional dimensions of teaching practice.

**Keywords:** Assessment of learning, Emotions, Teaching of statistics, Training of versatile teachers, Experiences.

### **Resumen**

Este artículo tuvo como objetivo analizar las experiencias de enseñanza y evaluación en Estadística de profesoras polivalentes durante su formación inicial para la docencia, considerando las dimensiones pedagógicas y emocionales que atraviesan dicho proceso. La pregunta de investigación buscó comprender cómo las prácticas de enseñanza y evaluación vividas en ese período influyeron en la relación de estas docentes, que actúan en los primeros años de la educación primaria, con los contenidos estadísticos y

con su propia formación profesional. El marco teórico articuló aportes sobre la base de conocimientos para la enseñanza, la evaluación de los aprendizajes y las implicaciones emocionales de la práctica docente. El estudio, de naturaleza cualitativa y enfoque interpretativo, involucró a doce profesoras polivalentes de escuelas públicas municipales de Paraná, Brasil, cuyos recorridos formativos incluyeron Magisterio, Pedagogía y otras licenciaturas. Los datos fueron producidos mediante entrevistas semiestructuradas y analizados a través de la metodología del Análisis Textual Discursivo, que permitió la construcción de categorías relacionadas con las prácticas evaluativas vividas, las emociones derivadas de dichas prácticas y sus implicaciones para el aprendizaje. Los resultados revelaron la predominancia de evaluaciones sumativas, centradas en exámenes y pruebas, que generaron sentimientos de miedo, ansiedad, inseguridad y frustración, afectando negativamente la relación de las profesoras con la Estadística y, en algunos casos, produciendo aversión hacia la disciplina. Se concluye que estas experiencias refuerzan la necesidad de repensar la formación inicial, diversificando estrategias evaluativas capaces de promover la alfabetización estadística, aprendizajes significativos y una mayor sensibilidad hacia las dimensiones emocionales de la práctica docente.

**Palabras clave:** Evaluación de los aprendizajes Emociones, Enseñanza de la estadística, Formación de profesoras polivalentes, Experiencias.

### **Résumé**

Cet article a pour objectif d'analyser les expériences d'enseignement et d'évaluation en Statistique vécues par des professeures polyvalentes durant leur formation initiale à l'enseignement, en considérant les dimensions pédagogiques et émotionnelles qui traversent ce processus. La question de recherche visait à comprendre comment les pratiques d'enseignement et d'évaluation expérimentées pendant cette période ont influencé la relation de ces enseignantes, actives dans les premières années de l'enseignement

fondamental, avec les contenus statistiques et avec leur propre développement professionnel. Le cadre théorique a articulé des contributions sur la base de connaissances pour l'enseignement, l'évaluation des apprentissages et les implications émotionnelles de la pratique enseignante. L'étude, de nature qualitative et d'approche interprétative, a impliqué douze professeures polyvalentes d'écoles publiques municipales du Paraná, au Brésil, dont les parcours formatifs comprenaient le Magistère, la Pédagogie et d'autres licences. Les données ont été produites à partir d'entretiens semi-structurés et analysées selon la méthodologie de l'Analyse Textuelle Discursive, permettant la construction de catégories liées aux pratiques évaluatives vécues, aux émotions générées par ces pratiques et à leurs implications pour l'apprentissage. Les résultats ont révélé la prédominance d'évaluations sommatives, centrées sur des examens et des tests, qui ont suscité des sentiments de peur, d'anxiété, d'insécurité et de frustration, affectant négativement la relation des enseignantes avec la Statistique et, dans certains cas, engendrant une aversion pour la discipline. Il en ressort que ces expériences renforcent la nécessité de repenser la formation initiale, en diversifiant les stratégies d'évaluation capables de promouvoir la littératie statistique, des apprentissages significatifs et une plus grande sensibilité aux dimensions émotionnelles de la pratique enseignante.

**Mots-clés :** Évaluation des apprentissages, Émotions, Enseignement des statistiques, Formation d'enseignants polyvalents, Expériences vécues.

### **Resumo**

Este artigo teve como objetivo analisar as vivências de ensino e avaliação em Estatística de professoras polivalentes durante sua formação inicial para a docência, considerando dimensões pedagógicas e emocionais que permeiam esse processo. A questão de pesquisa buscou compreender como as práticas de ensino e avaliação experienciadas nesse período influenciaram a relação dessas docentes, atuantes nos anos iniciais do Ensino Fundamental, com os conteúdos estatísticos e com sua própria

formação profissional. O estudo se fundamentou em referenciais teóricos sobre base de conhecimentos para o ensino, avaliação das aprendizagens e implicações emocionais da docência. A investigação, de natureza qualitativa e abordagem interpretativa envolveu doze professoras polivalentes de escolas públicas municipais do Paraná, cujas trajetórias formativas incluíram Magistério, Pedagogia e outras licenciaturas. Os dados foram produzidos por meio de entrevistas semiestruturadas e analisados pela metodologia da Análise Textual Discursiva, que possibilitou a construção de categorias relacionadas às práticas avaliativas vivenciadas, às emoções decorrentes dessas práticas e às implicações para a aprendizagem. Os resultados evidenciaram a predominância de avaliações somativas, centradas em provas e testes, que suscitaram sentimentos de medo, ansiedade, insegurança e frustração, impactando negativamente a relação das professoras com a Estatística e, em alguns casos, gerando aversão à disciplina. Conclui-se que tais vivências reforçam a necessidade de repensar a formação inicial, diversificando estratégias avaliativas capazes de promover o letramento estatístico, aprendizagens significativas e maior sensibilidade às dimensões emocionais da prática docente.

**Palavras-chave:** Avaliação das aprendizagens, Emoções, Ensino de estatística, Formação de professores polivalentes, Vivências.

# **Teaching and assessment of learning in Statistics: the experiences of multipurpose teachers in initial training.**

## **Introduction**

The initial training of teachers is a decisive moment for the construction of a teacher's identity and for the development of the foundation of the knowledge needed for professional activity. Several studies (García & Vaillant, 2009; Gatti, 2020, 2022; Grossman, 1990; Nóvoa, 2017; Pimenta, 1996; Pimenta, Fusari, Pedroso & Pinto, 2017; Shulman, 1986, 1987; Tardif, 2002; Zeichner, 2010) demonstrate that during this period many concepts about curriculum, didactics, teaching methodology, educational assessment and other aspects inherent to teaching and assessment processes are consolidated and directly influence future teaching practices. Thus, understanding how teaching programs organize the teaching of Statistics content is crucial to assess the quality of the training provided.

It is during initial training that most of the basic knowledge needed for teaching is developed. Hence, it is fundamental to reflect on how the components of this training and the actions of the teacher trainers in teaching programs interfere in the process, as well as on the emotions regarding the learning assessment of specific content and areas of knowledge.

Teaching and assessment of learning in Statistics have been pointed out as being complex and challenging areas (Batanero, 2009; Estrella, 2016; Dias, 2021; Lopes, 2013). The literature has shown that often a technical approach that focuses on calculations has prevailed, in detriment of assessment practices that favor the interpretation of data and the development of statistical literacy (Jacobbe, 2012; Schreiber & Porciúncula, 2022). Furthermore, recent research highlights the fact that assessment practices restricted to summative exams and tests can generate feelings of anxiety, insecurity, fear and an aversion to the content (Brandalise, 2020; D. Fernandes, 2009; Dias, 2021). This emotional dimension, albeit often

neglected, has a fundamental role in learning and in the development of teacher identity.

With this context in mind, it is pertinent to investigate how multipurpose teachers experience teaching and assessment in Statistics during their initial training. Therefore, this article, stemming from a doctoral research, aims to analyze the teaching and assessment experiences in Statistics of multipurpose teachers during their initial training as teachers, taking into consideration the pedagogical and emotional dimensions that pervade this process, to understand how the teaching and assessment practices experienced during this period affect the affinity of teachers who work with the first years of elementary school with Statistics and their own professional training.

The relevance of this study lies in the articulation of three dimensions that are not often explored together: the teaching of Statistics in initial training programs, the assessment practices adopted and the feelings and emotions that arise from this process. This approach contributes to expand the discussion about the need for more integrated training practices that consider not only the intellectual sphere but also the emotional impact of learning.

This text is organized into four sections, besides this introduction and the final considerations. The first discusses the foundation of teaching and assessment of Statistics learning; the second addresses the relevance of emotions in learning and in teacher training; the third describes the methodological direction of the research; and the fourth presents the discussion of empirical data produced by the interviews with multipurpose teachers.

### **Teaching and assessment of learning in Statistics: revisiting some foundations**

Teaching statistics is far from being a simple task. There is some research to attest to this fact, dealing with related knowledge and the many practices observed since the introduction of concepts in this area to the

curriculum of Elementary Education in several countries (Batanero, 2009; Dias, Pereira & Santos 2019; Dias, Silva, Santos & Mesquita, 2022; Estrella, 2016; Jacobbe, 2012; Lopes, 2008, 2013; Lopes, Almeida & Santos, 2024; Samá, Amorin & Batanero, 2023). Evaluating learning related to Statistics demands even greater attention due to the complexity inherent to any evaluative process.

For a teacher to be able to teach any content it is essential that they have available a solid basis of knowledge about the particularities of the area, the general pedagogical aspects related to education, curriculum, pedagogical knowledge related to content (*Pedagogical Content Knowledge* - PCK), the characteristics of students, besides understanding the processes of learning assessment (Dias 2021; Grossman, 1990; Shulman, 1986, 1987).

The proposal of PCK in 1986, created by Lee Shulman at Stanford University in the United States, defines it as a specific knowledge held by teachers that is the result of how pedagogical knowledge (teaching methodologies) is articulated or related to knowledge about the content or topic of a subject (what we know about what we need to teach). The author considers PCK as the core for the basis of teaching knowledge and crucial for the effectiveness of teaching and learning processes.

The structure for this knowledge requires studying, reflecting and coherent formative actions. In Shulman's theory (1986, 1987) and in the model presented by Grossman (1990) some sources for the development of PCK are mentioned: learning to observe, knowledge about specific content (teaching area), professional training and teaching experience.

Regarding professional training, which is given in teaching programs or, in Brazil, also in High School level teaching programs and Teacher Training in general, for teachers who work with the initial school stages (Early Childhood Education and first years in Elementary Education), both teaching and learning assessment in Statistics are necessarily included in their curricula. However, research shows that this training still presents gaps, especially in terms of assessment practices (Dias, 2021).

When proposing the Knowledge Bases for Statistics Teaching (BCEE), Dias (2021) demonstrated how assessment practices are affected by the knowledge teachers have about educational objectives and theoretical-methodological references. Furthermore, the author points out that this also extends to the knowledge about statistical content, the context in which teaching occurs, the curriculum and the way students learn. These are similar aspects to what was discussed by Schreiber and Porciúncula (2022) when they reflect on assessment in Statistics.

Both studies indicate that, although teachers express a formative perspective of assessment, the focus is still a specific summative assessment with the prevalence of exams and tests, expressing the need for the student to get calculations and procedures right in order to reach the expected results (Dias, 2021; Schreiber & Porciúncula, 2022). This perspective is focused on measuring learning and tends to see error as punishment and not as a starting point to regulate teaching and learning processes. It is a perspective that evokes the first generations of educational assessment, characterized by positivist concepts and the predominance of measurement, classification and comparison (D. Fernandes, 2009; Guba & Lincoln, 2011).

Besides these studies, research by J. A. Fernandes, Alves, Machado, Correia and Rosário, (2009) revealed that multipurpose teachers, although they use different forms of teaching and assessing in Statistics, demonstrate limitations and difficulties, demonstrating the view that statistical concepts were easy to teach. This may be related to a more technical and superficial approach without the development students need to understand concepts and interpretative, argumentative and communicative issues based on data.

Overcoming positivist assessment positions, that exclusively technical and centered on results, presupposes the use of diverse, integrated teaching, assessment and learning procedures in the classroom that can contribute to student development. In this sense, the *Assessment of Learning*, also called Pedagogical Assessment (D. Fernandes, 2022), brings

together both the Formative Assessment, or Assessment *for* Learning, and Summative Assessment or Assessment *of* Learning, a proposition that shows the theoretical evolution in the field of educational assessment in the last 50 years, acknowledging the relations between curriculum, teaching, assessment and learning. "To many authors, it is assessment, fundamentally, that determines how the curriculum is developed, in other words, what and how one teaches and what and how one learns and hence it has a huge predominance in these relations" (D. Fernandes, 2022, p. 6).

In this perspective, it is crucial that, in the assessment of learning, the particularities of the field of Statistics as a science of data be taken into consideration in order to go beyond the mere procedural aspects of applying formulas and doing mathematical calculations as is commonly observed in some teaching practices revealed in the research by Dias (2021) and Schreiber and Porciúncula (2022).

We must understand that the evaluation of the learning of statistical knowledge, when done in a minimally coherent manner, is that which takes into consideration the aims of teaching and learning established for a specific content or grade. This includes giving attention to criteria, rubrics, tasks and assessment instruments, besides feedback, as essential points for the entire process, as has already been discussed by Dias (2021), D. Fernandes (2009, 2019) and J. A. Fernandes *et al.* (2009)

These aspects also indicate that there is a need for change in the conception and practices of assessment in Statistics by diversifying assessment techniques and instruments to investigate more accurately the processes of teaching and learning that are adequate for collecting information and indicating the degree of interaction between competencies, "knowledge and the disposition of students and their capacity to significantly explore realistic issues, statistical problems or situations, results or messages", whether as producers or interpreters of data (J. A. Fernandes *et al.*, 2009, p. 58).

In the same line of thought, Chá (2013) explains that the use of different assessment procedures and instruments contributes to learning

and overcoming learning challenges students have in relation to content in Statistics. The same author also mentions that this approach enables the development of diverse capacities and competencies such as those related to oral and written communication and the use of technology and the interpretation of reality. These aspects have a significant impact on the Statistics literacy of participants.

Based on these thoughts, one can state that teaching and assessing learning in Statistics demand change, attention and training. These aspects must also be present in the teaching practices of the teacher trainer, as defended by (Dias, Brandalise, Santos & Mesquita, 2023), since they perform a significant role in articulating the learning of the prospective teacher and in the feelings the latter has in relation to the content being studied. Hence, it is crucial to be attentive to the emotions and feelings that are intrinsically connected to the learning process as will be seen in the next section.

### **Emotions and learning in teacher training**

Emotions are a part of every situation in human life and in teaching and learning processes this is no different. The development of Neuroscience and neuroimage technology has led to a significant expansion of this understanding, indicating that, contrary to what was believed in the past, "emotions capture attention and help memory, making these more relevant and clearer; their activation or somatic stimulation triggers connections that strengthen cognitive functions" (Fonseca, 2016, p. 368).

Therefore, emotion and cognition cannot be separated. Information is always evaluated by the human brain within an emotional and not merely rational perspective. In the words of Fonseca (2016, p. 368), the human brain "gives information instant affective color and guides it subjectively to make decisions." This means that positive or negative feelings act along with more complex mental processes, influencing action directly.

With this assumption in mind, learning is closely related to the "neuro-functional [interactions] of the emotions, with mood and stress, all

effectively going through the deep interpersonal dynamics between teacher and student and of the latter and fellow students” (Fonseca, 2016, p. 368). Consequently, learning becomes more effective when there is a socially pleasant environment of sharing and communication, which reduces situations of fear, nervousness and stress.

According to Pinheiro (2022), emotion, affection, motivation and desire are processes that are inseparable from learning. The author emphasizes that undoubtedly an unmotivated person will not look for new knowledge. In this sense, a warm, affectionate and supportive environment is the most productive motivator for a student’s learning to take place. When effort is deemed worthy, an error can be surmounted since in “a partnership, the learning space becomes an ecologically cognitive, successful learning environment, contributing to the success of the educator” (Pinheiro, 2022, p. 7).

It is important to note that affectionate and communicative relations not only benefit the student, but the teacher as well. Teaching implies knowing how to teach, which is the main feature of this profession. This function refers, essentially, to “making someone learn something” (Roldão, 2007, p. 94), which requires the development of environments and experiences that facilitate the learning process.

Furthermore, learning takes places as a process and thus there are many variables along the way that interfere and that often result in frustration. Therefore, to learn it is essential that a student feel safe and accepted. To Fonseca (2016), the brain of a learner needs the safety offered by the mature brain of a more experienced person such as the teacher. This feeling of safety is crucial for the learner to take on the risks that are inherent to the process, such as “making mistakes and generating initial in-adaptations for proposed tasks or problems” (Fonseca, 2016, p. 368).

Within this reasoning, teaching and assessment practices that do not consider mistakes as organically part of the learning process and that use assessment as a form of punishment or control over a student's behavior tend not to contribute to overcoming learning difficulties. On the contrary,

they can produce fear, anxiety and rejection towards the content being taught.

This does not refer only to a child's learning but applies to everybody, regardless of their age, including students of higher education as exposed by the research by Rodríguez and Merino (2019), in which there is an intrinsic relation between emotion and learning, demonstrating that, in general, knowledge is not internalized when facing specific emotions such as fear, sadness, anger or shame. On the other hand, the learning process is facilitated when positive emotions are felt, such as joy. This corroborates what is stated by Fonseca (2016, p.368), who highlights that

It is only in an environment of affective safety that the human brain can function perfectly; only then do emotions opens the path towards cognition. In a threatening environment, one that is oppressive, debasing, humiliating or that takes away self-worth, the limbic system, located in the center of the brain, blocks the functioning of its superior cortical cerebral substrates, in other words, that of the cognitive functions of input, integration, planning, execution and output, which enable access to symbolic learning and the solution of complex problems that belong exclusively to the human species.

Hence, it is clear that emotions are implied in teaching and learning. Thus, it is important for the teacher to consider the emotional aspect not only in planning lessons but also in teaching for learning to be more effective. In other words, teaching implies in the teacher being attentive and thoughtful about the emotions that specific contents or subjects can bring about, as well as about their own teaching position and methodology (Anzelin, & Marín-Gutiérrez, 2020).

With this in mind, teacher training must be thought of as a process that does not only take place in the classroom but also with experiences in Elementary Education and in the undergraduate programs, all of which have a fundamental role in the initial training of a teacher. As mentioned in the previous section, Grossman (1990) indicates that PCK formation is done through several routes, all of which move through Elementary school, teacher training programs, whether during High School or at the undergraduate level, and in teaching practices.

In this article, focus will be given to undergraduate and high school programs, understood as the initial training for teaching. This training has a central place in the development of the basis of the knowledge needed for teaching, since it is during initial training programs that teachers have contact with specific subjects related to the content they will teach. To Grossman (1990), these programs are the more formal and systematic part of learning about the profession. Hence, it is paramount that theories on learning be connected to teaching practices in teaching programs, not only to teach students about their profession, but also because it is crucial that teacher trainers be aware of the theories at the basis of the pedagogic practices needed for student learning to be consolidated.

In other words, the teacher trainer must be focused on the students, for both their needs and emotions. A reflection is needed concerning what the prospective teacher is learning and the mood and environment in which this learning is or, at least, should be taking place. This is intrinsically related to the teaching methodologies and learning assessments, processes that should be integrated and functioning to regulate teaching and perfect learning (D. Fernandes, 2009).

### **Methodological path of research**

The research, of a qualitative nature and interpretative approach, was carried out with twelve (12) multipurpose teachers who work with the first years of Elementary Education in public municipal schools in the state of Parana, Brazil. All are female. Participants were identified by codes (P1, P2, P3, ...P12.) to preserve their identity. Each code corresponds to a different formative trajectory: some teachers have focused their initial training on specific areas such as Math, Biology, Language/Literature and Arts, while others continued in the field of Pedagogy or teaching in general. The diversity of training pathways enabled analysis of how different knowledge bases influenced experiences related to teaching and assessment in Statistics.

The choice of participants in this research requires some clarification. Although the theoretical section discusses the Teaching program as an outstanding starting point for training, most of the participants in this research are teachers who graduated from High School Teaching programs and later expanded their education in Pedagogy or other teaching programs. Hence, the study presented in this article did not involve higher education teachers (trainers), only multipurpose teachers who have experiences in initial training in different modalities and historical moments. This difference is essential to understand the object of the research and avoid mistakes in interpretation.

Table 1 present some characteristics of the profile of the teachers who participated, such as how long they have worked as teachers, their initial training and how long this training took.

**Table 1**

*Characteristics of teacher profiles who participated in the research*

<b>Teacher</b>	<b>Academic education</b>	<b>Period of initial training (duration)</b>	<b>Length of time working as a teacher</b>
P1	High School program, Liberal Arts, Specialization	1980 and 1989	31 years
P2	High School program, Pedagogy, Specialization, studying for her master's at present	2010 and 2019	5 years
P3	Pedagogy, Specialization	2010 and 2019	3 years
P4	High School program, Pedagogy, Specialization, studying for her master's at present	2010 and 2019	5 years
P5	Pedagogy	2010 and 2019	3 months
P6	Pedagogy, Masters	2008 and 2011	8 years
P7	High School program, Pedagogy, Specialization, Masters	2000 and 2009	18 years
P8	Pedagogy, Specialization	2000 and 2009	5 years
P9	Biology, Pedagogy, Specialization, Masters	2010 and 2019	3 years
P10	High School program,	1990 and 1999	25 years

	Pedagogy, Specialization		
P11	High School program, Pedagogy, Specialization	2010 and 2019	10 years
P12	High School program, Business, Physical Education, studying Pedagogy at present	Not identified	16 years

The data was obtained through individual, semi-structured interviews done online between 2020 and 2021. The script for the interviews contemplated a broader context for investigation and considered aspects such as, a) representations on initial training for Statistics teaching; b) representations on extended training for Statistics teaching; c) ideas regarding teaching and learning Statistics; d) ideas regarding the problematization of teaching and learning Statistics. In this article, therefore, we have a sample produced with the answers about representations regarding the initial training of these multipurpose teachers.<sup>5</sup>

To analyze this data, the Discursive Textual Analysis (DTA) methodology was used according to Moraes and Galiazzi (2016), since it addresses the characteristics of the research carried out and is appropriate for the analysis of discursive data.

DTA is a constructive and self-organized process in which awareness and new perceptions arise from the recursive sequence of three components: unitarization, categorization and the metatext (Moraes & Galiazzi, 2016).

Unitarization is the deconstruction of texts, which means to take them apart and turn them into “elementary units that correspond to discriminating elements of meaning, important significations for the purpose of the research, that are called units of meaning” (Moraes & Galiazzi, 2016, p. 71).

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<sup>5</sup> The script for the interviews can be accessed with the entire research at: <https://repositorio.utfpr.edu.br/jspui/handle/1/27617>

In the process of unitarization of the textual corpus of the research, three units of meaning came up: the first was the assessment carried out by the teacher trainer; the second were the emotions and feelings of the teachers about the assessment performed by the teacher trainer; the third were the implications of the assessment process performed by the teacher trainer on the learning process of the multipurpose teachers.

The second element of the DTA cycle is the process of establishing connections between the units of analysis: categorization, a process in which elements of close signification are brought together. The category of the research presented in this article was called Learning Assessment of statistical knowledge in Initial Training, which addresses the specificities of the units of meaning that arose in the process of unitarization.

The categories created in this phase of the cycle are the structural basis for the metatext, which is the final element of the DTA cycle. In other words, it is the synthesis of the knowledge produced in the investigation. To Moraes e Galiuzzi (2016, p. 54), "metatexts are the result of description and interpretation, jointly representing the way the investigated phenomena are understood and theorized". This is the moment the researcher takes on the position of the author, describing and giving arguments about the conclusions based on the research and always being aware of the context of the investigation and the voices of those involved (Moraes & Galiuzzi, 2016).

In the following sections, the results of the analysis will be presented, with the inclusion of excerpts indicating the fulfillment of the units of meaning of that category.

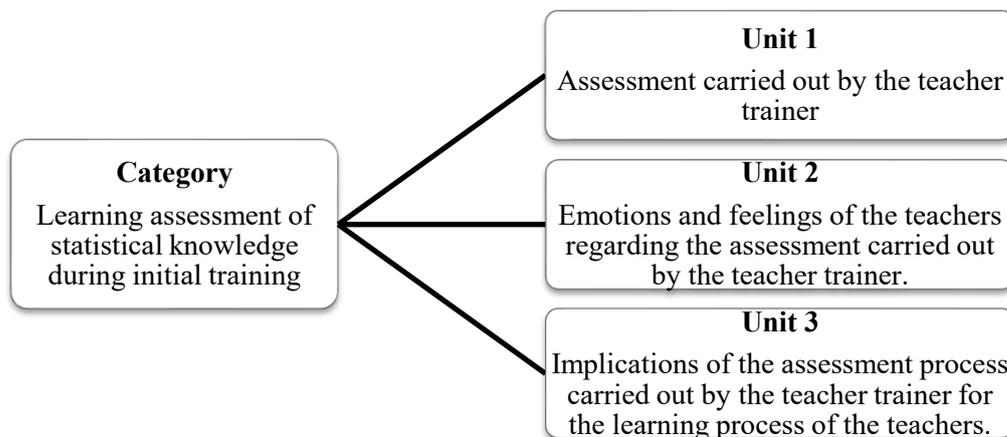
### **Experiences revealed by the multipurpose teachers**

The analysis of the teachers' narratives was performed with DTA (Moraes e Galizazzi, 2016), involving the processes of unitarization, categorization and the development of the metatext or synthesis.

The narratives of the teachers - experiences that occurred with subjects that involved statistical knowledge during initial teacher training - were grouped into four units of meaning that led to the category "Learning Assessment of statistical knowledge during initial training, as can be seen in Figure 1:

**Figure 1**

*Categories and units of meaning derived from empirical data*



Below, the analysis of the units of meaning that emerged from the collected data is presented. To represent the fulfillment of these units, excerpts were chosen based on their representativity and pertinence to the developed category: Learning Assessment regarding the statistical knowledge obtained during initial training. The choice of excerpts was made to bring to light different perspectives, avoiding redundancy and highlighting parts that could best illustrate the emerging meanings.

### **Assessment carried out by the teacher trainer**

In this unit of meaning, the excerpts are indicative of the learning assessment regarding statistical knowledge and the teaching methodology of the teacher trainer experienced by the teachers during their initial training. The excerpt below presents evidence of teaching practices when she says that the trainer was

Very traditional, you know, well, kind of practical, like if you said to me (name of interviewee), now we're going to see if you know your

multiplication... But she didn't tell me why, or how the multiplication table is developed or what it's for... I'm going to check and see if you know your multiplication table, have you memorized it? Sit over there and I'll see... So, it was a very practical thing, you know... But, in reality, it's not practical, it's somehow... To me, as a student, I...never understood why, OK. (P1)

By comparing the teacher's assessment with the traditional form multiplication is assessed, the teacher is describing a practice suggestive of an assessment that is detached from the process of teaching and learning and with no meaning to the teacher in training. We could say that the class, based on a traditional concept, is also revealed in the practice of assessment as a mere measure of the student's performance, with the teacher trainer occupying the main role in the process and acting as a judge of the knowledge obtained by the teacher in training, as presented by D. Fernandes (2009).

The lack of meaning as to the concept being learned and the assessment adopted can lead to more difficulties and challenges in the attainment of learning. In addition, there are also cases in which the teacher uses the assessment as a form of punishment, or a power mechanism in the relationship between teacher and student (Brandalise, 2020) This teaching attitude may use assessment to control the student's development and the assimilation of the proposed content, leaving a profound mark on the student, as seen in the following statement:

What stuck with me is that I remember it was a tough subject, the teacher was always enraged, the exams were very hard and that he...had a hard time really coming across to us, explaining the content in a way we could understand and even, maybe, be interested in...the subject, because he was so, what we call hard-nosed, OK. (P9)

The behavior of the teacher mentioned above by the interviewee ends up obstructing the learning process, as highlighted in the research by Fonseca (2016), Pinheiro (2022) and Rodríguez and Merino (2019). Research shows that there is really no way to disconnect feelings and emotions from the learning process, reaffirming that practices that do not

consider the safety, affection and emotions of students, whether they be children or adults, are sure to fail. The excerpts also suggest this regarding teaching and assessment practices:

To tell you the truth, I remember that, in this subject, I scored so badly on the first exam (laughter). I did really, really, terrible on that exam. (P10)

I remember it was very hard for me, to take the exams, or even study, you know. (P10)

We can see in P10's statement, when answering about the subject Statistics in her undergraduate program, there are difficulties in learning that the teachers experienced and that assessment was done at the end of a teaching period with exams being the main instrument used. These teaching practices can be related to a perspective of assessment *of learning*, i.e., essentially summative (D. Fernandes, 2019; Santos, 2019) and rooted in the idea of assessment as a measure that verifies learning through evaluation (D. Fernandes, 2009; Guba & Lincon, 2011).

### **Emotions and feelings of the teachers regarding the assessment of the teacher trainer**

In this unit of meaning, the narratives given by the teachers highlight the feelings and emotions that arose in the processes of teaching and assessment they went through in their initial training. The excerpt by P5 is an example of the idea of power related to assessment and the student's fear, expressed in the apprehension of the students when dealing with the subject, while the assessment process is used as a form of power by the teacher, since

There are teachers who think they're... I think it's funny because, oh, because lots... We hear a lot of stuff, like, "well, my class is the hardest, really, in this college". Students become so disturbed, I think it's wrong. (P5)

These practices by teacher trainers also harm the understanding of statistical concepts on the part of students and generate fear, anguish,

frustration, feelings of impotence and the incapacity to learn (Fonseca, 2016; Rodríguez & Merino, 2019), as seen in this statement:

So, it's... This subject was really hard in college. It was one of the hardest. With so many friends in DP and people really didn't like it much ... And the teacher's methodology [...]. (P9)

The excerpts by (P5) and (P9) reveal that the teachers, in their initial training, felt some negative emotions about the assessment carried out through exams and the teacher's methodology. The experience with these situations made the teacher and her whole class hate the subject, which negatively affected learning any statistical knowledge or feeling any joy in discovering what they could learn, since human beings tend to avoid situations in which they do not feel at ease or that bring them anxiety or any negative feelings (Fonseca, 2016; Pinheiro, 2022).

### **Implications of the assessment process carried out by the teacher trainer for the teachers' learning process**

In this unit of meaning, the statements made by the teachers demonstrate that the frustrating experiences they had with Statistics might have led to significant implications for learning, as well as the understanding they have as to what they know about the concepts and applications of statistical knowledge and, consequently, their own teaching practices. Negative feelings and emotions during initial training, in conjunction with the figure of an uncaring teacher, reveal a feeling of limitations in understanding Statistics, as expressed in the statement given by (P1):

I accept Statistics like a passenger a bus, saying so long to it (laughter), because, I didn't really understand, comprehend, interact, build and develop my knowledge... Not at all, I wasn't able to do that. (P1)

There are signs in this teacher's statement that say that studying the content given by the teacher was somewhat at a distance, something she couldn't learn but needed to accept because it was a part of the

undergraduate curriculum. The lack of understanding, that may reveal not having effectively learned statistical knowledge, can also be observed in this excerpt:

When I make a graph, I ask my husband to do it for me because I have no idea how it works. I watch him making it, you know? He starts it all by using Excel and this and that and chooses if he wants the graph to be this way or that, the color...that's how he does it, you know? (P12)

It is clear in the statement that the teacher says she does not understand the creation of graphic representations, especially when using electronic spreadsheets for her task. This may mean that, besides the practices not being significant for the internalization of concepts, they are also not significant for learning the procedures needed for the creation of statistical representations.

The statements indicate that the assessment practices and methodological options of the teacher trainers only opened a gap in understanding the relevance of Statistics, besides producing a misinformed idea that knowledge in this area is difficult and not for everybody.

It is important to notice that P12 is a teacher that has been part of a bachelor's undergraduate program and later went on to teaching, With the possibility of eliminating the subject the second time around as an undergraduate, she chose not to take the class again, explaining:

Since it was a subject that I did not really enjoy, not really being a big fan (laughter), I was able to get the credits for it, you know? (P12)

Once again, we see choices and options that are more accommodating, pointed out by the research that sees the relation between emotions and learning (Fonseca, 2016; Pinheiro, 2022).

### **In sum**

The units of meaning that emerged from the research data demonstrate that learning to teach Statistics requires attention to the consolidation of learning by the teachers who are in training. Furthermore,

it must be reinforced that, in this process, assessment has a central role in emotions, feelings and, consequently, in the learning process of the teacher in training and in future teaching practices.

In Units I and II, the excerpts highlight assessment practices that are based on positivist postulates, focused on the teacher in charge in the learning process, a person who does not always seem to show he or she cares, or is even a significant element for the effective learning process of the teachers.

The excerpts reveal feelings of fear, anguish, disgust and limitations as to learning Statistics. Hard exams and teacher trainers as the center of the process may have contributed to these negative feelings and emotions. After all, when a student is motivated, confident and feels safe in their journey towards learning, the tendency is that the emotions experienced during this process are positive. On the other hand, the absence of these elements can lead to negative emotions that are detrimental to learning (Anzelin & Marín-Gutiérrez, 2020).

The analysis of the excerpts in each of the units of meaning that emerge with the research data also illustrate the intrinsic relation between assessment, learning and emotions, as mentioned by Fonseca (2016, p. 369):

When we think about an action, such as the resolution of a mathematical problem or the application of an exam, we have emotional reactions based on our expectations in relation to the solutions we have provided and our past experiences. This process also involves historical and autobiographical aspects; that is why we learn with past results and, based on these, we regulate our future behaviors. Once again, the close connection between emotion and cognition is confirmed, as well as between these and motivation.

As seen in the excerpts, the teaching and assessment practices adopted by the teacher trainers, according to the teachers who participated in the research, did not contribute - or barely contributed - to the awakening of motivation, the pleasure of studying statistical knowledge and to the development of the learning process of the teachers in training. What

positive expectations can a student have when dealing with a challenging subject and a teacher who uses assessment as a form of power?

Assessment must contribute to regulating the teaching process and improving learning (D. Fernandes, 2009). Hence the importance of observing both *what* and *how* to assess learning, regardless of the stage or modality being taught. Learning as understanding must pass through meta-cognitive and socio-affective competencies and thus “it is important to know how to manage affects, emotions and attitudes” in assessment practices for statistics as well.

These issues translate the anguish of many teachers who start out in the profession without enough of the proper knowledge, whether content or pedagogical, to teach efficiently and mediate the students’ learning. These gaps in initial training can interfere in teaching since the curricular development performed by the teacher may not attend to the demand proposed in school curricula. These situations bring losses on both sides: for the student and for the teacher (Conti, Nunes, Estevam & Goulart, 2019).

With the same position, Gossman (1990) emphasizes that it is crucial that the teacher have solid knowledge of the content to be taught, as well as pedagogical knowledge for teaching (PCK). The discussion can be expanded here for the assessment process since there is no way of teaching without knowing content or assessing someone else’s learning process.

### **Final Considerations**

The aim of this study was to analyze the experiences in teaching and assessment in Statistics of multipurpose teachers during their initial teacher training, taking into consideration pedagogical and emotional aspects involved in this training process. This investigation sought to understand how the teaching and assessment practices experienced in this period

influenced the relation of first year elementary school teachers with Statistics and their own professional training.

The discussion proposed is not centered on judging the assessment practices carried out by teacher trainers, but in understanding how these practices interfere in developing a basis of knowledge for teaching Statistics and, consequently, in the curricular choices and practices for teaching and assessment.

Results made it clear that the prevalence of summative assessment practices, focused on exams and tests, contributes to the upsurge of negative feelings such as fear, anxiety, insecurity and frustration. These emotions directly impact the way the teachers relate to statistical content, creating an aversion to the subject in some cases. This finding reinforces the need to consider the emotional dimension as an integral part of learning since cognition and emotion are not dissociated in educational processes. Therefore, these are some of the likely implications for the practice of multipurpose teachers, since they can repeat these practices or not even address Statistics effectively in their own classrooms with children.

Furthermore, the research results may reveal the reasons for difficulties related to teaching Statistics, especially in the first years of school. Negative emotions experienced in initial training, as the analyzed data shows, have interfered - and still interfere significantly - in how students perceive learning Statistics content, besides leading to a distance in relation to what it represents.

These findings indicate the urgency of rethinking initial training to include diversified assessment strategies that can promote Statistics literacy and significant learning processes. The use of projects, portfolios and constructive feedback are alternatives that can contribute to overcoming traditional practices in teaching Statistics while expanding the critical understanding of data.

We consider that this study has contributed to the field of teacher training by articulating three frequently treated dimensions separately: the teaching of Statistics, assessment and learning practices, and emotions in learning. This integration represents a theoretical and methodological advancement and reinforces the perspective that training multipurpose teachers to teach Statistics requires more than conceptual mastery - it requires pedagogical sensibility and attention to the emotional dimensions of learning.

We hope the results presented in this article can contribute to reflections on the initial training of multipurpose teachers, considering that the emotions experienced during their undergraduate program influenced their learning process. Besides this, the need for changes in the attitude of teacher trainers stands out, both in relation to the teaching of Statistics and in the assessment of concepts and practices adopted. Concomitantly, it is expected that this study will contribute to the improvement of the practices of future multipurpose teachers and bring up the development of new studies and research.

## References

Anzelin, I., & Marín-Gutiérrez, A. (2020). Relación entre la emoción y los procesos de enseñanza aprendizaje. *Sophia*, 16(1), p. 48-64.  
<https://doi.org/10.18634/sophiaj.16v.1i.1007>

Batanero, C. Retos para la Formación Estadística de los Profesores. In J.A. Fernandes, F. Viseu, M.H. Martinho, & P.F. Correia (Orgs). *Actas o II Encontro de probabilidades e estatística na escola* (pp. 7-21). Centro de Investigação em Educação da Universidade do Minho.  
<http://repositorium.sdum.uminho.pt/handle/1822/9913>

Brandalise, M. Â. T. (Org.). (2020) *Avaliação educacional: Interfaces de conceitos, termos e perspectivas*. Editora UEPG.

Chá, A.V.C. (2013) *Instrumentos de avaliação ao serviço da aprendizagem em estatística* [Dissertação de mestrado em Ensino da Matemática no 3º ciclo do Ensino Básico e Secundário, Universidade da Madeira].

<https://search.proquest.com/openview/0a9769c3827b3dfd744a50dd3d942da0/1?pq-origsite=gscholar&cbl=2026366&diss=y>.

Conti, K.C., Nunes, L.N., Estevam, E.J.G., & Goulart, A. (2019). Um cenário da educação estatística em cursos de Pedagogia. *Revista Eletrônica de Educação Matemática*, 14(0), p. 1-15. <http://doi.org/10.5007/1981-1322.2019.e62802>

Dias, C. F. B. (2021). *Formação de professores dos anos iniciais do ensino fundamental: base de conhecimento no ensino da estatística* [Tese de doutorado, Universidade Tecnológica Federal do Paraná]. Repositório Institucional da UTFPR. <http://repositorio.utfpr.edu.br/jspui/handle/1/28345>

Dias, C. F. B., Pereira, C. S., & Santos Junior, G. (2019). Ensinar Estatística: uma revisão sistemática sobre a formação do professor. *Revista Eletrônica de Educação Matemática*, 14(0), 1–20. <https://doi.org/10.5007/1981-1322.2019.e62746>

Dias, C. F. B., Silva, G. C., Santos Junior, G., & Mesquita, C. (2022). Formação de Professores para o Ensino de Estatística: : um cenário a partir das teses e dissertações brasileiras da área de ensino. *Abakós*, 10(2), 104–129. <https://doi.org/10.5752/P.2316-9451.2022v10n2p104-129>

Dias, C. F. B., Mesquita, C., Santos Junior, G., & Brandalise, M. Â. T. (2023). Avaliação das aprendizagens em estatística: concepções e crenças de professoras polivalentes. In C. Mesquita, E. M. Silva, M. V. Pires, R. P. Lopes, & P. Vaz (Eds.), *VII Encontro Internacional de Formação na Docência: Livro de Atas / 7th International Conference on Teacher Education: Conference Proceedings* (pp. 187–198). Instituto Politécnico de Bragança. <https://doi.org/10.34620/incte.2023>

Estrella, S. (2016). Comprensión de la media por profesores de educación primaria en formación continua. *Revista Electrónica de Investigación Educativa*, 18(1), 13–22. [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S1607-40412016000100001](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1607-40412016000100001)

Fernandes, D. (2009). *Avaliar para aprender: fundamentos, práticas e políticas*. Editora UNESP.

Fernandes, D. (2019). Para um enquadramento teórico da avaliação formativa e da avaliação sumativa das aprendizagens escolares. In M.I.R. Ortigão, D. Fernandes, T.V. Pereira, & L. Santos (Orgs.), *Avaliar para aprender no Brasil e em Portugal: perspectivas teóricas, práticas e de desenvolvimento* (pp. 136-163). CRV.

Fernandes, D. (2022). *Avaliar e aprender numa cultura de inovação pedagógica*. LeYa Educação.

Fernandes, J. A., Alves, M.P., Machado, E.A., Correia, P.F., & Rosário, M.A. (2009) Ensino e avaliação das aprendizagens em estatística. In J.A. Fernandes, F. Viseu, M.H. Martinho, & P.F. Correia (Orgs). *Actas o II*

*Encontro de probabilidades e estatística na escola* (pp. 52-71). Centro de Investigação em Educação da Universidade do Minho. <http://repositorium.sdum.uminho.pt/handle/1822/9913>

Fonseca, V. da. (2016) Importância das emoções na aprendizagem: uma abordagem neuropsicopedagógica. *Revista Psicopedagogia*, 33(102), p. 365-384.

[https://pepsic.bvsalud.org/scielo.php?script=sci\\_arttext&pid=S0103-84862016000300014&lng=pt&nrm=iso&tlng=pt](https://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S0103-84862016000300014&lng=pt&nrm=iso&tlng=pt)

García, C. M., & Vaillant, D. (2009). *Desarrollo profesional docente: ¿ cómo se aprende a enseñar?* (Vol. 115). Narcea Ediciones.

Gatti, B. A. (2020). Perspectivas da formação de professores para o magistério na educação básica: a relação teoria e prática e o lugar das práticas. *Revista da FAEEBA: Educação e Contemporaneidade*, 29(57), 15-28. <https://doi.org/10.21879/faeeba2358-0194.2020.v29.n57.p15-28>

Gatti, Bernardete A.. (2020) Perspectivas da formação de professores para o magistério na educação básica: a relação teoria e prática e o lugar das práticas. *Revista da FAEEBA: Educação e Contemporaneidade*, 29(57), 15-28. Epub 16 de dezembro de 2020. <https://doi.org/10.21879/faeeba2358-0194.2020.v29.n57.p15-28>

Grossman, P.L. (1990) *The making of a teacher: teacher knowledge and teacher education*. Teachers College Press.

Guba, E.G. & Lincoln, Y.S. (2011) *Avaliação de quarta geração* (B. Honorato Trad.). Unicamp.

Jacobbe, T. (2012). Elementary school teachers' understanding of the mean and median. *International Journal of Science and Mathematics Education*, 10(5), 1143-1161. <https://doi.org/10.1007/s10763-011-9321-0>

Lopes, C. E. (2008). O ensino da estatística e da probabilidade na educação básica e a formação dos professores. *Cadernos CEDES*, 28(74), 57-73. <https://doi.org/10.1590/S0101-32622008000100005>

Lopes, C. E. (2013). Educação estatística no curso de licenciatura em matemática. *Bolema: Boletim de Educação Matemática*, 27(47), 901-915. <http://dx.doi.org/10.1590/S0104-40602013000200010>

Lopes, C.E. ., Almeida, J.L.D. ., & Santos, A.K.E. (2024) Recomendações curriculares para o ensino e aprendizagem da estatística e probabilidade na Austrália, Brasil e Portugal. *Revista Internacional de Pesquisa em Educação Matemática*, 14(3), 1-24. <https://doi.org/10.37001/ripem.v14i3.3853>

Moraes, R., & Galiazzi, M.C. (2016) *Análise textual discursiva* (3a ed.). Unijuí.

Nóvoa, António. (2017) Firmar a posição como professor, afirmar a profissão docente. *Cadernos de Pesquisa*, 47(166), 1106-1133. <https://doi.org/10.1590/198053144843>

Pimenta, S. G. (1996). Formação de professores: saberes da docência e identidade do professor. *Revista da Faculdade de Educação*, 22(2), 72-89. Recuperado em 14 de janeiro de 2026, de [http://educa.fcc.org.br/scielo.php?script=sci\\_arttext&pid=S0102-2551996000200004&lng=pt&tlng=pt](http://educa.fcc.org.br/scielo.php?script=sci_arttext&pid=S0102-2551996000200004&lng=pt&tlng=pt).

Pimenta, S.G., Fusari, J. C., Pedroso, C.C.A., & Pinto, U.A. (2017) Os cursos de licenciatura em pedagogia: fragilidades na formação inicial do professor polivalente. *Educação e Pesquisa*, 43(1), 15-30. <https://doi.org/10.1590/S1517-9702201701152815>

Pinheiro, J.D. (2022) Importância das emoções na aprendizagem: uma abordagem neuropsicopedagógica. *Research, Society and Development*, 11(17), p. e33411730125–e33411730125. <http://dx.doi.org/10.33448/rsd-v11i7.30125>

Rodríguez, R.Y.M., & Merino, J.A.V. (2019) A influência das emoções e corporalidade na aprendizagem de estudantes universitários. *RIDE. Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, 9(18), p. 254–274. <http://dx.doi.org/10.23913/ride.v9i18.423>

Roldão, M.C. (2007) Função docente: natureza e construção do conhecimento profissional. *Revista Brasileira de Educação*, 12(34), p. 94-103. <http://dx.doi.org/10.33448/rsd-v11i7.30125>

Samá, S., Amorim, M.E., & Batanero, C. (2023). Idoneidade didática na formação de professores: análise do ensino de estatística por meio de projetos. *Ensino em Re-Vista*, 30, e029. Epub 22 de dezembro de 2023. <https://doi.org/10.14393/er-v30a2023-29>

Santos, L. (2019). Reflexões em torno da avaliação pedagógica. In M.I.R. Ortigão, D. Fernandes, T.V. Pereira, & L. Santos (Orgs.), *Avaliar para aprender no Brasil e em Portugal: perspectivas teóricas, práticas e de desenvolvimento* (pp. 168-190). CRV.

Schreiber, K., & Porciúncula, M. (2022). Avaliação da aprendizagem em estatística: conhecimentos que emergem de um grupo de formação colaborativa de professores. *Revemop*, 4(0), p. 254–274. <https://doi.org/10.33532/revemop.e202217>

Shulman, L. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, 15(2), p. 4-14. <http://www.jstor.org/stable/1175860>

Shulman, L. (1987). Knowledge and teaching: foundations of the New Reform. *Harvard Educational Review*, 57(1), p. 1-23. <http://hepgjournals.org/doi/10.17763/haer.57.1.j463w79r56455411>

Tardif, M. (2002). *Saberes docentes e formação profissional* (5. ed.). Vozes.

Zeichner, K. (2010). Repensando as conexões entre a formação na universidade e as experiências de campo na formação de professores em faculdades e universidades. *Educação UFSM*, 35(03), 479-503. Recuperado em 14 de janeiro de 2026, de

[http://educa.fcc.org.br/scielo.php?script=sci\\_arttext&pid=S1984-64442010000300009&lng=pt&tlng=pt.](http://educa.fcc.org.br/scielo.php?script=sci_arttext&pid=S1984-64442010000300009&lng=pt&tlng=pt)