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Investigation of Individual Characteristics in Handwriting of a Brazilian Amazonian Group

Investigação de características individuais na caligrafia de um grupo da região Amazônica do Brasil

Sadi Luis Valiatia¹, Jesus Antonio Velho^{1,2}, Aline Thaís Bruni^{2*}

¹ *Setor Técnico-Científico, Polícia Federal- Belém do Pará, Brazil*

² *Departamento de Química, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, USP, Brazil*

** Corresponding author: aline.bruni@usp.br*

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Abstract In this work we have performed an analysis over graphic characteristics of people from Pará State, Brazil. The main issue was to identify the particularities of natural written and to calculate the corresponding frequencies. The standard template to collect the manuscripts was an invitation letter, entitled "Forensic Letter of Belém", which contains all the letters of the alphabet of Portuguese language (lowercase and uppercase); symbols; and the Arabic numerals (0-9). Parameters were established to evaluate and to separate them into class and individual characteristics. 100 (one hundred) sets of samples were analyzed and 170 features and their frequencies were selected and analyzed by an expert experienced in graphoscopy. Results suggest that there is no peculiar graphical structure that, alone, can be classified as an individual characteristic. The importance of this work relies on its potential to be a training tool for young professionals who work with graphoscopy.

Keywords: Brazilian Amazonian group; Class features; Documentoscopy; Graphic frequency; Forensic letter.

Resumo. No presente trabalho nós analisamos as características na escrita em um grupo de pessoas do estado do Pará, Brasil. O objetivo principal foi identificar as particularidades naturais da escrita e calcular a sua frequência. O modelo padrão para se coletar os manuscritos foi uma carta intitulada "Carta forense de Belém" que contém

todas as letras do alfabeto português (minúsculas e maiúsculas); símbolos e números arábicos (0-9). Foram estabelecidos parâmetros para avaliar e separar em classes e características individuais. Foram analisadas 100 amostras e 170 características, suas frequências foram selecionadas e analisadas por um perito em grafotécnica. Os resultados sugerem que não há estrutura gráfica que sozinha possa classificar uma característica individual. A importância deste trabalho está em seu potencial de ser uma ferramenta de treino para jovens profissionais que trabalha com grafotécnica.

Palavra-chaves: Grupo amazônico brasileiro; Características de classes; Documentoscopia; Frequência gráfica; Carta forense.

1. Introduction

Each letter of the alphabet may submit multiple forms and various construction schemes in which they establish the sequences of movements that generate to graphic symbols. The letter is the fundamental unit of the words; each one is associated with a grapheme, which corresponds to a set of possibilities to represent it. The term allograph, in turn, indicates each possible way to represent a grapheme and it corresponds to the different ways that a specific letter can be drawn. The variety of allographs is defined by the standards of handwriting used in schools in each region and country.¹ The final appearance of a letter on the paper contains the features of allographs chosen and the peculiarities of execution of each writer, as a result of the embedded habits in writing. This is the graph, i.e. the letter effectively written. Graphical peculiarities refer to special characteristics of a graph.

The way that people write is a combination of “class” and “individual” characteristics, which fits the unique design characteristics²⁻⁴.

Class features are related to the style that a person was exposed in the learning process; it is common to a group way of writing⁴. The group of writers of any established class can vary in size from a small number to continental populations. There may be geographical, religious, national, academic and/or political boundaries within which the writing has certain characteristics that makes the group identifiable.

Individual characteristics occur when the shape of the letters is far from the usual model of calligraphy copybook³. Individuality is usually displayed by writers in the execution of letters of more difficult drawings. Currently it is very difficult to identify the system or method used in teaching an individual by means of a simple

test of writing. This is because there are loads of material prescribed that exposes students to different systems and methods of teaching during literacy^{2,4}.

The most important components for the examination in graphoscopy are the individual characteristics of handwriting. Such characteristics can add, or omit, some traits of handwriting^{5,6}. The graphical individualities are considered valuable once they indicate authenticity and graphical authorship. However, in the practice of these exams, a big challenge is involved when trying to detect and to differentiate individual graphical variations from a populational group or some groups, since the literacy process can insert variations in the regional alphabet traits.

There are some studies dealing with the determination of class characteristics of a population group⁷⁻¹⁰. As an example, class characteristics of English writing in three ethnic groups: Chinese, Malay and Indian, were investigated in Singapore¹¹. In another work¹² class characteristics were investigated in English writing produced by Poles; the aim was to separate the characteristics that differentiate the Poles writings from those made by the British's.

Despite the writing analyses being among the most common occurrences of the Brazilian Criminalistics, there is no much information about people's graphic characterization according to each region. As an example, more than 50% of the documentoscopic exam demand in the federal criminalistics at Pará State in Brazil is related to graphoscopy and requires studies with structured information aiming the continuous quality of the reports.

It is not easy to characterize the writing of a country with continental dimensions like Brazil; the quest for differentiation between individual characteristics and class characteristics in Pará State is crucial for continuous quality improvement in the area of Graphoscopy. In this sense, the following questions were raised:

- a) Are these features specific to an individual or to a group?
- b) How often do they occur?

The main aim of this work was to identify the graphic peculiarities presented in natural written of a subgroup of the population from Pará State, calculating the frequency in which they occur. Parameters were established to seek, to identify and to differentiate class characteristics from those individual ones. Finally, we

sought to develop a database with key quirky graphic shapes of this population. It must be stressed that, there is no similar work done in Brazil about this subject.

1.1. Aspects of the Brazilian writing system

These individual and class definitions, adopted in countries where the teaching and learning system materials are unified, is not the most appropriate to be used in Brazil. Some of Brazilian aspects must be explained to a better understanding of our writing system.

The teaching of letters began to be popularized in the eighteenth century after the invention of metallic pen and paper pulp^{13,14}. Booklets were used in Brazil since the colonial period. The national production of booklets had started in the beginning of the 1880s. The Childhood Booklet appeared at the same time, based on syllabification, and it was used in Brazilian schools until the 1980s. From 1980, the booklets were gradually abandoned because of the advances in psychology, linguistic and psycholinguistic. The use of texts that circulated in everyday society as didactic material for teaching was prioritized¹⁵. Over time the playbook has changed and has been updated on various aspects, such as material support and themes of the lessons. However, it remained as a crucial instrument for achieving a specific method of teaching and early learning reading and writing¹⁶.

Other influences must be considered in Brazilian features. The English writing formed the basis for important writing systems in the United States and Portugal^{13,17}. Besides, the vertical writing was indicated instead of the slanted writing, because it was considered that the vertical one was more appropriate for school work since the body would not require abnormal positions as those required to perform the leaning writing^{18,19}. Besides English and Vertical calligraphies, the main models of writing used in Brazil, throughout the twentieth century were: Round Calligraphy; The Simple Spencerian; Muscular Calligraphy; School Staff Letter and Cursive²⁰⁻²².

Finally, in Brazil, schools and teachers are free to choose the material they deem to be most appropriate. This circumstance can derail the choice of a calligraphic necessary to perform the collation to sort the examined graphical standard construction.

2. Material and methods

This study was developed through action research²³, conceptualized as a kind of empirical social research whose base is designed and carried out in close association with a class action. Researchers and participants are representative of the situation and are involved in a cooperative and / or participatory manner.

Usually the booklets are distributed to schools by the government with the purpose of being used as standards for the learning of writing. We took as standards textbooks that had been used during school learning period of the analyzed graphic material suppliers (approximately 1930-2005).

Natural written from 100 members of the population from Pará state were studied to identify unique characteristics through a careful analysis by graphoscopy. The 100 sets of samples were analyzed by an experienced expert in Graphoscopy (over 500 reports prepared) to identify unique graphic constructions present in the writing of each person.

Participants filled out a form detailing their age, gender, marital status, place of birth, occupation and address. Therefore, there are participants from different occupations and levels of education. The collection of manuscripts was performed with three types of support: on lined paper, unlined paper and even on lined paper with limited graphic field (see supplementary material). This enabled the creation of a comprehensive field for the expression of the printing characteristics of the people under study. The goal was to create a very broad field so that employees could express their graphic characteristics.

The age of the participants was within a range of 07 to 80 years. The samples were divided into groups according to age groups. The objective was to facilitate the study and map the distribution of graphic peculiarities selected in different intervals.

The boundaries of age groups were established seeking to adapt them to the four writing development phases. Writing presents structured in phases similar to those that accompany human development: a) childhood, b) adolescence, c) maturity d) old age²⁴. The determination of these stages is pointed out in literature⁵ and it's not possibly to date exactly the beginning and the end of each one. As a general rule, adolescence ends at the age of 21, maturity ends at the age of 60 and old age with death. The possibility of a period not appearing cannot be ruled out. For example: if a person has not learned how to write as a child, the first

phase will not appear; if a person leaves the use of writing after the learning, maturity will not occur and the involution will take place instead.

Participants were divided into age groups. A code consisting of two letters was assigned as shown below:

- aged 7 to 15 years old - IN code;
- aged between 16 and 20 years old - AD code;
- aged between 21 and 59 years old-code MA;
- over 60 years old - SE code.

Table 1 summarizes the participants' profiles.

Table 1. Participants' distribution by age and gender.

Age	Code	Male	Female	Total
07 – 15	IN	9	15	24
16 – 20	AD	6	14	20
21 – 59	MA	10	27	37
60 and over	SE	7	12	19
Total		32	68	100

Individuals involved in collecting manuscripts are from eighteen municipalities of the State, which are arranged below in alphabetical order (Table 2).

Table 2. Participants' distribution according to different locations.

City	Participants	City	Participants
Almeirim	1	Marabá	1
Barcarena	1	Marapanim	1
Belém	58	Mocajuba	1
Bragança	2	Óbidos	1
Bujaru	1	Prainha	4
Cametá	2	Santa Isabel do Pará	17
Castanhal	1	Santarém	5
Itaituba	1	Soure	1
Itupiranga	1	Tomé Açu	1

Out of 100 participants, 58 are natural of Belém. The approximate population of Belém is 1,408,847 inhabitants, while the estimated population of the

other 18 cities represented in the table above is 1,367,474 inhabitants (IBGE - 2007); there is proportionality between capital and participants of the participants in the state.

Handouts used during the research:

- A4;
- Bic Ballpoint Pens: medium point blue color;
- Computer;
- Printer;
- Scanner (HP Photosmart C4280 - Resolution 200 DPI selected);
- VSC 5000 (Video Spectral Comparator)
- Cartridges black and color ink;
- Booklet notes;
- Clipboards;
- Magnifiers increase.

Data collection involved the following steps:

1. Each participant received a letter stating:
 - The purpose of the research;
 - The importance of their participation
 - Consent to collect their personal data
 - The use of their graphic material as a research subject.
2. Participants signed an informed consent (IC).
3. Completing the identification of participants with personal record data.
4. Collecting graphic material.

The standard for collecting graphic material text was an invitation letter, entitled "Forensic Letter of Belém", which was developed and tested by Krag and Siqueira²⁵ and contains all the letters of the alphabet of Portuguese language (lowercase and uppercase) and the Arabic numerals (0-9). Features adaptations of the use of words commonly used in the regions of the State of Pará were made, specifically in Belém region. This letter is transcribed below in Portuguese:

Belém, 16.08. 2008.

De: João Humberto Icoaraci Lopes

Endereço: Quadra Uirapuru. Rua Marajoara, nº 54. Bairro: Guarás.

Para: Zilda Francisca Xavier Trindade

Prezada Senhora,

Venho através desta convidar-lhe a participar das festividades do Círio de Nazaré, no 2º domingo de outubro, aqui na Cidade das Mangueiras. Essa festa religiosa de devoção a Nossa Senhora de Nazaré, a “Rainha da Amazônia”, acontece desde 1793 em Belém. Reunindo milhões de pessoas em romaria nas ruas, nos rios, de dia e à noite, faça chuva ou faça sol, o círio já é a maior festa religiosa do Brasil.

Durante a procissão muitas homenagens à santinha que passa esplendorosa na berlinda. Logo atrás vem a corda dos promesseiros, demonstração viva de fé e gratidão do povo romeiro. Indo na romaria tu vás passar pelo mercado Ver-o-peso, pela Estação das Docas, pela Praça da República e pegando a Av. Nazaré vai até a Basílica Santuário reforçando sua fé.

O almoço do Círio também é tradição, nele não falta a maniçoba, o pato no tucupi, o vatapá, o tacacá e o açaí com peixe frito ou camarão.

Posso te esperar? Serás muito bem recebida pelo povo do Pará!

Um cordial abraço,

João.

Destinatário: Zilda Francisca Xavier Trindade

Avenida Presidente Vargas 123 – apartamento 6789 –

Recife - Pernambuco – CEP. 045.177. 000

Groups of letters in the text of the letter are:

1. a, e, i, m, n, o, r, s, u, v, w, x, z (without loops).
2. b, d, h, l, f, t (upper loops).
3. g, j, p, q (lower loops).

The numbers used in writing the text that were Arabic: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. It was also used: period (.), Comma (,), exclamation (!), Question mark (?), Colon (:), double quotation marks (""), acute accent ('), grave accent (`), tilde (~), degree (°), some specific elements such as C cedilla (ç), nh and lh.

Whereas writing consists of a succession of small movements that form the graphic gesture, applying a standardized forensic letter helps to identify

characteristics that describe the peculiarities of the trace. The content of the letter consisted of an invitation, in narrative text for the Círio de Nossa Senhora de Nazaré, an important religious festival in northern Brazil. Words from regional culture were used as well as the citation of names of some typical dishes from Pará cuisine and sights of the town of Belém. The letter was copied by participants repeated times, as follows: a) on lined paper; b) unlined paper; c) copy of a paragraph in a field of reduced dimensions on a sheet of A4 paper. Each selected feature received an alphanumeric identification code to facilitate its location in the sample.

2.1. Procedure of analysis

Samples were analyzed to identify graphic characteristics that could be considered as unique. 170 features and their frequencies were selected.

The graphics in question were compared to copybooks to assess the difference in relation to the school standard. It was verified if that construction were repeated on/in other samples and then counting was performed. Relative frequency (%) was found by dividing the total number of repetitions per/ by 100.

We evaluated:

Elements writing goals - size, inclination, spacings, progress, alignments; angular and curvilinear values, grammatical relations of proportionality.

b) subjective elements - trace quality; degree of handle ability, pace of the writing; speed and graphic dynamism.

The frequency of occurrence of these peculiarities was used to assess the ability to differentiate between individual characteristics and class characteristics for the studied population; we analyzed how important these elements in the individualization of writing are. In this work, main models used in Brazil in the twentieth century were used as a parameter to determine the individual characteristics of the formal styles of writing.

Initially, the objective and subjective elements of writing were analyzed, verifying the existence of peculiar graphic constructions that could be considered as individual characteristics or mannerisms that are particular to writer qualities.^{5,6} This study emphasized the analysis of singular form of letters, and inter-literal connections, because it is graphical constructs easier viewing. As said before, the international definitions for the class features and individual characteristics²⁶,

adopted in countries where the system of education is unified, it is not an appropriate use in Brazil, where the education system is freer regarding to the tools used for teaching and learning. This circumstance can derail the choice of a calligraphic necessary to perform the collation to sort the examined graphical standard construction.

3. Results

The distribution of 170 selected graphic constructions by age is shown in Table 3. It is observed that the largest number of selected graphic constructions (44%) occurred in the group whose age ranged from 21 to 59 years old. The occurrence of graphic peculiarities in samples of participants aged 07 years old and 80 years old were found and examples can be seen in Figure 1. Figure 2 shows samples of writing from a participant of 07 years old compared to the writing of another participant 80 years old with the typical features of writing in each age group. Figures 3 and 4 demonstrate that other factors, such as the writing style and alignment, can represent salient features for individualization of writing.

Table 3 – Distribution of graphical constructions by age.

Age interval	Number of participants	Number of selected characteristics	%	Average graphical constructions per participant
07 a 15	24	42	25	1.7
16 a 20	20	26	15	1.3
21 a 59	37	74	44	2.0
60 and over	19	28	16	1.5
Total	100	170	-	-

Figure 1. Examples of quirky graphic constructions - participants of 07 and 80 years old, respectively.

Figura 2. Examples of writing - Participant 07 (top) and 80 (bottom).

Figure 3. Alignment as an individual characteristic.

The frequency observed in the study population ranged from 4% to 32%. Therefore, such characteristics behaved more like graphic peculiarities of a group than in a specific individual.

In the literature we find cutoffs to identify peculiar graphic features based on frequency of occurrence of these in the studied population. They are

considered as unusual: (0-10%); uncommon: (11-24%), common: (25-39%), and very common (40% or more)²⁷.

Figure 4. General style of writing as an individual characteristic.

Furthermore, when the graphic constructions are identified by 10% or more of the writers, they can be considered as class characteristics.²⁸ Adopting this concept, Figure 5 contains eight characteristics of class, which represents 5% of total peculiar traits.

The connections between letters can also express the individuality of writing. In Figure 6, we have some examples of links between the sets "be", "bi", "ve", "vi" which appear to form the letter "r"; the set "be" appearing to form the letter "x"; the set "br" linked in a peculiar angle and the sets "ão" and "ÂO" presenting omission of character. These peculiarities are quite useful in identifying the process of writing.

The Figures show very limited graphic field to express individuality. The order of authorship of digits is not always possible. The divergence from the calligraphy copybook is quite common and also suffers cultural and geographical influences. It is common to present the same wrist two or more graphic peculiarities for the same character. In Figure 7, we can see examples of peculiarities in the digit "1" with their incidence in the population studied.

	20% ²		10%	10%		15%
	11%		10%		34%	37%

Figure 5. Peculiar graphic constructions that are considered class characteristics according to the sampling frequency. Letters with a grey background are the representative characters of the alphabet; those with white background show the frequency in the population studied.

	8%		1%			17%	
	19%		21%		1%		1%

Figure 6. Peculiar graphic constructions formed by joining letters. Letters with a grey background are the representative characters of the alphabet; those with white background show the frequency in the population studied.

2%	1%	32%

Figure 7. Peculiar graphic constructions - digit "1".

Figure 8 contain the 170 selected graphic peculiarities, the representative character of the alphabet and their frequencies in the population studied.

01	1% ²	1%	1%	1%	1%	1%

2%	2%	1%

02	3%	2%	4%			

Figure 8(a): selected graphic peculiarities for uppercase “A” and lowercase “a” (grey cells) and their frequencies in the population studied (white cells).

03	2%	1%	1%	1%

04	1%	1%	20%	1%

Figure 8(b): selected graphic peculiarities for uppercase “B” and lowercase “b” (grey cells) and their frequencies in the population studied (white cells).

05	1%

06	9%

Figure 8(c): selected graphic peculiarities for uppercase “C” and lowercase “c” (grey cells) and their frequencies in the population studied (white cells).

07	1%	1%	4%	1%	1%	5%

5%	1%	1%	6%	1%

08	1%	1%				

Figure 8(d): selected graphic peculiarities for uppercase “D” and lowercase “d” (grey cells) and their frequencies in the population studied (white cells).

09	9%	1%	1%

Figure 8(e): selected graphic peculiarities for uppercase “E” (grey cells) and their frequencies in the population studied (white cells).

10	6%	1%	1%

11	1%	9%	1%	1%	10%	1%

1%	1%	10%	6%	1%		

Figure 8(f): selected graphic peculiarities for uppercase “F” and lowercase “f” (grey cells) and their frequencies in the population studied (white cells).

12	a - 1%	b - 1%

13	a - 2%	

Figure 8(g): selected graphic peculiarities for uppercase “G” and lowercase “g” (grey cells) and their frequencies in the population studied (white cells).

14	a - 4%	b - 1%	c - 1%	d - 4%

15	a - 3%	b - 2%	c - 1%	

Figure 8(h): selected graphic peculiarities for uppercase “H” and lowercase “h” (grey cells) and their frequencies in the population studied (white cells).

16	1%	1%	15%	1%	1%	4%

17	11%					

Figure 8(i): selected graphic peculiarities for uppercase “I” and lowercase “i” (grey cells) and their frequencies in the population studied (white cells).

18	3%	1%	1%	1%

19	2%			

Figure 8(j): selected graphic peculiarities for uppercase “J” and lowercase “j” (grey cells) and their frequencies in the population studied (white cells).

20	10%	1%	5%	7%	1%

21	1%				

Figure 8(l): selected graphic peculiarities for uppercase “L” and lowercase “l” (grey cells) and their frequencies in the population studied (white cells).

22	1%	1%	1%	1%	1%	1%

g - 1%	h - 1%	i - 1%

23	1%	1%				

Figure 8(m): selected graphic peculiarities for uppercase “M” and lowercase “m” (grey cells) and their frequencies in the population studied (white cells).

24	1%	1%	1%	1%	3%

1%	2%	4%	2%	1%

	2%	1%			

Figure 8(n): selected graphic peculiarities for uppercase “N” and lowercase “n” (grey cells) and their frequencies in the population studied (white cells).

27	1%	3%	1%	2%	1%	1%

5%	1%	1%	1%	1%	1%

28	2%	1%	1%			

Figure 8(p): selected graphic peculiarities for uppercase “P” and lowercase “p” (grey cells) and their frequencies in the population studied (white cells).

29	1%	1%	30	2%

Figure 8(q): selected graphic peculiarities for uppercase “Q” and lowercase “q” (grey cells) and their frequencies in the population studied (white cells).

31	1%	1%	2%	1%	1%	1%

32	1%	1%	8%			

Figure 8(r): selected graphic peculiarities for uppercase “R” and lowercase “r” (grey cells) and their frequencies in the population studied (white cells).

33	1%	1%	1%	34%	1%

34	37%	2%		1%	

Figure 8(s): selected graphic peculiarities for uppercase “S” and lowercase “s” (grey cells) and their frequencies in the population studied (white cells).

35	1%	1%	1%	1%	1%	f - 2%

g - 5%

36	1%	1%	8%	1%	2%	1%

Figure 8(t): selected graphic peculiarities for uppercase “T” and lowercase “t” (grey cells) and their frequencies in the population studied (white cells).

37	1%	38	2%

Figure 8(u): selected graphic peculiarities for uppercase “U” and lowercase “u” (grey cells) and their frequencies in the population studied (white cells).

39	10%	5%	1%	1%	1%	1%

1%	1%

40	1%					

Figure 8(v): selected graphic peculiarities for uppercase “V” and lowercase “v” (grey cells) and their frequencies in the population studied (white cells).

41	a - 3%

Figure 8(x): selected graphic peculiarities for lowercase “x” (grey cells) and their frequencies in the population studied (white cells).

42	5%	43	1%

Figure 8(z): selected graphic peculiarities for uppercase “Z” and lowercase “z” (grey cells) and their frequencies in the population studied (white cells).

Figure 8. Peculiar graphic constructions for each letter of the alphabet (uppercase and lowercase): grey cells contain the representative character of the alphabet; white cells represent the frequency in the population studied according to each representative character.

4. Discussions

The graphoscopy expert examination is founded on the observation of the presence or absence of a significant combination of quirky graphic constructions that can be convergent or divergent when compared with a standard of comparison.

This work suggests that there is no peculiar graphical structure that alone can be classified as an individual characteristic. Actually, these peculiar graphical structures are quite frequent and, depending on the context, may together have a significant weight in the individualization of the writing process. The set of such characteristics, rather than specific, is normally used to distinguish one writer from the other.

The model of forensic letter which was designed and implemented in this paper can be used in the field of graphoscopy as a reference material in the collection of standards for implementation of skills involving texts in Portuguese; content and peculiar characteristics can significantly help in determining the most relevant changes from the graphoscopy point of view.

The challenge of action to identify and correctly classify the particular graphic features of writing shows that it is necessary to find the systematic identification of these. The production of specific works and a database will provide a greater understanding of the peculiar features presented in the writing of the population and this, in turn, will allow an increase of the security level in the identification of natural writings of members of the population, both Pará state and from other states. The need for database develops identified through this work is still just an expectation. Improving the security level to identify the writings will immediately result in an increased amount of conclusive reports in the area of graphoscopy.

5. Conclusions

The search for systematic identification of class characteristics in Pará is of fundamental importance for the characterization of natural graphics written by members of the state's population. No prior knowledge structured around specific jobs, or by consulting the database, can bring difficulties to classify the desired level of certainty the peculiar constructions presented in writing a natural population. The international definition of individual characteristic as "that which

occurs when the shape of the letter does not follow the usual model of calligraphy copybook" is difficult to be applied to the Brazilian reality, since there is no standard playbook. In Brazil, schools and teachers are free to choose their own teaching materials. Thus, an alternative would be to build a database of location data based on calligraphic frequency with which the graphical constructs of interest are repeated in the writings of members of the population circulating in each forensic unit. The material developed in this research will be a training tool for young professionals who will work in the state of Pará, and it will serve to mitigate the negative effects of high turnover of experts in Documentoscopy recorded in Technical and Scientific Sector of the Federal Police of Pará.

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