

# A systematic model to evaluate the academic productivity of Brazilian faculty undergraduate courses

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## **ABSTRACT**

In an increasingly competitive scenario in the Higher Education segment, Higher Education Institutions (HEI) have been looking for ways to manage the productivity indicators of their undergraduate courses, in order to meet the criteria established by the National Institute of Studies and Research Educational Institutions Anísio Teixeira (INEP). Thus, this paper aims to present a systematic model to evaluate the academic productivity of Brazilian faculty undergraduate courses, considering the indicators proposed by INEP. The academic productivity criteria were quantitatively and qualitatively evaluated using Scriptemec, a tool developed exclusively to measure the academic data of undergraduate faculty. As a contribution, it reinforces the construction of a systematic model to assist in the automation and continuous monitoring of academic productivity in undergraduate courses, presenting a computational tool that assists in this process, as well as a dashboard for managerial control in Brazilian HEIs.

**Keywords:** Scriptemec. Undergraduate courses. Academic productivity. Performance management. Innovation in education. Higher education evaluation

## **Modelo sistemático de avaliação de desempenho em produtividade acadêmica de professores brasileiros em cursos de graduação**

### **RESUMO**

*Em um cenário cada vez mais competitivo no segmento de educação superior, as instituições de ensino superior (IES) têm buscado meios de gerenciar os indicadores de produtividade de seus cursos de graduação, no intuito de atender aos critérios estabelecidos pelo Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep). O presente estudo tem como objetivo apresentar um modelo de avaliação de desempenho da produtividade acadêmica do corpo docente de cursos de graduação brasileira, considerando os indicadores propostos pelo Inep. Os critérios de produtividade acadêmica foram avaliados de forma quantitativa e qualitativa utilizando o Scriptemec, ferramenta desenvolvida exclusivamente para mensurar os dados acadêmicos do corpo docente de graduação. Como contribuição, reforça-se a construção de um modelo sistemático para auxiliar na automatização e acompanhamento contínuo da produtividade acadêmica em cursos de graduação, indicando uma ferramenta computacional que auxilia neste processo, bem como um dashboard para controle gerencial em IES brasileiras.*

**Palavras-chave:** *Scriptemec. Cursos de pós-graduação. Produtividade acadêmica. Gestão do desempenho. Inovação em ensino. Avaliação do ensino superior.*

## **Modelo sistemático de evaluación de desempeño en productividad académica de profesores brasileños en cursos de pregrado**

### **RESUMEN**

*En un escenario cada vez más competitivo en el segmento de Educación Superior, las Instituciones de Enseñanza Superior (IES) han buscado formas de gestionar los indicadores de productividad de sus cursos de graduación, con el fin de atender a los criterios establecidos por el Instituto Nacional de Estudios e Investigaciones educativa Teixeira (INEP). Así, el presente estudio tiene como objetivo presentar un modelo de evaluación de desempeño de la productividad académica del cuerpo docente de cursos de graduación brasileña, considerando los indicadores propuestos por el INEP. Los criterios de productividad académica fueron evaluados de forma cuantitativa y cualitativa utilizando el Scriptemec, herramienta desarrollada exclusivamente para medir los datos académicos del cuerpo docente de graduación. Como contribución, se refuerza la construcción de un modelo sistemático para auxiliar en la automatización y seguimiento continuo de la productividad académica en cursos de graduación, presentando una herramienta computacional que auxilia en este proceso, así como un dashboard para control gerencial en IES brasileñas.*

**Palabras clave:** *Scriptemec. Cursos de postgrado. Productividad académica. Gestión del rendimiento. Innovación en enseñanza. Evaluación de la enseñanza superior.*

## INTRODUCTION

Brazilian higher education institutions (HEI) are in a highly competitive environment, especially because of the constant changes related to their internal and external clients, as well as the educational policies established by the government agencies (MACCARI, ALMEIDA, RICCIO, & ALEJANDRO, 2014). For this scenario of constant pressure on educational organizations, HEIs' directors seek strategic management based on their resources, in order to obtain greater organizational efficiency and improvement in the performance of this organization model (R. P. MARTINS, LACERDA, & ENSSLIN, 2013). However, management models still remain very close to those practiced in other types of organizations (Baeta, Brito, & Souza, 2014), not being efficient in the higher education segment, which has unique institutional and political characteristics (MEYER, PASCUCCI, & ANDRIGUETTO, 2017).

Such policies are constantly evaluated by government agencies, such as the National Institute of Educational Studies and Research Anísio Teixeira – INEP (POLIDORI, RETTL, MORAES, & CASTRO, 2011), which is linked to the Ministry of Education - MEC.

In order to verify the quality of the Teaching-Pedagogical Project, Infrastructure, and Teaching and Tutorial Training (POLIDORI *et al.*, 2011; Sobrinho, 2010), INEP periodically evaluates the undergraduate courses of Brazilian HEIs. The last dimension, Teacher and Tutorial Training, is responsible for the dissemination of knowledge through teaching and research in the HEIs. In addition, this dimension represents 30% of the final grade of the undergraduate course evaluation, being essential for the measurement of the HEIs quality (HOFFMANN *et al.*, 2014). Thus, Marchelli (2007) reinforces that the indicators related to the academic productivity of HEI faculty deserve more attention when evaluating undergraduate courses.

Polidori & Carvalho (2016) justify that these organizations seek the accreditation of quality of their undergraduate courses based on the reinforcement of the teaching and research promoted by them, and by the correct fulfillment of the evaluation instruments (SOBRINHO, 2010).

To improve the completion of these Brazilian higher education evaluation instruments, by automating the process, several authors recommend the use of computational tools, which help academic managers to insert information in these assessment platforms (A. D. ALVES, YANASSE, & SOMA, 2012; W. ALVES, SANTOS, & SCHIMIT, 2016; FERRAZ, MACCARI, QUONIAM, SILVA, & MODKOVSKI, 2017; FERRAZ, SILVA, RAMÃO, & PETTA, 2016; MENA-CHALCO & JUNIOR, 2009; SILVA & FERRAZ, 2017).

Bavaresco (2017) presents and justifies the use of the Scriptemec tool, dedicated to the evaluation of the academic productivity of undergraduate courses researchers, being an instrument of teaching and student performance management, through indicators, which can be used by HEIs academic managers.

Based on the problem presented so far, this paper intends to answer the following research question, which will guide its development: "How to evaluate, in a continuous and automated way, the performance in academic productivity of professors in undergraduate courses of Brazilian HEIs?"

In this context, the purpose of this paper is to present a model to evaluate the performance of Brazilian professors in undergraduate courses, considering some indicators proposed by INEP, and related to the Teaching and Tutorial dimension. Thus, this paper demonstrates that, with Scriptemec, it is possible to monitor the academic productivity of the professors over a specific period, to evaluate the levels of transparency/popularization of the researches and analyze the social responsibility of these studies.

For this, in addition to this Introduction, the section on Theoretical Framework presents the main theoretical pillars that support the results of this paper. Following, in Methodology section is demonstrated the data collection and analysis procedures of the present study, as well as the characterization of the HEI that will be used as the object of this experimentation. Next, the section entitled Results presents the data generated by Scriptemec, related to the academic productivity of the analyzed professors. In the Discussion and Analysis section, the results obtained in the previous section are discussed, according to the literature, as well as the presentation of a previous model to evaluate the performance of undergraduate professors by the HEI managers. Finally, in the Conclusion section, is argued about the use of Scriptemec as a strategic tool to evaluate the performance in academic productivity of Brazilian HEI professors in undergraduate courses, and the development of a systematic model to evaluate all professors staff.

## **THEORETICAL FRAMEWORK**

### **BRAZILIAN HIGHER EDUCATION ASSESSMENT SYSTEM**

The evaluation of Brazilian higher education has been a topic discussed since the 1950s, when CAPES was created, whose main objective was to improve the quality of the teaching service provided by HEIs, focusing on *Stricto sensu* courses (CAPES, 2016). In the 1970s, the evaluation of Brazilian higher education had been intensified, because of the growth in the number of Master's and Doctoral courses in Brazil (MACCARI *et al.*, 2014).

However, only in the 1980's, thirty years after the Brazilian system of higher education initiated the measurement of the quality of services provided, undergraduate courses began to be evaluated (Sobrinho, 2010). The evaluations were initiated by MEC, based on a series of tools, such as the University Reform Assessment Program (PARU), the constitution of the "Commission of Notables" and the Executive Reform Group for Higher Education - GERES (POLIDORI *et al.*, 2011).

After these first initiatives for the evaluation of undergraduate courses in Brazil, exclusively through governmental actions directed by MEC, the HEIs began to organize themselves to define instruments that promoted their self-assessment that, according to Polidori & Carvalho (2016), was a form of accreditation and self-knowledge developed by this kind of organization. Based on the self-assessment, the HEIs began to organize their data, so they could obtain their indicators and thus establish a model for presenting quality results that would meet the recommendations of the government agencies (HOFFMANN *et al.*, 2014).

After the self-evaluation initiatives promoted by HEIs were established as an adequate way to measure the quality of Brazilian higher education, the Institutional Evaluation Program of the Brazilian Universities - PAIUB was created, regulated by MEC. However, even with the strengthening of this new model, the PAIUB still did not have criteria for measuring the quality of teaching and research services parameterized among all Brazilian HEIs (SOBRINHO, 2010). Because of PAIUB not being a complete evaluation tool, between 1996 and 1997, the National Exam of Courses (ENC) was created, known as "Provão". This new model of evaluation had as main objective to regulate the institutional growth and to measure the performance of all Brazilian HEIs (BARREYRO, 2008; POLIDORI *et al.*, 2011). Only after the "Provão", the MEC was able to establish the criteria for authorization and recognition of undergraduate courses in Brazil. Meanwhile, in order to make the evaluation of these courses even more complete, MEC developed two more tools that would complement the "Provão", which were the Assessment of Teaching Conditions and Institutional Evaluation (MEC, 2017; SOBRINHO, 2010).

Therefore, in 2004, the National System for the Evaluation of Higher Education (SINAES) was created with the mission of being a unified system to promote a complete evaluation in all HEI, fulfilling the definitions established by the Brazilian government agencies (LACERDA, FERRI, & DUARTE, 2016; POLIDORI & CARVALHO, 2016; SOBRINHO, 2010).

Thus, SINAES, which is under the coordination of INEP, can meet the quality parameters defined by the National Commission for the Evaluation of Higher Education – CONAES (CANAN & ELOY, 2016), establishing three axes for measuring the quality of teaching: Institutional Evaluation of HEIs, Student Performance Assessment, and Evaluation of Undergraduate Courses.

The first axis, which is the Institutional Evaluation of HEIs, meets the criteria defined by Law 10,861/04 and by Administrative Rule 2051 of July 9, 2004 (MEC, 2017), which made it mandatory for all HEIs to create their Commissions of Evaluation - CPA. The commission is an internal instrument of institutional evaluation that allows HEIs to plan actions, improving student and teacher performance (POLIDORI, RETTL, MORAES, & CASTRO, 2011), infrastructure and social responsibility (BERNARDES & ROTHEN, 2016), and their financial sustainability (GALVÃO, CORRÊA, & ALVES, 2011; GOMES, MACHADO-TAYLOR, SARAIVA, & SANTOS, 2015).

The second axis, the student performance assessment, is used in the National Student Performance Examination (ENADE, in portuguese), to evaluate the technical and academic performance of students graduating from an HEI (MEC, 2017). This exam is an evaluation that can meet the needs of the students of the HEI, relating academic theory with professional practice (POLIDORI *et al.*, 2011), the authentication of the knowledge obtained throughout the undergraduate course (CASTRO, SOUZA, GAVA, SILVA, & PEREIRA, 2016), the alignment of the technical-scientific knowledge of the student in relation to their peers in Brazil (BRITO, 2008; SOBRINHO, 2010), and the recognition of the quality of the IES undergraduate courses by graduates (CANAN & ELOY, 2016; HOFFMANN *ET AL.*, 2014; POLIDORI & CARVALHO, 2016).

Thus, ENADE has a strategic role in HEIs, enabling these institutions to promote actions that improve the quality of teaching and research services provided, increase the results of institutional evaluations, and improve the accuracy of the data presented to INEP, periodically (SILVA & FERRAZ, 2016).

Even with an internal assessment by CPA and an evaluation focused on student performance as measured by ENADE, the HEIs undergo an external evaluation process, promoted by on-site visits of specialists designated by MEC (SOBRINHO, 2010). These external committees aim to evaluate the teaching conditions provided by HEIs to assist in the authorization or recognition of undergraduate courses (HOFFMANN *et al.*, 2014).

Thus, in Brazil, the third axis practiced by SINAES - the student performance assessment - is a valid instrument and systematizes a large amount of information, based on indicators that allow the accreditation of the quality of services provided by HEIs (POLIDORI & CARVALHO, 2016). Besides, the use of the external evaluation committee allows for transparency in the evaluation process of undergraduate courses, as well as a confirmation of the results obtained through the other two evaluation axes.

However, several authors (BARREYRO, 2008; FERREIRA, BOENTE, SANTOS, BREVILATO, & BOENTE, 2016; LACERDA *et al.*, 2016; POLIDORI *et al.*, 2011; SOBRINHO, 2010) have argued that SINAES needs to be revised, both in the political sphere and in its format and application, to present real improvements in the measurement of the quality of the services provided by HEI.

In addition, Marchelli (2007) emphasizes that the pillars of the Faculty, Work Regime, and Publications and Productions of the Faculty, present in the Faculty and Tutorial dimension, are the main indicators that should be reviewed in the SINAES, because of the adherence to the main objective of HEIs, which is to disseminate knowledge through teaching and research to the whole community (MEC, 2017).



## ORGANIZATIONAL PERFORMANCE EVALUATION

Strategic planning is essential for the development of methodologies related to organizational performance improvement (PORTER, 2008), in any organization model (POMPEU, PINHEIRO, & RABAIOLI, 2015). It should be emphasized that, through strategic planning, defined by indicators established by organizations, managers are able to have a more appropriate direction for decision making (JORDÃO, MELO, & NETO, 2016).

Decision making in organizations is one of the most important criteria for achieving the objectives defined in the strategic planning (SOUZA, SILVA, JUNIOR, & SILVA, 2012), allowing these institutions to perform better in the face of competition (GALVÃO *et al.*, 2011), and generating a competitive market advantage (BARNEY, 1991; WERNERFELT, 1984). In addition, strategic decisions involve all internal and external audiences of organizations, and prior knowledge about factors that impact organizational performance is required (BORGES, CABRAL, & PETRI, 2014).

Ceulemans *et al.* (2015) point out that, for a complete assessment of the performance of organizations, it is necessary to define previous and posterior indicators, allowing a comparative analysis of the results. According to the authors, for this management control to be adequate to strategic decisions, it is recommended to use tools that speed up the process of collecting and analyzing the previously defined indicators.

Thus, the evaluation of organizational performance is a form of managerial control (JORDÃO *et al.*, 2016), which allows the development of tools that help in productivity management and in the definition of institutional strategies in high competition segments (POMPEU *et al.*, 2015), as is the Brazilian higher education market (HOFFMANN *et al.*, 2014).

The Brazilian higher education market is a highly contested segment, because of the large number of institutions (INEP, 2017), the pressures of internal and external audiences (MEYER JR, PASCUCCI, & MANGOLIN, 2012), and changes in measurement policies of the quality of the services provided (GOMES *et al.*, 2015; SOUZA *et al.*, 2012). To support all this segment pressure, several HEIs have sought strategic management tools, based on indicators, that can support the decisions made by their managers (R. P. MARTINS *et al.*, 2013)..

Thus, Gnaldi e Ranalli (2016) recommend that HEIs should develop models of managerial control through specific indicators of the segment. The authors explain that, only from the development of dashboards with indicators of the HEI, it is possible to analyze the performance of educational organizations.

Consequently, performance management of higher education organizations should follow their own managerial control and adapted to the peculiarities of the segment (BAETA *et al.*, 2014; GNALDI & RANALLI, 2016; JORDÃO *et al.*, 2016). In addition, for this strategic management process to be effective, Ceulemans *et al.* (2015) recommend the definition of indicators that allow a prior and posterior analysis of organizational performance. For this, Kalimullin *et al.* (2016) suggest the use of innovations that help this process, optimizing the presentation of results and analysis of performance indicators of organizations.

## 2.3 USE OF COMPUTATIONAL TOOLS TO EVALUATE AND MANAGE ACADEMIC PRODUCTIVITY IN HEIS

Through a coercive isomorphic process (DIMAGGIO & POWELL, 2005) for the evaluation of undergraduate courses in Brazil, academic managers use the technical-administrative staff to collect and organize the data to be presented to the INEP.

In this context, for the management and evaluation of academic productivity, the HEIs have designated executive secretaries (SCHERER, REMPEL, MARTINS, & HAETINGER, 2012), who access the Lattes Platform to collect the data of the researchers/professors, which compose the faculty of undergraduate courses.

The data are tabulated in spreadsheets and later, manually organized, within the model established by INEP, for evaluation (POLIDORI *et al.*, 2011). This process is susceptible to errors (BAVARESCO, FERRAZ, BARRO, & BOEIRA, 2015), since it is done manually, and can lead to losses in the evaluation of HEIs, resulting in sanctions promoted by INEP, such as, the reduction in the grade of undergraduate courses, which varies from 1 to 5.

In order to solve possible manual errors in the data collection process of the Lattes Platform, Silva & Ferraz (2017) presented the four main computational tools that help the HEI academic directors to manage the academic productivity of the faculty: the Lattes Extractor and Lattes Miner (A. D. ALVES *et al.*, 2012), Scriptlattes (MENA-CHALCO & JUNIOR, 2009; NIGRO, FERRAZ, QUONIAM, ALVES, & MESSAIS, 2016) and Scriptsucupira (BAVARESCO, FERRAZ, BARRO, & BOEIRA, 2015; FERRAZ *et al.*, 2016; RAMÃO, FERRAZ, SILVA, & ALVES, 2017).

Among all, the most important are Scriptlattes and Scriptsucupira, which are open source computational tools. The difference between the tools is mainly regarding to the complexity of the analysis that each one allows. Scriptlattes enables only a list of researchers to be evaluated on a timely basis, while Scriptsucupira runs multiple Scriptlattes concurrently, which allows an assessment of academic productivity, in a broader and longer period, based on several lists of researchers provided to the computational tool at the beginning of the data extraction process (W. ALVES *et al.*, 2016; SANTOS, 2017).

Several studies have already presented the practical application of both Scriptlattes and Scriptsucupira in *Stricto sensu* graduate courses, such as Business (FERRAZ *et al.*, 2017), Law (NIGRO, FERRAZ, QUONIAM, & ALVES, 2015), Production Engineering (NIGRO, FERRAZ, QUONIAM, ALVES, *et al.*, 2016), Biophotonics (FERRAZ, SILVA, RAMÃO, & PETTA, 2016), and Rehabilitation Sciences (RAMÃO *et al.*, 2017).

However, there are still few studies on the evaluation of undergraduate courses using computational tools (BAVARESCO, 2017; BAVARESCO *et al.*, 2015; SILVA, 2017), which can be explained by the fact that Scriptlattes and Scriptsucupira were developed to meet, initially, to the criteria established by CAPES, which evaluates only Masters and Doctoral Programs in Brazil. Therefore, even if these tools were used to evaluate an undergraduate course, the results obtained would not yet meet the requirements requested by INEP (MEC, 2017; POLIDORI *et al.*, 2011).

Thence, for the academic managers of the undergraduate courses to fulfill the criteria established by INEP, based on the Faculty and Tutorial dimension, which evaluates the academic production, it is necessary to use an exclusive tool for this course model, and that works in a similar way that Scriptsucupira works with *Stricto sensu* Graduate Programs. Thus, Bavaresco (2017) presented a tool called Scriptemec to assist the evaluation of undergraduate professors, in relation to their academic productivity.

Scriptemec is an open source computing tool, similar to Scriptsucupira, developed for the Linux platform. It is based on the definition of a previous list of undergraduate professors, extracting and organizing the academic and professional data registered in the Platform Lattes (W. ALVES *et al.*, 2016; SANTOS, 2017).

## METHODOLOGY

This study aims to present a model for evaluating the academic productivity performance of undergraduate professors in Brazilian HEIs, measuring the intellectual production of a group, the social responsibility of their research and the level of transparency/popularization of the researches.

In this context, this study is framed as a descriptive and exploratory research, in which a logical sequence of data analysis is followed for a better understanding of the studied phenomena (SMALL, 2011). In this paper was used the strategy of sequential exploration of information (PARANHOS, FIGUEIREDO FILHO, ROCHA, SILVA JÚNIOR, & FREITAS, 2016), in which data were initially collected quantitatively, and that were later analyzed qualitatively, allowing generalizations about the research. The choice of this method for the present research is reinforced, since Creswell & Poth (2017) affirm that this approach is the most adequate to improve or develop tools to analyze the collected data, helping in the understanding of the new phenomenon.

Another approach of the present study is the description of the operational functions of Scriptemec, a computational tool that has the objective of extracting and organizing the data concerning the academic productivity of Brazilian undergraduate faculty, highlighting the previous procedures for its execution, the extraction process, as well as the presentation of data obtained through the Lattes Platform.

To present the effectiveness of using Scriptemec tool for the continuous and automated evaluation of professors' productivity, a Brazilian HEI was selected that could cover the greatest number of criteria proposed by the INEP evaluation instrument.

The criteria for the definition of the HEI studied were: 1 - To have undergraduate courses with the possibility of renewal of recognition and/or subject to authorization, according to guidelines defined by INEP/MEC; 2 - To have institutional values related to social responsibility and assistance to the local community; 3 - To have a faculty formed by Masters and Doctors, assisting in the analysis of the Teaching and Tutorial dimension, according to the "instrument" established by the INEP; 4 - Have the undergraduate course in Medicine within the academic portfolio, considering that this course has specific criteria for analysis by the "instrument"; 5 - Provide the necessary information about the academic productivity of undergraduate teaching staff.

Thus, *Alfa* was defined as the object of this study (the HEI did not authorize the use of its real name, and from that moment on it is called *Alfa*), which meets all the criteria mentioned above.

*Alfa* is a private HEI, comprising 9 campi distributed in the states of São Paulo (6), Paraná (1), Rio de Janeiro (1) and Minas Gerais (1). Although the institution offers from Open Courses to Post-Graduation *Stricto sensu* (MSc and PhD Academic), the focus of this study will be undergraduate courses, which are offered only in the São Paulo campus.

*Alfa*, which is an HEI focused on Health Sciences, has only two undergraduate courses, these being Nursing, which fits the possibility of renewal of recognition, and Medicine, which fits within the scope of authorization of the course, fulfilling criteria 1 and 4 to define this HEI as the object of the present study. Since *Alfa* is part of a charity, and that has among its institutional values Social Responsibility and Support to Poor Communities, this HEI meets criterion 2 of selection. To fulfill criterion 3, *Alfa* has only professors with Master and Doctors degree in its undergraduate courses. Finally, the HEI allowed access to the academic and professional data of the 45 professors of its undergraduate courses, fulfilling criterion 5, and justifying its choice.



To obtain updated data on the academic productivity of teachers through the execution of Scriptemec, the following data were collected from *Alfa*'s faculty: Name, Time of the Professional Hiring, Course to which it is currently registered, Institutional Registration and ID Lattes, for start the analysis in the Diagnostic Phase. In addition, the Lattes Platform was used to obtain data on the academic productivity of this group, such as Bibliographic Production, Technical Production, Research Projects, Orientations and Ongoing Supervisors, among other indicators.

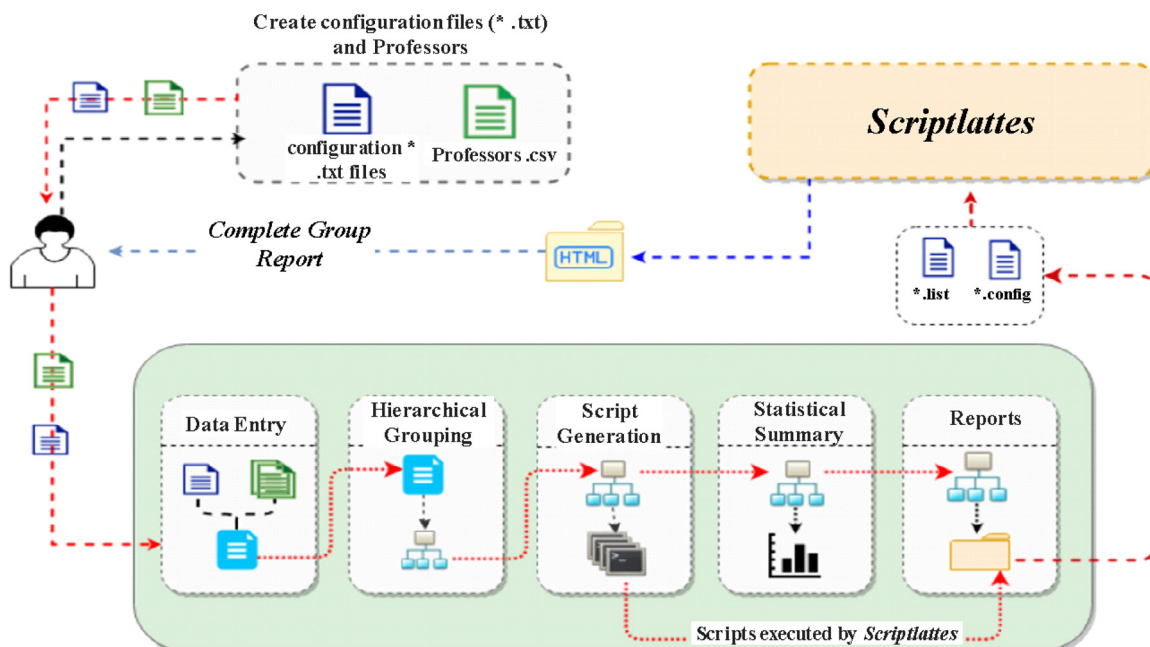
This paragraph explains the procedure for collecting the data of the group of professors of this research. Initially, the ".csv" entry list was constructed to execute Scriptemec, allowing the extraction, organization and presentation of the academic productivity data of the faculty, for later analysis. This entry list in ".csv" had the following order of information from the professors: ID Lattes, Enrollment, Full Name, Bound Program/Course (Nursing or Medicine), Period of Beginning of Hiring, Period End of Hiring (if any). Concurrently, a configuration file with the extension ".txt" was created to set a hierarchy of information that would be extracted by Scriptemec. Following, hierarchical grouping of the information occurred, generating the scripts that were executed by Scriptlattes. Subsequently, the Scriptlattes were executed, through Scriptemec, extracting all the curricula of the previously listed professors. In the next stage of the process, the Scriptlattes organized all the academic data of the faculty according to the requested period (2014 to 2016), which is the last triennial evaluation cycle of INEP. Data were extracted regarding the academic productivity performance of the professors, such as bibliographic production, technical production, orientations in progress, etc., dealing with the redundancies related to these productions through the exclusion of titles overlaps.

These scripts generated files with the extension ".list", containing the Lattes IDs and the name of the professors, and with the extension ".config", with the academic productivity data registered by each member in the Lattes Platform. Finally, after a new execution of Scriptlattes with the files, the reports were obtained with the indicators of academic productivity of the group, being presented in HTML format, and generating the Complete Group Report, for later analysis.

Figure 1 summarizes the stages of operation of Scriptemec, to extract the indicators of academic productivity of the undergraduate students of *Alfa*. More information of computational order can be obtained in the work of Santos (2017).

After the extraction and organization of the academic data of the *Alfa*'s faculty, performed by Scriptemec, all indicators of bibliographic production, technical production, artistic production, orientations, research projects, prizes and titles, participation in events and organization of events, concerning the professors from the undergraduate courses of *Alfa*, were analyzed quantitatively. At the same time, all the data were analyzed in a qualitative approach, based on the evaluation of the level of social responsibility of the research conducted by the HEI faculty and on the transparency/popularization of these researches.

Figure 1 – Scriptemec Scripts Overview



Source: Santos (2017).

## RESULTS

This section presents the results obtained with the use of Scriptemec, which, because it is a Brazilian computational tool, has its texts in portuguese, and it is not currently possible to translate all of its content.

Figure 2 refers to the initial screen, made available by Scriptemec after extracting the professional and academic data from *Alfa* professors registered in the Lattes Platform.

In this figure, it is possible to visualize the links of access to the pages with the indicators of academic production of the evaluated faculty, as well as the productions by course and per year, highlighting the link dedicated to the data of the last triennial evaluation cycle of the INEP (red arrow).

By accessing the link Triênio 2014-2016, indicated by the red arrow in Figure 2, the screen shown in Figure 3 is accessed, where it is possible to identify all links to each of the indicators related to bibliographic production, technical production, artistic production, teacher-led orientation, research projects, prizes and titles, and participation and organization of events.

This article intend to present a model to evaluate the performance of undergraduate courses' professors in Brazilian HEIs. So, it was opted to highlight the indicators that allow the monitoring of faculty academic productivity over a specific period and to evaluate the social responsibility of the studies promoted by the researchers linked to the *Alfa*'s undergraduate courses.

Thus, to demonstrate the volume of bibliographic productions evaluated by INEP in the three-year period (2014-2016), the indicator link "Complete articles published in periodicals", presented in Figure 3, was used.

After clicking on this link, 215 articles published in the triennium 2014-2016, measuring the pillar Scientific, cultural, artistic or technological production, present in the Teacher and Tutorial Training dimension of the INEP evaluation instrument, can be seen in the Figure 4. Besides, it is verified that there are no inconsistencies in filling the Lattes curricula of the *Alfa*'s undergraduate faculty in this period, which should have contributed to the process of institutional evaluation and accountability to the INEP.

Figure 2 – Initial page with the links to results generated by Scriptemec



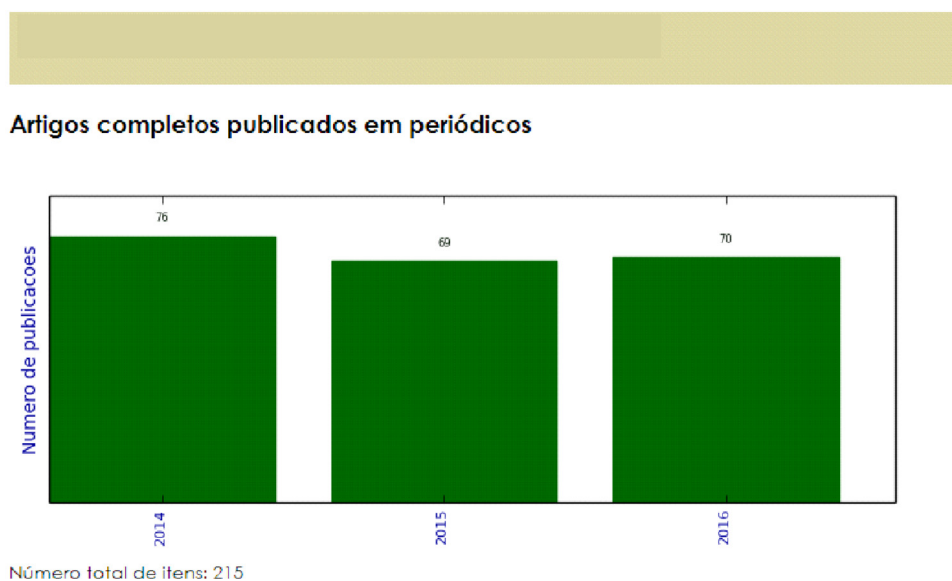
Source: <http://ec2-35-164-224-104.us-west-2.compute.amazonaws.com/scriptdataset-result>.

Figure 3 – Screen with links of access to the different types of production of the evaluated staff



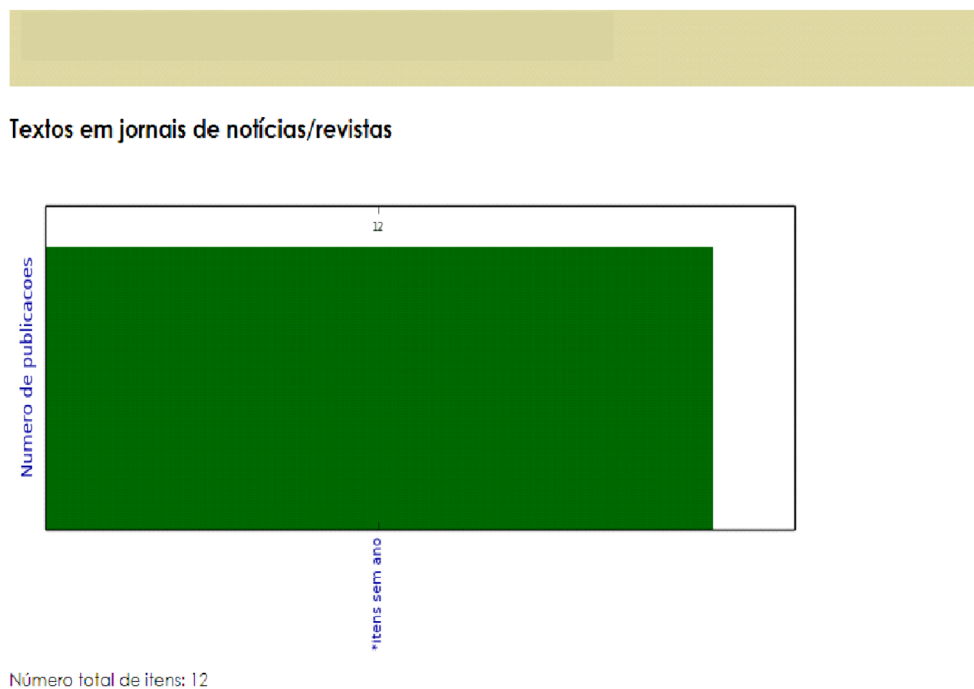
Source: <http://ec2-35-164-224-104.us-west-2.compute.amazonaws.com/scriptdataset-result>.

Figure 4 – Results of the indicator “Complete articles published in periodicals” in the triennium 2014-2016



Source: <http://ec2-35-164-224-104.us-west-2.compute.amazonaws.com/scriptdataset-result>.

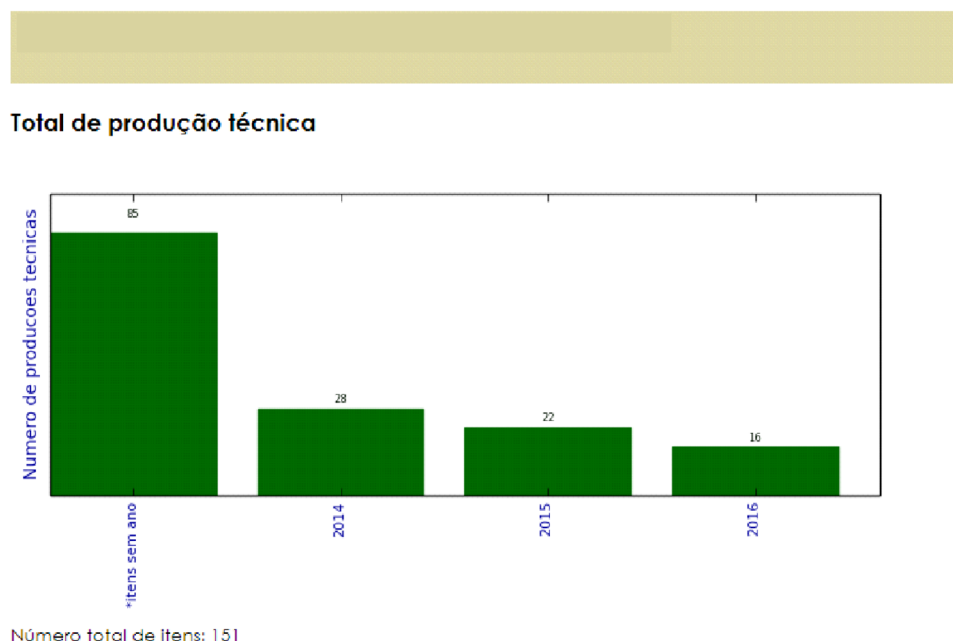
Figure 5 – Results of the indicator “Texts in newspapers of journals/magazines” in the triennium 2014-2016



Source: <http://ec2-35-164-224-104.us-west-2.compute.amazonaws.com/scriptdataset-result>.



Figure 6 – Results of the indicator “Total technical production” in the triennium 2014-2016



Source: <http://ec2-35-164-224-104.us-west-2.compute.amazonaws.com/scriptdataset-result>.

For the analysis of the index of popularization/transparency in researches, the link of the indicator “Texts in newspapers of journals/magazines” was used, going to the screen represented in Figure 5. In the period from 2014 to 2016, the total number of publications of this indicator was 12, and all publications were not registered correctly in the Lattes Platform by the group of researchers studied.

Differently from what was observed in the indicator shown in the previous figure, this indicator presents several inconsistencies related to the production register without the correct annotation of the year.

It is worth noting that this error can affect the institutional evaluation of the HEI, besides not allowing the index of popularization/transparency of the published researches by its faculty to be correctly measured, being a very important qualitative indicator in the analysis of the academic productivity of the institution’s teaching staff (FERRAZ *et al.*, 2016; Nigro, Ferraz, Quoniam, Alves, *et al.*, 2016).

Through the analysis of the indicator “Total technical production”, the level of social responsibility of the research carried out by *Alfa* professors’ undergraduate courses were identified. In Figure 6, among the 151 technical productions identified in the triennium 2014-2016, it is noted that 85 of them (56% of the total) are registered with \* items without a year.

Thus, as presented in the analysis of popularization/transparency of research, the data of this indicator were not correctly filled in the Lattes curricula of *Alfa* professors’ undergraduate courses, which may have generated losses to the HEI in the rendering of accounts to the INEP, considering that they were produced during the last three years of evaluation.

A quantitative and qualitative analysis of the indicator “Total of orientations in progress” was carried out for the prospective evaluation of the ongoing research of the professors and students of undergraduate courses in Nursing and Medicine at *Alfa*, in the 2014-2016 triennium.

## DISCUSSION AND ANALISYS

In this section was discussed the results of the current study, aiming to achieve its objectives to explain the phenomenon analyzed, and demonstrating a model of performance evaluation in the scientific productivity of Brazilian undergraduate faculty.

### SCRIPTEMEC RESULTS ANALYSIS

For this, the social responsibility of the researches developed by the *Alfa* professors' undergraduate courses was quantitatively evaluated through the analysis of the "Total technical production" indicator. This indicator is extremely relevant (BOLAN & MOTTA, 2007), since it deals with the volume of publications that are reverted to society, such as patents, software, among other technologies (CNPq, 2017; NIGRO, FERRAZ, QUONIAM, & ALVES, 2016).

Currently, Nigro et. al (2016) published a study to evaluate the social responsibility of the research conducted by *Stricto sensu* Post-Graduation professors from a course in Medicine of a private university located in the city of São Paulo (Brazil). The results of this study showed that the technical productions represented only 9.7% (277 in total) of the total published articles. Already in the current study, the same evaluation demonstrated that the number of technical productions represented 70.2% (151, total) of the total of articles published, indicating a high level of social responsibility with regard to the research developed at *Alfa*. Thus, it is understood that the incentive for this type of production in the HEI must be constant, contributing to the fact that the indicator presented is higher than the one reported in the literature.

For the evaluation of the level of popularization/transparency of the researches, the indicator "Texts in newspapers of journals/magazines" was used, which allows to identify all the productions that have been divulged by conventional means, allowing the access of scientific knowledge to the lay public (BAVARESCO, 2017; FERRAZ *et al.*, 2016).

The results presented in the current research demonstrated that the texts in mass media represented only 0.5% (12 productions in total) of the published articles, classifying the transparency of the results of *Alfa* professors' as low, at least when compared to the previous literature on the subject. For example, Bavaresco (2017), which analyzed this same indicator in undergraduate courses at an HEI in southern Brazil, found that the institution's professors produced 337 texts in newspapers and magazines with a large circulation (representing 56% of total of published articles). Even if the analysis developed by Bavaresco (2017) considered only the productivity of courses in Biology, since *Alfa* only has undergraduate courses in Medicine and Nursing, the indicator would show 240 texts in newspapers and magazines, being twenty times greater than that obtained for the HEI object of the current study. Thus, it is understood that the *Alfa* professors need to be encouraged to increase the volume of publications in newspapers/magazines, seeking to raise the level of popularization/transparency of research conducted at the HEI.

Thus, the results obtained with the use of Scriptemec allowed *Alfa* a view of all academic productivity indicators of their undergraduate professors in a single dashboard, easy to access and presented on screens in HTML format, assisting in accountability to INEP, which occurs periodically. In addition, the dashboard showed the historical evolution of all the analyzed indicators, allowing the continuous and automated management of the professors' intellectual production in undergraduate courses of the Brazilian HEIs.

### MODEL FOR ASSESSING THE INTELLECTUAL PRODUCTIVITY OF A GRADUATE FACULTY

According to the aforementioned analysis, an inconsistency was identified in the completion of the Lattes Platform, carried out by *Alfa's* faculty, which is a database for the creation of a dashboard for a performance analysis in its academic faculty skills. These inconsistencies undermine a general analysis of HEIs, as well as a rendering of accounts of INEP/MEC.

Thus, this paper suggests a model to evaluate the academic productivity of Brazilian undergraduate faculty. The model becomes relevant, since it is mandatory to send the information to the INEP/MEC and also a way of monitoring the academic performance of the professors, by the HEI managers. Therefore, in the following paragraphs, the proposed model is briefly explained.

The model is composed of five main steps, being academic manager the central point for the execution and evaluation the productivity data of the faculty. In step (1), the academic manager requests the technical-scientific production data to the professors, who extract such information from Lattes Platform.

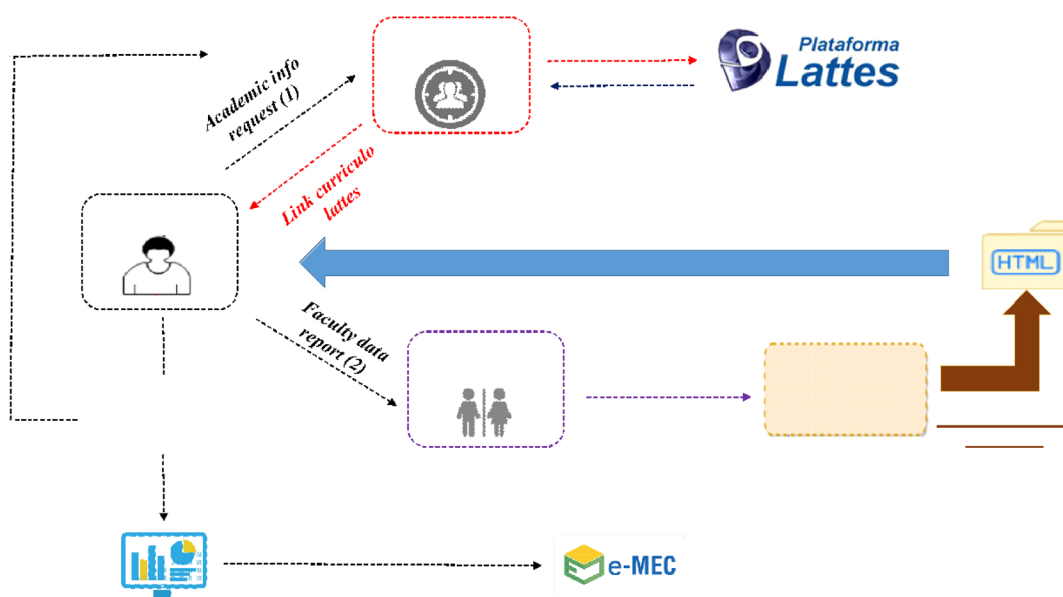
It should be emphasized that it is necessary for all faculty to update their information on the platform, and later send the link of their Curriculum Lattes to the requesting manager. Thus, in step (2), the links are sent to executive secretaries (or other technical-operational professionals, according to the HEIs organizational model) who prepare all configuration (\*.txt) and \*.csv files to be inserted in Scriptemec.

In this process, the tool automates the collection, extraction and organization of Lattes Platform data, converting them into HTML files and, finally, to the Complete Group Report.

This report is received by the academic manager, who analyzes the consolidated data and creates a dashboard for a systematic view of the academic productivity of the faculty, performing step (3). After that, in step (4), the academic manager completes the necessary data in the e-MEC platform, fulfilling the standards established by INEP.

Finally, in step (5), the academic manager, with all the faculty scientific productivity data, identifies the failures presented in the reports and defines a plan of action to promote improvements, avoiding unforeseen events in the next sending of data to INEP. Next, the systematic process is shown in Figure 7.

Figure 7 – Model to evaluate the academic productivity of undergraduate faculty



Source: Prepared by the authors (2019).

## CONCLUSION

Using Scriptemec computational tool, it is understood that the academic managers of the Brazilian HEIs can continuously monitor the academic productivity of undergraduate faculty. In this way, it was possible to strategically evaluate and manage the various productivity indicators, which are so important when reporting to INEP. It is also believed that it is possible, based on the information provided by the tool, to execute action plans in a timely manner to leverage the scientific productivity of professors, when necessary. In this way, sanctions promoted by INEP could be avoided, for example, the reduction of the assessment grade, or even the graduation of undergraduate courses, which would bring institutional and financial losses to HEIs.

In addition, this paper presents a systematic model to evaluate the faculty productivity that allows a high managerial control by HEI managers. Through this model, it is possible to monitor all evaluation process, the correct completion of the information for the INEP, as well as to plan continuous improvement actions. It is emphasized that the automation of the processes of monitoring professors' productivity allows the control of this important internal capacity, which can positively influence the competitive advantage. It is also understood that the process of automation of research productivity management with the use of Scriptemec computational tool allowed the development of an innovative culture in the higher education segment, with a more conscious use of HEI resources.

After this study, it is recommended to develop future researches that identifies actions for an improvement in the completion of the Lattes Platform, which may help in the resolution of inconsistencies in the indicators of academic productivity. With this, the effectiveness in the use of Scriptemec could be even more evident, to be able to present updated and correct data of the researchers. Another suggestion is the annual and triennial follow-up, INEP evaluative period, of the academic productivity indicators of undergraduate professors with the help of Scriptemec, to reinforce the use of the tool in the strategic management process of Brazilian HEIs.

Finally, the current research has as theoretical contribution the possibility of studying the academic performance in scientific productivity of undergraduate courses professors with the support of a strategic tool that allows an optimization in the analysis of intellectual productivity indicators, as well as the possibility to develop an institutional model, which can guide the strategic management decisions of Brazilian HEIs. As an academic contribution, this is a new way of analyzing a subject that has not yet been explored in undergraduate courses (Meyer *et al.*, 2017), which is the strategic evaluation of the indicators of academic productivity of researchers, impacting the institutional value of teaching and research from Brazilian HEIs.

The limitations of the current study are that the research was performed in a single private HEI, which allowed only a unique analysis of the data without the possibility of comparing the results in different realities. Another limitation refers to the use of Scriptemec itself, since the tool still has specific and complex computational routines for its execution, being somewhat inaccessible to the lay public, but with the advantage of being a totally free software. As recommendations for future research, it is suggested that this systematic model, presented in this paper, be developed in other institutions, with different aspects of the HEI object of the current study, generating new results and contributions for the evaluation of indicators in academic productivity of undergraduate faculty.

Another suggestion concerns the possibility of extending the period of continuous evaluation, which would allow a deeper monitoring of the results at different times. It is also understood that a qualitative study interviewing managers of HEIs and seeking to identify positive aspects of the use of Scriptemec could bring several contributions to the current research theme.



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