



## RESEARCH ARTICLE

### FACTORS AFFECTING LEARNERS IN THE STATISTIC APPLIED TO EDUCATION AT THE UNIVERSITY INSTITUTIONS IN CABINDA AND M'BANZA CONGO

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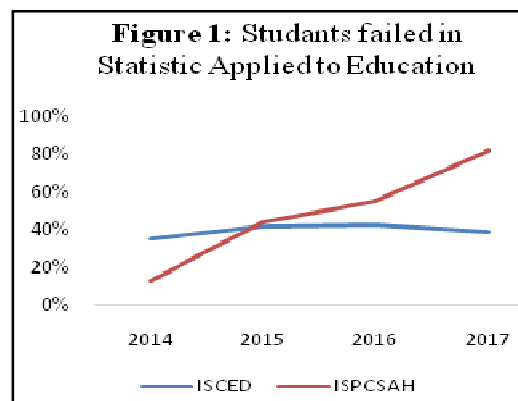
#### ABSTRACT

This study aims to identify the factors that underlie the difficulties in the teaching-learning process of Statistics Applied to Education at ISCED-Cabinda and at the Higher Pedagogical Social Sciences Arts and Humanities Institute of M'Banza Congo. For this purpose, in a population of 314 students and 6 teachers, a sample of 157 students and 6 teachers was chosen, from which they answered the questionnaires, whose opinions served for the diagnosis of the current situation of the teaching-learning process of this discipline, verifying the hypotheses and develop a conceptual model to mitigate the factors that make learning difficult. The research was quantitative-qualitative, where the questions of the questionnaires obeyed the Likert-type scale with statistical analyzes made with the help of the SPSS software, where it was found that the factors that make teaching-learning difficult in these institutions are: 1) the non-use of statistical softwares during teaching-learning process; 2) Negative results due to difficulties in calculating statistical measures of data grouped by classes, in classifying variables, in interpreting statistical measures and the behavior of data from graphs; and 3) the type of answers to the questions most valued by the teachers, which must coincide with the notes in the didactic material. The Mitigation Conceptual Model developed could serve to improve the current situation.

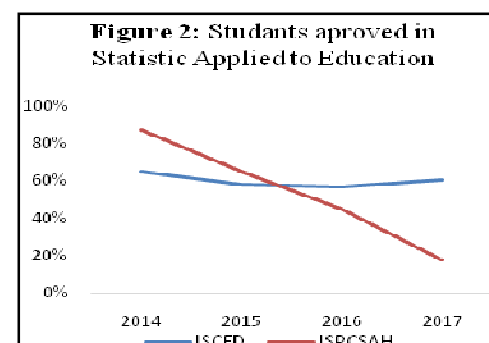
#### INTRODUCTION

Several increasingly current studies have investigated the factors that hinder the teaching and learning process. These studies converge in concluding that the family, the student himself and the school are at the base of these difficulties Soares (2004) and Lima (1995). For Bordenave & Pereira (2002), Marques et al (2012), Correia (1997), Gonçalves, and Pile (2004) and Martins (2004), the factors reside in the relationship between student, content, teacher, pedagogical/didactic issues and the school environment. The study of Statistics Applied to Education in higher education in the Angolan provinces of Cabinda and Zaire, more specifically in the Higher Institute of Educational Sciences of Cabinda and in the Higher Pedagogical Institute of Social Sciences, Arts and Humanities of M'Banza Congo, has been hampered due to some factors that the present research sought to clarify, since the levels of annual failures have an increasing trend, in the courses of Pedagogy, Teaching Biology, Psychology, History and Physics as shown in the Figure 1. There are cases of good academic performance in both institutions that stem from the good commitment to the subjects taught by some professors, but in general, year after year, there is a decreasing behavior in the number of approvals, as can be seen in the Figure 2.

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Source: DAAC-ISCED-Cabinda and M'Banza-Congo, 2019



Source: DAAC-ISCED-Cabinda and M'Banza-Congo, 2019

In several courses, the contents of Statistics are the same, differing only in the contexts of application, the preparation of teachers, and how each teacher articulates certain dimensions such as Didactic material, Use of computer applications, Learning difficulties, Evaluation system, Academic performance and Mitigation of problems. Given these situations, *what factors are at the base of the difficulties in the teaching-learning process of Statistics Applied to Education for students from Cabinda and M'Banza-Congo?*

**The hypotheses that we raised around this problem were the following:**

**H<sub>1</sub>:** The non-use of the appropriate didactic material by the students contributes to the increase in the teaching-learning difficulties of the Statistics Applied to Education's contents;

**H<sub>2</sub>:** The use of computer applications in teaching-learning such as SPSS and others helps to improve academic performance in the discipline of Statistics Applied to Education;

**H<sub>3</sub>:** Learning difficulties in Statistics do not help students' academic performance.

**H<sub>4</sub>:** The evaluation system applied by the teachers does not help in the students' academic performance.

This article aims to identify the factors that underlie the difficulties in the teaching-learning process of Statistics Applied to Education for students from Cabinda and Mbanza-Congo and to suggest a conceptual model for their mitigation.

## MATERIALS AND METHODS

### Basic concepts

**Inhibiting learning factors:** These are objective or subjective phenomena or elements that prevent or negatively influence the assimilation of content during the teaching-learning process.

**Didactic material:** these are pedagogical products used in education and, specifically, a instrumental material that is elaborated for didactic purposes. The definition of teaching material is linked to the type of support that makes it possible to materialize the content. This condition was defined by the French historian Chartier in 2002.

**Computer applications:** These are software designed using a programming language to perform a group of coordinated functions, tasks or activities for the benefit of the user. According to Gladcheff, Zuffi and Silva (2001), the use of software can be an important ally in the cognitive development of each student, facilitating work that adapts to different learning rhythms and allows students to learn from their mistakes.

**Learning Disabilities:** is a general term that refers to a heterogeneous group of disorders manifested in the acquisition and use of hearing, speech, reading, writing, reasoning, or mathematical or social skills Correia (1997).

**Evaluation system:** is a set of assessments that allows the teacher or the school to carry out a diagnosis of content

assimilation, academic performance and factors that may interfere with the performance of those involved in the teaching-learning process. Evaluations can be diagnostic (analytical), formative (controlling), summative (classificatory) Luckesi (2003) and Bloom (1983).

**Academic performance:** it is a measure of the student's abilities, which expresses what he has learned throughout the training process. It also encompasses the student's ability to respond to educational stimuli. In this sense, school performance is associated with aptitude Rodrigues (2010).

**Problem mitigation:** consists of interventions aimed at reducing or remediating the harmful impacts of a problem. It also refers to the act of alleviating the negative effects of a problem.

**Conceptual Model:** According to Irla Reball is a set of assumptions based on a real world that will indicate the business rules of a system. It is the description of a proposed system in the form of a set of integrated ideas and concepts regarding:

- What should the system do?
- How should he behave?
- What must he look like?

The purpose of its establishment is that it can be understood by the user in the intended way. It helps to highlight important connections in real-world processes and systems and can be enriched with more specific features from the generation and development of more complex models. It is represented through a graphical interface.

## METHODOLOGY

**Instrument for data collection and sample:** To carry out the research, some opinions were collected. Two well-structured questionnaires were applied to 320 elements, of which 6 professors and 314 students, which aimed to identify the factors that underlie the difficulties of the teaching-learning process of the discipline of Statistics Applied to Education in the two university institutions where the discipline is taught, namely the Higher Institute of Educational Sciences of Cabinda and the Higher Pedagogical Institute of Social Sciences, Arts and Humanities of Mbaza Congo. The questionnaire included six dimensions where problems are frequently observed, namely *use of teaching material, use of software, learning difficulties, evaluation system, academic performance and measures to overcome difficulties*. Nominal variables were measured using the Likert scale, comprising 52 analysis variables for the questionnaire applied to teachers and 44 variables for the questionnaire applied to students.

**Data Analysis:** the IBM-SPSS software was used to process the data of the applied questionnaires, having verified reliabilities of 84.4% and 86.7% respectively, being within the statistically admissible limits for Cronbach's Alpha, evidencing acceptable internal data consistency. In the diagnosis, the opinions of the respondents were extracted based on the convergence of the data to the median facilitated by the analysis of the data normality, where it was found that the data did not follow a normal distribution due to the fact that the p-values were lower than 0.05 in the non parametric test of Kolmogorov-Smirnov.

Main Components Analysis was performed, where the Kaiser-Meyer-Olkin sphericity coefficient was 84% for the students' opinions with significance levels of 0.0 in the Bartlett test, indicating suitability of the samples for the aforementioned analysis and consequent acceptable correlation between the component variables. The hypotheses were verified by applying the independence test using the contingency tables, taking Pearson's Chi-square and its significance levels to reject the Null hypotheses (of independence) and accept the alternatives (of dependence), once that the levels of significance were lower than 0.05.

## MATERIALS

### Determination of factors that hinder the teaching and learning process:

The factors were determined based on the variables with the greatest weight grouped into 11 main components, according to the components matrix, and on the associated variables on each hypothesis. Table 1 illustrates that the variables under analysis were grouped into 11 components, explaining 68.3% of the variability of opinions, as described below:

**Component 1:** with 20% weight, with 7 variables, of which the 7 are positively correlated (identification of statistical variables, raw data, simple list and frequency list, absolute, relative and accumulated frequencies, construction of frequency distribution tables of data not grouped by classes, calculation of the mean, mode and median for data not grouped and grouped by classes, interpretation of the mean, mode and median results, construction of graphs (of lines, bars, sectograms, and histograms), calculation of dispersion measures (variance, standard deviation and coefficient of variation), implying that they have a positive impact on the success of teaching and learning statistics applied to education.

**Component 2:** with a weight of 11.3%, with a total of 3 variables, the 3 of which are positively correlated (it arouses curiosity and interest in the contents due to the facilities in the construction of tables and graphs of statistics applied to education, puts the height of new challenges in the teaching-learning process, improvement of the evaluation system of statistics applied to education), illustrating that the teaching of statistics with the aid of computer applications has a strong impact on teaching and learning.

**Component 3:** With a weight of 8.8%, with 2 variables, one with a positive correlation (uses some software to teach Statistics) and the other (increases the academic performance of students and professional performance) with a negative correlation, which demonstrates a low incidence in the teaching-learning process of Statistics, as no software is used, having affected with greater emphasis on increasing the income and professional performance of teachers.

**Component 4:** With a weight of 6.6%, having a single variable (use of compass, protractor ruler and colored pencils to build a sectogram) that has a positive correlation, illustrating the use of compasses in the construction of a sectogram.

**Component 5:** With a weight of 6.1%, with 2 variables, both of which contain a positive correlation (access to bibliography, internet access), illustrating that there are difficulties in terms of accessing information on some contents.

**Component 6:** With a weight of 3.5%, with a single variable (Task resolution and research work) has a positive correlation, illustrating that, for the improvement of grades and student performance as well as the reduction of the failure rate in the chair of Statistics Applied to Education, students must carry out some research work.

**Component 7:** With a weight of 2.9%, with 2 variables, one of which has a positive correlation (what type of answer does the teacher value more) and the other (use of a calculator machine to make calculations) with a negative correlation, which demonstrates the weak methodology that is applied at the time of correction of the tests regarding the answers that the students answer.

**Component 8:** With a weight of 2.8%, with a single variable (use of a ruler to construct the frequency tables) that has a positive correlation, illustrating that the construction of the tables requires the use of didactic material.

**Component 9:** With a weight of 2.6%, with a single variable (what kind of questions does the teacher ask in the tests), it has a positive correlation, illustrating the difficulties related to the type of questions that the teachers ask in the tests.

**Component 10:** With a weight of 2.5%, with a single variable (final averages in the course of Statistics), which has a negative correlation, illustrating the poor academic performance (with low) grades in the course of Statistics Applied to Education.

**Component 11:** With a weight of 2.4%, with a single variable (use of some statistics books), which has a positive correlation, illustrating that the use of didactic material is necessary to obtain greater efficiency in the teaching-learning process.

**Conceptual models of the factors that hinder the teaching-learning of statistics applied to education and of overcoming measures:** According to the opinions of the respondents and the analysis of the Matrix of Main Components, two models (Figure 3 and Figure 4), of the factors that hinder the teaching-learning and offactor mitigation measures, were elaborated. For each dimension, we considered the hierarchy of factors without the intention of excluding any, due to the need to understand the effect of each in the referred process and to envisage its treatment.

## RESULTS

### The opinions of students and teachers regarding the questions asked by each of the dimensions were as follows:

**Learning difficulties:** The students' difficulties are related to the classification of statistical variables, the construction of frequency distribution tables of data grouped by classes, calculation of the mean, mode, and median for data grouped by classes, in the interpretation of results of the mean, mode, and median, construction of a sectogram, calculation of separatrices, calculation of measures of dispersion (Variance, Standard Deviation and Coefficient of Variation) and interpretation of variability from the coefficient of variation.

**Use of teaching material:** students always use a ruler to build the frequency tables, a calculator machine, they use pencils, erasers, and colored pencils to paint graphs.

They do not use a protractor to measure angles, sometimes they use some statistics books and have never used a compass to construct a sector.

**Teaching Statistics with the aid of computer applications:** No software is used for teaching and learning Statistics and, sometimes, interest in the contents of Statistics Applied to Education is aroused, curiosity due to the facilities in the construction of statistical tables and graphs, allows accelerating the fulfillment of the program due to its speed and for being iterative, raises the height of new challenges in the teaching and learning process and increases the academic performance of students and poor professional performance.

**Evaluation system:** The detail lies in the type of answers that the teacher values most. Teachers consider more those answers that coincide with the notes in the support material provided by them. They do not value the right answers very much, but with logical steps at the student's discretion). The teachers put mixed questions on calculations and theory in the tests.

**Academic performance:** 75% of the final averages in the Statistics course are negative and range from 6 to 9.4 points.

**Solutions for overcome difficulties:** Priority is given to improving working conditions in classrooms, linking theory with practice and more research activities. Teachers found it less of a priority to increase learning activities, improve teaching methods and the evaluation system, and apply the scientific theories of teaching and learning by various authors such as Vigotsky, Galperin, Van-Hiele and others. The factors that affect university students in Cabinda and M'Banza Congo in Statistics Applied to Education are: The non-use of computer applications in teaching-learning; Negative results due to difficulties in calculating statistical measures of data grouped by classes, in classifying variables, in interpreting the behavior of data from graphs and statistical measures; evaluation system (the type of answers to the questions most valued by teachers, which should coincide with the notes in the teaching material).

## DISCUSSION

The mitigation of the factors reduces the teaching and learning difficulties of Statistics Applied to Education in the two Institutions. For this purpose, the software must be used in the teaching of Statistics, improve the evaluation system, apply the overcoming measures within the course and recommend the use of the didactic material necessary for the study of Statistics. In both institutions, ISCED-Cabinda and ISPCSAH of Mbanza-Congo, it is necessary to use ICTs to arouse the interest of the students for the contents of Statistics Applied to Education, to facilitate the construction of statistical tables and graphs, and acceleration of the fulfillment of the program due to its speed and for being iterative. The overcoming measures to be applied should include: 1) More independent activities in the learning of Statistics Applied to Education; 2) Methodological treatment of contents according to Learning Theories; 3) Improvement of working conditions in classrooms; 4) Improvement of the evaluation system in the discipline of Statistics Applied to Education. The use of didactic material should consider the use of colored pencils to paint graphics; and scientific calculator. The evaluation system should pay attention to the type of answers that the teacher values most (those that encourage student creativity as long as the steps are logical and the result is correct).

All these measures may raise the index of positive final averages (from 10 to 20) in the Statistics discipline to more than 50%.

## CONCLUSION

In this article we propose conceptual models of the factors that hinder the teaching and learning process of Statistics Applied to Education and to mitigate these factors in two Higher Education Institutions, namely ISCED-Cabinda and ISPCSAH in Mbanza-Congo. These factors are: 1) the non-use of computer applications in teaching and learning; 2) Negative results due to difficulties in calculating statistical measures of data grouped by classes, in classifying variables, in interpreting the behavior of data from graphs and statistical measures; and 3) the type of answers to the questions most valued by teachers in the assessment of knowledge, requiring that they must coincide with the notes in the teaching material.

The non-use of didactic material by the students does not contribute to the increase in the teaching-learning difficulties of the contents of Statistics Applied to Education. The use of computer applications in the teaching and learning of statistics helps to improve students' final averages. Learning difficulties influence students' failure. The evaluation system applied by the teachers (in terms of the most valued type of answer, whose answers must coincide with those in the support material) favors negative results. The conceptual model of mitigation developed could serve to improve the current situation in the discipline of Statistics Applied to Education.

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APPENDIX 1

Table 1. Components Matrix of Factors that make it difficult to learn Statistics Applied to Education in Cabinda and Zaire

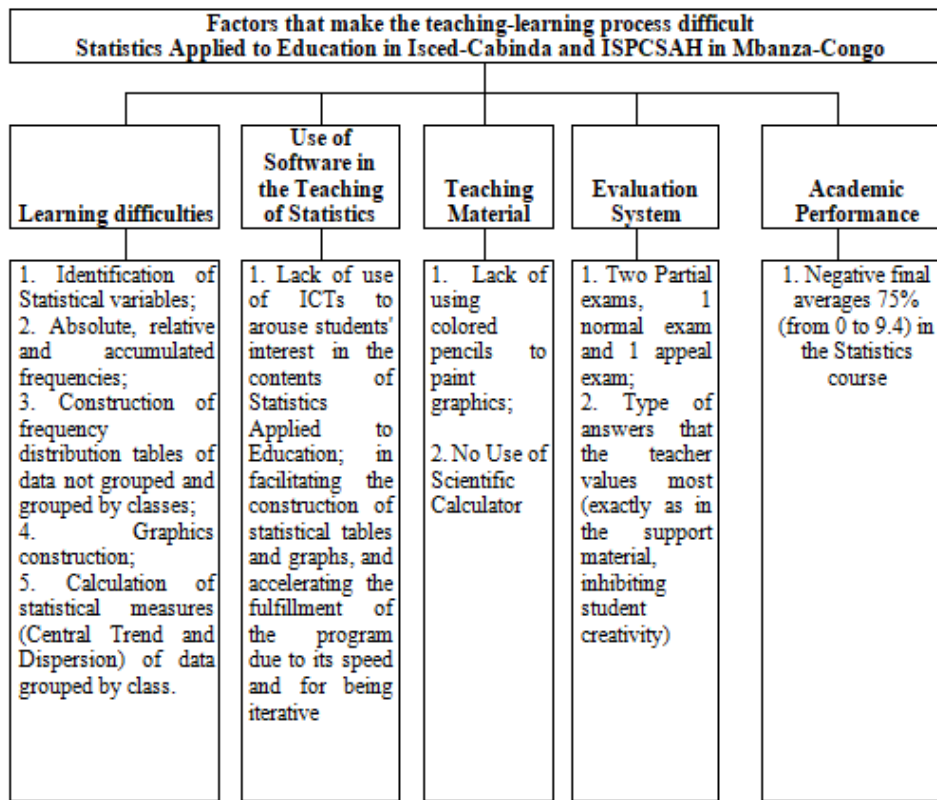
	Components											
	1	2	3	4	5	6	7	8	9	10	11	
Identification of statistical variables	0.6	-0.1	-0.0	0.2	-0.4	0.2	0.1	0.1	-0.1	-0.1	0.0	
Absolute, relative and cumulative frequencies	0.7	-0.1	0.0	0.2	-0.3	0.2	-0.0	0.1	-0.2	0.0	0.1	
Construction of frequency distribution tables for data not grouped by classes	0.7	-0.2	0.0	0.2	-0.3	0.1	-0.0	-0.1	-0.2	-0.0	0.1	
Calculation of the mean, mode and median for ungrouped data and grouped by classes	0.7	-0.1	0.0	0.0	-0.1	-0.2	-0.0	0.2	0.1	-0.0	0.3	
Interpretation of mean, mode and median results	0.7	-0.1	0.1	-0.1	0.1	-0.2	-0.1	-0.0	0.1	0.0	0.1	
Graph construction (from lines, bars, sectograms, and histograms)	0.8	-0.1	-0.1	-0.0	-0.0	-0.1	-0.1	-0.2	0.1	-0.0	0.0	
Calculation of dispersion measures (Variance, Standard Deviation and Coefficient of variation)	0.6	-0.0	-0.1	-0.1	0.3	-0.2	0.1	0.2	0.0	0.3	0.0	
It arouses curiosity and interest in the contents due to the facilities in the construction of tables and graphs of Statistics Applied to Education	0.1	0.7	-0.5	0.2	0.1	-0.0	0.0	-0.0	0.0	-0.0	-0.0	
It rises to new challenges in the teaching-learning process	0.2	0.6	-0.6	0.1	0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.2	
Improvement of the Applied Statistics	0.2	0.5	0.2	-0.5	-0.1	-0.0	-0.1	0.0	-0.2	-0.1	0.2	
Assessment of any software	-0.1	-0.5	0.5	-0.1	0.0	0.1	-0.1	-0.1	0.1	0.2	0.2	
Increases student academic performance and professional performance	0.2	0.6	-0.6	0.1	0.1	0.0	-0.0	0.0	-0.0	0.0	0.2	
Using a compass, protractor ruler and colored pencils to build a sectogram	0.1	0.4	0.5	0.4	0.1	-0.1	0.2	-0.3	-0.1	0.1	0.0	
Access to bibliography	0.2	0.1	0.0	-0.3	0.6	0.4	0.1	0.1	-0.0	-0.3	-0.0	
Internet access	0.2	0.1	0.1	-0.2	0.6	0.4	0.1	0.1	-0.1	-0.2	-0.0	
Resolution of tasks and research works	0.4	0.1	0.1	-0.1	0.2	0.5	-0.0	-0.2	0.1	0.3	-0.1	
Using a calculator to do calculations	0.1	0.4	0.4	0.3	0.1	-0.1	-0.4	0.3	0.1	-0.0	0.1	
What kind of response does the teacher value most?	-0.2	-0.1	0.1	0.1	-0.2	0.0	0.4	0.4	0.4	0.2	0.3	
Use of a ruler to build the frequency tables	0.2	0.3	0.4	0.3	0.1	-0.1	-0.2	0.4	-0.0	0.045	0.2	
What kind of questions does the teacher ask in the tests	0.0	-0.0	0.2	0.2	0.0	0.1	0.4	0.1	0.5	-0.1	0.1	
Final averages in the chair of Statistics	0.4	0.0	0.1	0.2	-0.0	-0.2	0.3	0.1	0.2	-0.4	-0.2	
Use of some statistics books	0.0	0.3	0.1	0.3	-0.0	0.1	0.3	0.2	-0.3	-0.0	-0.4	<b>TOTAL</b>
<b>% of variance</b>	<b>20</b>	<b>11.3</b>	<b>8.8</b>	<b>6.6</b>	<b>6.1</b>	<b>3.5</b>	<b>2.9</b>	<b>2.8</b>	<b>2.6</b>	<b>2.5</b>	<b>2.4</b>	<b>68.3</b>

Source: Extracted from Questionare's data using SPSS

Table 2. Summary of hypothesis verification through cross-reference tables

Hypotheses	p-value (2 tails)	Veracity
The non-use of didactic material by the students contributes to the increase of the teaching-learning difficulties.	> 0.5	Not proven
The use of computer applications such as SPSS and others in teaching-learning helps to improve academic performance.	< 0.5	Proven
Statistics learning difficulties do not help students' academic performance.	< 0.5	Proven
The evaluation system applied by teachers does not help in the students' academic performance.	< 0.5	Proven

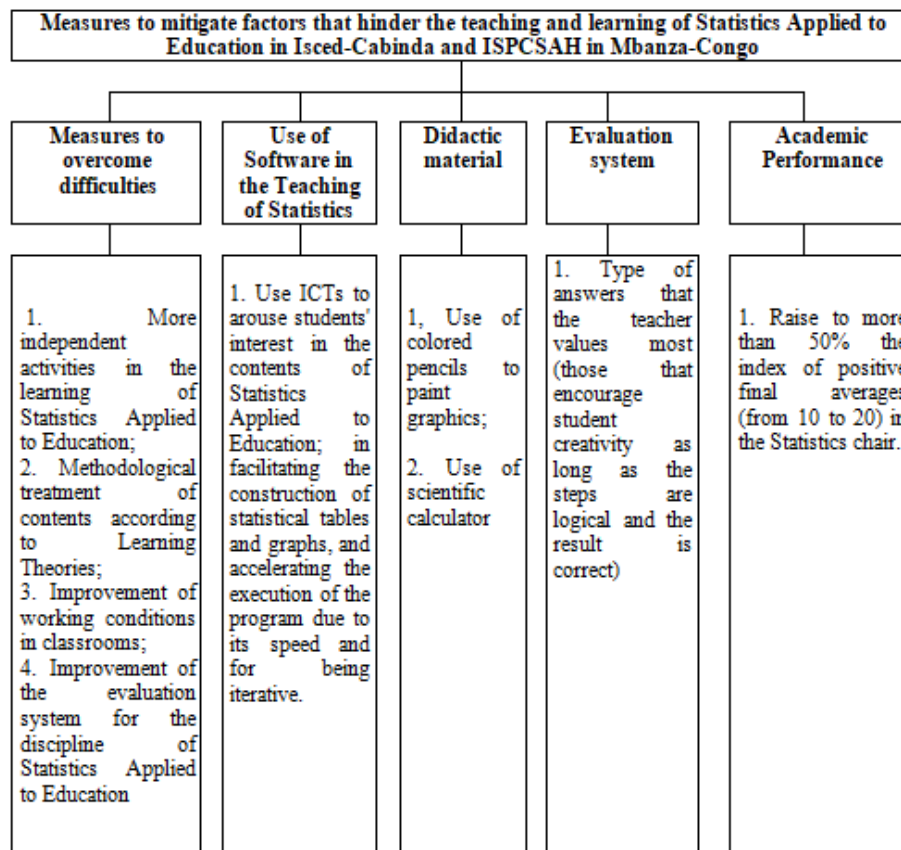
APPENDIX 2



Source: Elaborated by the authors from de Matrix Component according to each dimension

Figure 3. Model of the factors that hinder the teaching and learning of Statistics Applied to Education

Figure 4. Model of mitigation measures of the factors that hinder the teaching and learning of Statistics Applied to Education



Source: Elaborated by the authors from the Figure 3