SUSTAINABILITY INDICATORS FOR HIGHER EDUCATION INSTITUTIONS: A PROPOSAL BASED ON THE LITERATURE REVIEW

Gilberto Soares da Silva[1]
Lia de Azevedo Almeida[2]

ABSTRACT

Objective: This article aims to propose a set of sustainability indicators that comprise its three dimensions (social, environmental, and economic), based on a literature review, capable of assess the sustainable performance in Institutions of Higher Education.

Methodology: This is a study of theoretical nature, with an exploratory and qualitative approach from a literature review of national and international works that presented tools for measuring sustainability in Institutions of Higher Education and other organizations, concluding with validation of group of specialists.

Originality/Relevance: We have identified that the existing tools do not contemplate all three dimensions of sustainability (social, environmental and economic), therefore, the proposed tool intended to fill this gap.

Main results: As a result, this research presents a set of 57 indicators that were divided into six main aspects: academic community; administrative staff; operations and services; teaching; research, and extension. Not only did the proposal emphasize that the indicators are significative in at least one sustainability dimension, it also highlights the interconnection [of indicators] in two or more dimensions, so that each aspect can be contemplated in different dimensions.

Theoretical/Methodological contributions: The main contribution of this work is to present a holistic tool that can be applied in any university in Brazil. **Conclusion:** We propose that this tool is applied annually, observing the measurement frequency of the indicators, contributing the performance assessment of Institutions of Higher Education, as well as being used as a comparative parameter between different universities.

Keywords: Sustainability Indicators. Institutions of Higher Education. Sustainable Development.

[1] Mestrado em Gestão de Políticas Públicas pela Universidade Federal do Tocantins – UFT. Palmas, Tocantins, (Brasil). E-mail: gilbertosoares@uft.edu.br. ORCID: https://orcid.org/0000-0003-4595-9031.
[2] Doutorado em Administração pela Universidade de Brasília – UNB. Brasília, Distrito Federal, (Brasil). E-mail: – Brasil. E-mail: lia.almeida@uft.edu.br. ORCID: https://orcid.org/0000-0002-6586-4067.

INDICADORES DE SUSTENTABILIDADE PARA INSTITUIÇÕES DE ENSINO SUPERIOR: UMA PROPOSTA BASEADA NA REVISÃO DE LITERATURA

RESUMO

Objetivo: Este artigo tem como objetivo, propor um conjunto de indicadores de sustentabilidade que compreenda suas três dimensões (social, ambiental e econômico), baseado na revisão de literatura, capazes de avaliar o desempenho sustentável de Instituições de Ensino Superior (IES).

Metodologia: Foi realizado um estudo de natureza teórica, com abordagem exploratória e qualitativa, a partir de uma revisão de literatura em trabalhos internacionais e nacionais que apresentassem ferramentas de mensuração da sustentabilidade em IES ou outras organizações, finalizando com a validação por um grupo de especialistas.

Originalidade/ relevância: Foi identificado que as ferramentas existentes não contemplavam as três dimensões da sustentabilidade (social, ambiental e econômica), por isso a ferramenta proposta pretendeu superar essa lacuna.

Principais resultados: Como resultado, este estudo apresenta um conjunto de 37 indicadores, que foram divididos em seis aspectos principais: corpo acadêmico; corpo administrativo; operações e serviços; ensino, pesquisa; e, extensão universitária. A proposta salienta que os indicadores são significativos em pelo menos uma das dimensões da sustentabilidade, como também, observam a interligação [dos indicadores] em duas ou mais dimensões, de modo que, cada aspecto possa ser contemplado em diferentes dimensões.

Contribuições teóricas/metodológicas: A principal contribuição do trabalho é apresentar uma ferramenta holística e aplicável em qualquer universidade do Brasil.

Conclusão: Propõe-se que a ferramenta seja aplicada anualmente, observando a frequência de mensuração dos indicadores, contribuindo para a análise do desempenho das IES, bem como, servindo de parâmetro comparativo entre diferentes universidades.

Palavras-chave: Indicadores de Sustentabilidade. Instituições de Ensino Superior. Desenvolvimento Sustentável.

INDICADORES DE SOSTENIBILIDAD PARA INSTITUCIONES DE ENSEÑANZA SUPERIOR: UNA PROPUESTA BASADA EN LA REVISIÓN DE LITERATURA

RESUMEN

Objetivo: Este artículo tiene como objetivo, proponer un conjunto de indicadores de sostenibilidad que comprenda sus tres dimensiones (social, ambiental y económico), basado en la revisión de literatura, capaces de evaluar el desempeño sustentable de Instituciones de Enseñanza Superior (IES).

Metodología: Se realizó un estudio de naturaleza teórica, con abordaje exploratorio y cualitativo, a partir de una revisión de literatura en trabajos internacionales y nacionales que

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presentaran herramientas de medición de la sostenibilidad en IES u otras organizaciones, finalizando con la validación por un grupo de especialistas.

Originalidad / relevancia: Se ha identificado que las herramientas existentes no contemplaban las tres dimensiones de la sostenibilidad (social, ambiental y económica), por lo que la herramienta propuesta pretendió superar esa laguna.

Principales resultados: Como resultado, este estudio presenta un conjunto de 37 indicadores, que se dividieron en seis aspectos principales: cuerpo académico; cuerpo administrativo; operaciones y servicios; enseñanza, investigación; y extensión universitaria. La propuesta subraya que los indicadores son significativos en al menos una de las dimensiones de la sostenibilidad, como también, observan la interconexión [de los indicadores] en dos o más dimensiones, de modo que, cada aspecto pueda ser contemplado en diferentes dimensiones.

Contribuciones teóricas / metodológicas: La principal contribución del trabajo es presentar una herramienta holística y aplicable en cualquier universidad de Brasil.

Conclusión: Se propone que la herramienta sea aplicada anualmente, observando la frecuencia de medición de los indicadores, contribuyendo para el análisis del desempeño de las IES, así como, sirviendo de parámetro comparativo entre diferentes universidades.

Palabras clave: Indicadores de Sostenibilidad. Instituciones de Enseñanza Superior. Desenvolvimiento sustentable.

1. INTRODUCTION

The consequences of the degradation of natural resources, promoted by industrialization, populational growth and increased consumerism levels has directly influenced how society has becoming more aware. In this sense, Warken, Heen and Rosa (2014) highlight that concern with sustainability has changed a number of productive and economic processes. Notwithstanding, Institutions of Higher Education have demonstrated their main role in raising social awareness on the need to protect the environment and achieving sustainable development goals.

Due to the increasing supply of higher education, the relevant role of the universities towards sustainability has expanded internationally. (Beringer, 2007). Thus, this issue comes from the forces that push towards the promotion of socio-environmental management in universities. (Huyan & Yang, 2012). According to Cortese (2003), Institutions of Higher Education have great potential for sustainable development. This is due to the diverse competences and knowledge they produce, the diffusion of innovative ideas and, the ability to discuss and intervene, facing the challenges regarding sustainable life.

Costa and Almeida (2013) mention that the assessment of sustainable practices in Institutions of Higher Education are becoming more common. The authors emphasize that these works are important as they expand opportunities, leading the academic community to publicize empiric researches. When it comes to sustainability indicators, growing concern regarding this issue is noticeable in multiple organizations, including higher education (Hasan & Morrison, 2008). As argued by Veiga (2010), proper sustainability assessment demands three indicators as it is not possible to think sustainable development without imagining a balance between environment, welfare and economy.

In this perspective, Shriberg (2002) has analyzed 11 sustainability assessment tools in Institutions of Higher Education, thereby concluding that even though most of the analyzed tools focus on sustainability, they mostly approach the environmental context, yet, some of them prioritize socio-economic dimensions. Other authors proposed researches in order to measure sustainability in Institutions of Higher Education, such as Cole (2003), Arvidson

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(2004), Lozano (2006), Madeira (2008). Nevertheless, these authors propose indicators that are not quite appropriate to the context of Brazilian universities. The tools proposed by them are, in many cases, adapted from organizational models, not only focusing solely on environmental sustainability but also detailing a great number of indicators that are not measurable in their whole.

Brazilian works that analyzed sustainability through the use of indicators are recent, such as in Costa (2012), who has researched sustainability practices at PUC-Rio, in accordance to A3P guidelines. Freitas (2013) proposes a tool to assess Institutions of Higher Education which is applied by Warken (2014) at the South Frontier Federal University. Oliveira (2015), applied a number of indicators in order to measure socio-environmental sustainability in a university in Sergipe. Drahein (2016) analyzed service operations sustainability at the Brazilian Federal Professional, Scientific and Technologic Schools.

Therefore, it is possible to notice that most of the works aiming to analyze sustainability in Institutions of Higher Education do not include all three dimensions (social, environmental and economic), moreover, international works do not show adhesion and applicability in the Brazilian universities' contexts. It is important to highlight that in analysis such as Cole (2003), Drahein (2016), Lozano (2006), Oliveira (2015) and, Shriberg (2002), the dimensions applied to sustainability usually refer to environmental sustainability, not frequently applying a more complete analysis, which also focus on social and economic dimensions.

On these grounds, the main goal of this work is to propose a set of indicators, based on a literature review, to assess the socioenvironmental performance of Institutions of Higher Education so that they are aligned to social, environmental and economic dimensions of sustainability. As a pragmatic contribution, this work provides a tool capable of assessing socioenvironmental performance in Institutions of Higher Education in a holistic manner, using indicators that depict institutional practices aiming social, environmental and, economic sustainability. To validate this tool, we have relied on many professionals and specialists to include or exclude indicators that were not measurable. We consider that operations, services and, academic activities are common pillars in Brazilian universities, therefore, the proposed model can, not only be applied in different Institutions of Higher Education, but also adapted according to each context.

With the above, this article is organized in three main parts, besides this introduction and the final considerations. The first part contains a theoretical review where it is possible to find the definition of sustainability and its dimensions, as well as the role of Institutions of Higher Education in the search for sustainable practices, in addition to a review on indicators, along with their use, benefits and, socioenvironmental assessment tools that were created for high education. The second part discuss the methodology used in the proposal of this tool, enabled by a bibliographic review, of descriptive nature, exploratory objective and, qualitative approach. Subsequently, we have proposed a tool based on indicators in order to assess sustainability in Institutions of Higher Education.

2.   SUSTAINABILITY AND THE UNIVERSITY'S ROLE

Concern about natural resources depletion has increased due to the human ability to interfere in the environment, which proves its interdependence with Economy (Donaire, 1999). Hence, Sen (1990) states that development must be thought beyond economic growth, in other words, it must not be seen as mere wealth accumulation. Thus, in this new perception of development, growth must include issues related to welfare and social justice. For instance, balance between resource distribution, reducing inequalities and environment preservation (Sachs, 2008; Sen 1990).

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Therefore, society needs to reflect on sustainable development and yet, assure humanity is supported. Taking into consideration that we find ourselves amidst a civilization crisis of multiple, interdependent and interpenetrating dimensions: ecological, social, political, human, ethnical, moral, religious, affective, mythological, etc., the very perception of development is a complex issue as its essence is weaved in a tissue of inseparable issues, requiring an epistemological change. (Morin, 2008)

These issues have become a topic of discussion among countries for some time, as it was seen at the United Nations Human Development Conference, the Rio de Janeiro Earth Summit, the United Nations General Assembly, the Johanesburg Conference and, at the Rio de Janeiro Earth Summit 2012. These events have deepened the necessary discussion between economical, social, technological and, political sectors. Therefore, they have pointed to the adoption of a stance that answers the preservation of natural resources and social equality. (Barbieri, 2007)

The publication of the Brundtland Report, in 1987, by the World Commission on Environment and Development (WCED), headed by the prime minister of Norway, Gro Harlem Brundtland, defined sustainable development. At this point, this concept gained popularity and recognition. According to the aforementioned document, sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". (WCED, 1988)

This concept was based on three fundamental pillars: economic, social and environmental. Passing through two points: 1) The concept of "needs", in which special attention and priority should be given to the poorest part of the population; 2) The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet the needs of present and future societies. (WCED, 1988).

According to Sachs (2009), sustainable development emerged as a compromise between purely economic speeches and environmental fundamentalism. This idea is supported on three pillars: social relevance, ecological prudence, and economic viability. The author states that in order to make sustainability possible, economic growth is indispensable, however, it must allow a responsible stance regarding the social dimension, moreover, it must be implemented by mechanisms which the environment can benefit from.

In the same manner, teaching institutions should align sustainability to the teaching, research and extension triad, prioritizing the planning of actions and policies that promote welfare and the quality of life of all those involved in the educational process (Brandli, Frandoloso, Fraga, Vieira & Pereira, 2012). Walchiz and Carvalho (2015) emphasize the role of the universities that are involved in the effectiveness of sustainability and environmental protection principles, committing to educate actors who are prepared for the future, in the construction of a fairer and more sustainable community.

Some authors, such as Velasquez, Munguia, Platt and Taddei (2006), sought to conceptualize sustainable Institutions of Higher Education. For them, in order to be recognized as sustainable, universities should care, embrace and promote the reduction of the environmental impact at a local or global level. Cole (2003) states that sustainable teaching institutions allow campus community to take action to protect and improve health and quality of life of the internal and external communities, as well as its ecosystems.

Aiming to develop researches that analyses sustainability performance of Institutions of Higher Education, mechanisms are proposed to measure the practices of these institutions using indicators. In the following section, we approach an analysis of the tools created to measure sustainability in Institutions of Higher Education.

2.1 SUSTAINABILITY INDICATORS FOR HIGHER EDUCATION INSTITUTIONS: LITERATURE REVIEW

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The Organization for Economic Co-operation and Development (OECD) defines the term indicator in a generic way as "a parameter, or a value derived from parameters, which provides information about a phenomenon." (OECD, 1993. p. 5) The series of events on sustainable development that happened in the 1990's led to the need of sustainability indicators. That happened mainly within governmental and non-governmental organizations, research centers, and Institutions of Higher Education worldwide. (Marzal & Almeida, 2000). Jannuzzi (2005) ratifies this idea by associating the use of indicators by society, in the monitoring of government actions and private organizations. This social control happens due to the attention given to the efficient and effective use of financial resources and their impact.

Hence, indicators are used to measure the distance between the current conjuncture of a community and its development goals. Additionally, it should become an aid instrument in the sustainability implementation and in the practical execution of government policies (Campos & Melo, 2008; Jannuzzi, 2005; Guimarães, 1998). They can also direct perceptions and trends that cannot be immediately detected. (Hammond, Adriaanse, Rodenburg, Briant & Woodward, 1995; Spangenberg, 2002).

Thus, the use of sustainability indicators can be beneficial for decision making support, aiding leaders in fund attribution, great natural resources allocation, comparing processes and situations, pointing trends, warning and anticipating future situations (Uliani, Rodrigues, Faria, Badaró, Romano, Mendes & Sumita, 2011). These indicators can still make the comparison between what was planned and what was accomplished possible. (Calijuri, Santiago, Camargo e Moreira, 2009; Stubbs, 2004).

When analyzing sustainability in Institutions of Higher Education, the modification of tools previously elaborated to measure organizations in general should be carefully made, for they have a different nature. (Lozano, 2006). However, the Global Reporting Initiative (GRI) is mentioned since it is a tool that has already been applied in some universities. (Lozano, 2006; Madeira 2008.) According to this directive manual, indicators are meant to show the real situation of the sustainability level of organizations to decision makers, as well as to be accountable to internal and external stakeholders. (Global Reporting Initiative, 2015)

Cole (2003), Lozano (2006) e Madeira (2008), highlight that the GRI tool present many useful elements in their report system yet, most categories do not apply to universities. Even though it has presented difficulties when facing Institutions of Higher Education analysis trials, the method shows great potential to be used on Campus. This method is internationally acknowledged and some of its directives are already used in some universities.

Meanwhile analyzing the literature about tools specially created to measure the level of sustainability in Institutions of Higher Education, we have found that some authors have made a comparative analysis of some of these tools.

According to Nixon (2002), when analyzing and propagating sustainability on campus the main goals should be: to connect the position of the institution regarding sustainability to sustainable goals; to identify bottlenecks and strategies that improve institutional performance; and, to allow the construction of a culture focused on sustainability.

In his article on institutional assessment instruments for Higher Education, Shriberg (2002), confronted multiple sustainability assessment instruments for Higher Education, concluding that they should meet the following conditions:

a) detect important fields – the mechanism used to measure sustainability should be directed to relevant issues for the campus, regarding social, environmental and economic efforts;

b) be measurable and confrontable – in spite of the fact that some tools are not quantitative, the qualitative ones should provide comparative analysis and validation;

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c) allow assessment beyond eco-efficiency – a warning to those who intend to measure sustainability is that the tools that are mostly used are more worried about measuring eco-efficiency instead of sustainability per se. In summary, the difference resides in the comprehensiveness of the measurement. Eco-efficiency is more related to the utilization of materials, environmental performance, and compliance with regulations. Otherwise, sustainability emphasizes the relationship between social, environmental and economic aspects, in order to eliminate negative impacts;

d) gauging procedures and motivations - the instruments of quantification / qualification of sustainability should assist the decision makers, requiring information regarding the institutional mission, incentives, values, among others;

e) to be understandable - the tools for estimating sustainability need to be intelligible to at least a large number of stakeholders.

In this investigation, Shriberg (2002), identifies that part of the analyzed tools focus on sustainability. However, they only approach the environmental context, some prioritize economic and social dimensions. Lozano (2006) emphasizes that it would be important that universities create their own tools instead of adapting and/or using other methodologies. Nevertheless, this process of creating indicators is usually expensive and it could reduce the possibility of comparison with other universities.

Cole (2003) agrees with the work done by Shriberg (2002) when researching sustainability assessment on Canadian campuses for his thesis. During his work, the author develops a sustainability analysis table for universities. For that, the author counted on the support of a research team to propose a suitable concept for sustainable campus.

The author still highlights that the collected data was critically evaluated following the precepts of the action research. The result was the construction of his own tool that counted with 175 long and short-term indicators. The tool has a performance for each indicator, and an association procedure that propose a campus sustainability index, hierarchically organized in a system with two groups. This tool is known as *Campus Sustainability Assessment Framework* [CSAF]. Cole (2003) asserts that the subsystems are interconnected in a way that the "people" group is within the universe of the "ecosystem" group, and, the five dimensions in each of the groups represent fundamental aspects of the sustainability implementation on campus, as in Table 1.

Table 1 – Sustainability indicators for Institutions of Higher Education as proposed by Cole

Groups	Dimensions
People	Knowledge Community Economy and Prosperity Administrations Health and Welfare
Ecosystem	Water Air Soil Materials Energy

Source: Elaborated by the author based on Cole (2003)

It is noticed that in the analysis of Cole (2003) and Shirberg (2002) the tools are important in the measurement of sustainability goals for universities. Still, there are some weaknesses that need to me minimized. The first of them is the existence of models that focus solely on environmental sustainability. In Cole (2003) there is no systematic analysis of the three dimensions of sustainability in his 175 indicators. Another issue is the adaptation to the Brazilian reality, especially in relation to the performance of each indicator, since it is a tool developed to analyze Canadian institutions.

Differently, Madeira (2008) based her work on the analysis of several sustainability indicators, as in Table 2. Among the analyzes made, the works of Cole (2003) and Shriberg (2002) are widely cited. Her proposal was to develop a set of indicators to measure sustainability in Institutions of Higher Education, with the purpose of gathering the strengths of the tools observed, minimizing the weaknesses already discussed, mainly in relation to the applicability and excessive focus only on environmental sustainability.

Table 2 – Sustainability indicators prosed by Madeira

Areas	Categories
Academic community	Characterization (students and staff) Work conditions Absenteeism Education Campus occupational safety Campus security Campus health and welfare
Operations	Environmental indicators (materials, energy, water, grey water, waste and hazardous waste, air quality) Economic indicators
Teaching	Access to the teaching institution Performance of students Curriculum Quality of the courses with sustainability topics
Research	Investigation projects Publication Academic Community and investigation in sustainability
Extension	Economic impact of the institution Alumni Sustainability projects involving the community

Source: Elaborated by the author based on Madeira (2008)

The research involved 110 indicators distributed in five thematic axes (academic community, teaching, research, operations and impact in the external community), which were grouped into 16 categories and 9 subcategories (Madeira, 2008). This tool proposed by Madeira (2008) was applied at the Faculty of Engineering of the University of Porto [FEUP], in Portugal, although it still presents some indicators that were not raised, due to the difficulty in obtaining the data. However, the author points out that more than 60% of them were analyzed, due to the quality of FEUP's information system.

In the case of this tool, there are indicators that are difficult to apply in Brazilian institutions (grey water, air quality, quality of courses, economic impacts of extension projects), due to local specificities, as well as the fact that they present weaknesses regarding some indicators. The author herself was not able to collect data from all the indicators.

Regarding Brazilian Institutions of Higher Education, we highlight the works from Costa (2012) who proposed a wide range of result indicators and assessment tools to be considered by PUC-Rio in order to analyze the sustainability levels on campus, according to the directive of PUC-Rio's Environmental Agenda and to international referential. The work presented a conceptual version for measuring sustainability of Institutions of Higher Education, through a set of indicators for measuring sustainability to put the Environmental Agenda into practice. (COSTA 2012). The weak spot of the tool proposed by this author is the fact that the scope of the research is limited to the environmental dimension of sustainability. The analyzed structures were divided into seven modules: biodiversity, water, energy, atmosphere, materials, waste, and environmental education. (Costa, 2012)

In the context of Brazilian Institutions of Higher Education, we can also highlight the works of Freitas (2013), who aimed at the presentation of a Socioenvironmental Sustainability Assessment Model (SSAM) for Federal Institutions of Higher Education (FIHE). His results provided a list of 231 yes or no questions to analyze sustainability on campus. SSAM was

designed in six assessment axis − administration, infrastructure, purchase, teaching, research, and extension; also distributed in 2 assessment extensions (management and services), as in Table 3.

Table 3 – Socioenvironmental Sustainability Assessment Model for University Campuses by Freitas

Dimension	Group	Assessment Axis
Management	Purchase	Suppliers Acquisitions
	Infrastructure	Facilities and equipment (buildings, electrical, hydraulic and involved processes)
	Administration	Community Service Human Resources Socioenvironmental Responsibility Planning and Strategy Accounting (Control and Evidence) Audit and Corporate Governance Accounting (Control and Evidence) Audit and Corporate Governance
Services	Teaching	Teaching
	Research	Research
	Extension	Extension

Source: Elaborated by the author based on Freitas (2013)

In the construction of this assessment model, Freitas (2013) performs a bibliometric review, from preliminary work developed in the context of his dissertation and bibliographic portfolio raised. Thereby, the author proposed this tool based on the relevance of the axis and dimensions, according to his research. It is also observed that the model includes some relevant administrative aspects, besides adding the activities of university management to the tripod: teaching, research and extension. Warken (2014) applied this tool at the South Frontier Federal University, concluding that it proposes important questions to measure socioenvironmental level in Institutions of Higher Education, however, the great amount of data made their practical application (Warken, 2014). Another weakness is related to the data collection methodology, in which numeric data are not sought, but rather the existence or not of institutional practices, which prevents a more precise diagnosis.

More recently, it is possible to highlight the dissertation of Oliveira (2015), in which the author aimed at the analysis of a set of indicators for Sergipe Federal University, based on the definition of sustainable development, as in Table 4. The author sought to do a survey of specific indicators to measure social and environmental sustainability in accordance with the institutional context. In that sense, social indicators were used: training and sensitization of the academic community, quality of life at work (insalubrity, dangerousness, ionizing radiation); environmental indicators: materials, waste, sewage treatment plant and afforestation. Finally, indicators related to teaching, research and extension were also designed.

Table 4 – Social and environmental indicators for sustainability measurement in Institutions of Higher Education

Dimension	Axis	Indicators
Environmental	Materials	Chlorinated and recycled paper Ink Cartridges
	Waste	Common solid waste Recycled Waste Food Waste Health Campus Waste (common waste, infectious waste)
	Sewage treatment	Size of the sewage treatment plant
	Afforestation	Afforestation and tree coverage index
Social	Staff training	Environment training
	Sustainable bidding	Sustainable biddings
	Quality of life	Programmes related to quality of life

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	Teaching	Courses about Environment Subjects about Environment
	Research	Projects about Environment Published Works about Environment
	Extension	Events about Environment

Source: Adapted from Oliveira (2015)

Oliveira (2015) collected data from visitation and interviews with the heads of the administrative departments of the institution. The analysis of the indicators the author suggested reflect are similar a great part of the indicators previously approached, such as Cole (2003), Lozano (2006), and, specially, Madeira (2008). What can be emphasized as the weak spot of this analysis is the absence of indicators that measure economic sustainability in the researched institution.

Another noteworthy research was made by Drahein (2016). This work proposed an analysis of sustainability techniques on service procedures in Institutions of Higher Education of the Brazilian Federal Professional, Scientific and Technologic Schools. To do so, the author developed a model that became known as *Sustainability Assessment for Higher Technological Education* [SAHTE] (Picture 1).

Picture 1 – Indicator based sustainability assessment model as proposed by Drahein
Source: Drahein (2016, p. 102)

This tool has five aspects that should be analyzed in Institutions of Higher Education: Governance and Policies, People, Food, Water and Energy and Waste and the Environment, with a total of 134 indicators. Aiming to achieve his research goals, Drahein (2016) has done a scientific literature survey about assessment models for Institutions of Higher Education, similarly to the work of Freitas (2013). Thus, the author raises thirteen models, applying them trough case studies, comparing the sustainable performance if service operations in the analyzed institutions. The author introduces a tool to assess the service in Federal Institutes, however the model is not indicator based, moreover, it presents gaps when one intends to analyzed other types of Institutions of Higher Education due to the particularities of the Federal Institutes.

Therefore, it should be noted that the study of other works that have sought to develop tools to measure sustainability in Institutions of Higher Education or that have been adapted for this purpose are crucial in proposing a more complete tool that encompasses all dimensions of sustainability, being at the same time measurable and applied to different Institutions of Higher Education, which is the objective of this work.

In this way, it is pointed out that, according to the tools analyzed, most of the proposals did not consider the three dimensions of sustainability: social, environmental and economic. And even though some authors such as Cole (2003), Drahein (2016), Lozano (2006), Madeira (2008) and Oliveira (2015) have sought to elaborate a tool to measure the sustainability of Institutions of Higher Education, that in general, the tools emphasized only one or two dimensions, or were not feasible due to the large number of indicators proposed.

It should also be noted that some tools needed to be adapted for the case of Brazilian Institutions of higher education, due to the particularities of university Campuses. Table 5 summarizes the tools analyzed, presenting the aspects that guided literature review, serving as a basis for the proposal and structuring of the tool elaborated in this work.

Table 5 – Summary of the tools proposed to analyze sustainability in Institutions of Higher Education

Authors	Aspects analyzed	Weak spots
Cole (2003)	Social (knowledge, community, health, and welfare); environmental (water, air, soil, materials, and energy); e, economic (administration, economy, and prosperity).	In its 175 indicators, there is no systematic analysis of the three dimensions of sustainability, another issue is the adaptation for the Brazilian reality, especially regarding the performance of each indicator, as they are a tool developed to analyze Canadian institutions.
Madeira (2008)	Social (academic community, teaching, research and extension); e, environmental and economic (operations).	In the case of this tool, there are indicators that are difficult to apply in Brazilian institutions (wastewater, air quality, quality of courses, economic impacts of extension projects), due to local specificities, as well as, some indicators, including the author herself was not able to collect the data of all the indicators.
Costa (2012)	Environmental (biodiversity, water, energy, atmosphere, materials, waste, and environmental education).	The tool proposed by the author has a scope limited to the environmental dimension of sustainability.
Freitas (2013)	Social (teaching, research and extension); e, economic (purchase, infrastructure, and administration).	The tool proposes important questions to measure the socio-environmental level of Institutions of Higher Education. However, the large amount of data made impossible the practical application of all of them, according to a study by Warken (2014). Another point is the way of collecting the data, where the numerical data are not sought, but rather the existence or not of the institutional practices, which prevents a more precise diagnosis.
Oliveira (2015)	Social (staff training, sustainable bidding, quality of life, teaching, research, and extension); and, environmental (materials, waste, sewage treatment and, afforestation).	Absence of indicators that measure economic sustainability in the institution researched. And presence of indicators of difficult measurement in the environmental aspect (afforestation, treatment of sewage and residuals).
Drahein (2016)	Social (people and food); environmental (energy, water, waste and, environment) e, economic (governance and policies).	The model is not indicator based, and it presents gaps when used to analyzed other Institutions of Higher Education, due to some particularities and differences between Federal Institutes and other Institutions of Higher Education. The model is based only on absence / presence, without quantifying the data, thus limiting the tool.

Source: Elaborated by the authors

At times, the tools created by the aforementioned authors did not measure sustainability observing its tripod (social, environmental and economic), or presented indicators that are difficult to measure, such as biodiversity, grey water, afforestation, air quality, power sources, and consumption, etc.; as well as a large number of indicators, which made data collection difficult; or still, did not apply to the Brazilian context, as university access policies, issues related to waste treatment and even power sources used on campuses. Finally, this proposal aimed at elaborating a tool not only based on revised indicators but also taking into consideration the sustainability tripod, that is, selecting indicators that comprise the social, environmental and economic dimensions, providing a holistic view of sustainability

development in Institutions of Higher Education, demonstrating the university reality towards sustainable development.

Therefore, we indicate that the literature review showed frailties as well as highlights of the proposed tools. However, the tools reviewed in this section were used as a base for the proposal of a tool and all data were observed when the proposal presented in this article is outlined. The next section approaches the methodological course used in this research in order to achieve the goals.

3. METHODOLOGICAL PROCEDURES

When analyzing the importance of scientific research, it is possible to perceive that its main goal is to understand and clarify phenomenon, presenting solutions or alternatives that answer to those problems. To make this possible, the researcher relies on reflections made throughout his or her life and that come before the, and by the manipulation of different methods and techniques, focusing on the answers for their restlessness. (Prodanov & Freitas, 2013).

Table 6 presents the theoretic-methodological fundaments used in this research.

Table 6 – Theoretical-methodological aspects

Aspect	Classification	Description/Reference
Nature of the research	Theorical	This type of research allows the growth of knowledge about the theory that proposes to study, contributing to the improvement of the theoretical foundations, and, therefore, their practices (Ribeiro, 2011).
Objectives	Exploratory	Its purpose is to provide more information about the subject that we are going to investigate, enabling its definition and its delineation, that is, facilitating the delimitation of the research topic; to guide the setting of objectives and the formulation of hypotheses or to discover a new kind of approach to the subject (Prodanov & Freitas, 2013, pp. 51-52). For Gil (2010), this type of research aims at understanding the problem researched and make it clearer.
Procedure	Bibliographic Review	According to Lakatos and Marcone (2010: 166), the main objective of this type of research is to provide data on the research problem, not just the repetition of what has been written or said about the subject. The main advantage of bibliographical research is that it allows the researcher to cover a much broader range of phenomena than he could research directly. "This advantage becomes particularly important when the research problem requires much space-scattered data." (Gil, 2010, p.30)
Problem approach	Qualitative	As for qualitative research, the researcher tries to resolve the gap between the theoretical base and the data (Chizzotti, 2003). For Ribeiro (2011), the qualitative research aims to explain the reason of things, using a variety of approaches, which can be explained individually or globally.

Source: elaborated by the authors

Considering that the objective of this study is to develop a proposal for sustainability indicators for Institutions of Higher Education, it is worth noting that we must observe the peculiarities, objectives and goals of what we intend to understand. Veiga (2009) points out that it is very difficult to achieve broad acceptance of the models adopted to measure sustainable development, or even only environmental sustainability, although much has been sought to achieve this ambitious purpose.

Thus, the selection of indicators to measure the level of sustainability in organizations has achieved great relevance, especially when the objectives and functions have defined goals, aiming to achieve sustainable development. Institutions of Higher Education are not different, even if, some particularities should be analyzed. For example, after reviewing the literature, we

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selected as inclusion criteria for tool development indicators that 1) contemplate all three dimensions; 2) are measurable; 3) are relevant to the decision maker.

In the preparation of this proposal, with a preliminary list of indicators, the tool was validated by specialists from a Federal Institution of Higher Education. This stage was necessary in order to exclude indicators that are not measurable, as well as the addition of other indicators that are considered important for socioenvironmental diagnosis in Institutions of Higher Education. It is also worth mentioning that the specialists are professionals who work directly with the data, giving credibility to the tool, through analysis of the operating systems that can provide the information to be collected.

We also point out that the specialists assisted in the elucidation of frequency and periodicity to measure each indicator, generating at the end a sustainability report that can be analyzed annually.

4. SUSTAINABILITY ANALYSIS FOR FEDERAL INSTITUTIONS OF HIGHER EDUCATION: AN INDICATOR BASED TOOL PROPOSAL

This section aims to describe the criteria adopted in the selection of the sustainability indicators that will be applied in Institutions of Higher Education. Regardless of the region, management policies, human and financial resources, among others factors, it is necessary that the researcher take the particularities into consideration when creating a model which is most suitable to analysis.

It should be emphasized, therefore, that the model proposed here consider the analysis of the observed literature and points out that some criteria must be taken into account, namely: the University needs to present clear goals in the promotion of sustainable measures, as well as the person in charge of the elaboration should observe the bottlenecks that should be addressed regarding the development of these policies. Jannuzzi, 2005; Nixon, 2002). Additionally, the Universities should understand sustainability beyond environmental or even just social factors, it is important to examine the dimensions as an intersection between them. Therefore, the dimensions should comprise, at least, social, environmental and economic factors.

Indicators that are measurable or comparable are also considered for qualitative analysis, and when they are too complex, methodologies that make them intelligible should be created, especially for those involved in the decision making process, or for those who will benefit from the policies, as indicated by Shriberg (2002) and the *Global Reporting Initiative* (2015) directives.

Thus, in order to carry out the Sustainability Assessment in Higher Education, the indicators to be used in this research include aspects related to teaching, research and extension, as well as administrative services and operations, in compliance with the sustainability tripod: environmental, social and economic. In order to do that, it is necessary to analyze the departments that are involved in the execution of these tasks (administrative staff), the operations and services, and finally, the subjects involved in this process – the academic community (professors and students).

It is noted in the studies of Cole (2003), Freitas (2013), Lozano (2006), Madeira (2008) and Oliveira (2015) that the teaching, research and extension aspects should cover contents that demonstrate the capacity of the institution to address sustainable content and environmental education in their academic activities. In Madeira (2008), it is important to map the number of teaching, technical-administrative and student workers, since they are important for parameterizing other indicators such as consumption, institutional spending and social aspects.

The indicators most related to the environmental dimension are proposed in the operations and services, where the factors such as consumption of water consumption, energy,

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materials; payroll, and residual treatment and reuse are presented, supported by studies by Cole (2003), Drahein (2016), Freitas (2013), Madeira (2008), Oliveira (2015). Quality of life, occupational health, sustainable purchases and bidding were proposed based on the works of Drahein (2016), Freitas (2013), Lozano (2006), Madeira (2008) e Oliveira (2015).

On table 7 (below), we detail the items that will be analyzed within each aspect selected for this proposal. They are six: academic, administrative, operations and services, teaching, research, and extension. The table also presents a proposal of the variables for measuring the indicators and possible departments as a source of data collection, considering the similarities between the Institutions of Higher Education.

Table 7 – Indicators to be analyzed in Institutions of Higher Education

Aspects	Social, Economic, and Environmental Indicators	Variables	Data Source	Periodicity
Academic Community	A1: Distribution of Campus students by course (social)	Number of Campus students by course	Report of the Academic Secretary	Semiannual
	A2: Distribution of Campus professor by course (social)	Number of Campus professors by course	Report from Human Resources	Semiannual
	A3: Number of Students per professor	Quantitative of students per professor based on courses	Reports from Human Resources and Academic Secretary	Semiannual
	A4: Number of professors with degrees related to sustainability (social and environmental)	Quantitative of teachers with training in some area focused on sustainability	Report from Human Resources	Semiannual
	A5: Ratio between institutional expenses with professors by students (economic)	Total amount of expenses in Reais with professor remuneration per total of students	Report from Human Resources	Semiannual
Administrative Staff	B1: Distribution of administrative technicians by level of classification in the career (social)	Quantitative of administrative technicians by Level of Degree in the Career Path	Report from Human Resources	Semiannual
	B2: Distribution of outsourced by function (social)	Number of servers by function	Report from Administrative Coordination	Semiannual
	B3: Ratio between professors and technicians by the number of outsourced (social)	Number of servers per outsourced	Reports from Human Resources and the Administrative Coordination	Semiannual
	B4: Technicians who work directly with services related to sustainability (social e environmental)	Presence or Absence of technicians that work in areas related to sustainability	Reports from Human Resources and Head Office	Semiannual
	B5: Number of administrative technicians with qualification in the sustainability field (social e environmental)	Number of technicians with education in some field related to sustainability	Report from Human Resources	Semiannual

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Administrativ e Staff	B6: Institutional expenses with administrative technicians working on Campus (economic)	Total expenses with the payroll of the technicians in Reais	Report from Human Resources	Semiannual
	B7: Training courses focused on sustainability (social e environmental)	Absence and / or presence of trained servers	Report from Human Resources	Annual
	B8: Actions taken to promote health and quality of life of employees (social)	Presence and/or absence of actions	Report from Human Resources	Annual
	B9: Servers allocated in places considered unhealthy / perilous / radioactive (social e environmental)	Number of servers per location	Report from Human Resources	Semiannual
	B10: Number of reported accidents at work (social)	Absence and / or presence of accidents at the Campus	Report from Human Resources	Semiannual
	B11: Amount of absenteeism related to the treatment of diseases (social)	Average number of absences per applicant	Report from Human Resources	Semiannual
Operations and Services	C1: Amount of paper consumed per user (environmental)	Quantitative consumption in reams per user	Reports from the Administrative coordination, university prefecture and labs	Bianual
	C2: Number of disposable cups consumed per user (environmental)	Quantitative consumption in reams per user		Bianual
	C3: Number of tonners per user (environmental)	Quantitative of tonners consumed per user		Semiannual
	C4: Total number of recycled tonners reused (environmental)	Quantitative of reused tonners		Semiannual
	C5: Amount of monthly energy consumed per user (environmental)	Quantitative energy consumption in Kw/h consumed per user		Monthly
	C6: Expenses with power per user in Reais (economic)	Amount of money spent with power per user in Reais		Monthly
	C7: Amount of monthly water consumed per user (environmental)	Quantitative of water consumed per user		Monthly
	C8: Expenses with water per user in Reais (economic)	Amount of Money spend with water per user		Monthly
	C9: Amount of solid waste produced (environmental)	Amount of waste produced in kilograms		Monthly
	C10: Recycling of common solid waste (environmental)	Absence/Presence of recycled waste		Monthly
	C11: Recycling/Reuse of dangerous waste (environmental)	Absence /Presence of dangerous waste		Monthly
	C12: Number of kilometers driven per employee (environmental)	Quantitative of kilometers driven per user		Semiannual

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	C13: Expenses with fuel per user in Reais (economic)	Amount of Money spent with fuel in Reais per user		Semiannual
	C14: Contracting of services and / or materials through sustainable bids (environmental and economic)	Absence or presence of sustainable bids		Semiannual
Teaching	D1: Number of subjects approaching sustainability (social and environmental)	Number of subjects that approach sustainability	Reports from faculty coordinations	Annual
Teaching	D2: Number of undergraduation and graduation programs in environmental themes (social and environmental)	Number of undergraduation and graduation programs in environmental themes	Reports from the Office of Undergraduation and from the Office of Graduation	Yearly
Pesquisa	E1: Number of research projects approaching sustainability (social and environmental)	Number of research projects approaching sustainability	Reports from the Office of Undergraduation and from the Office of Graduation	Semiannual
Pesquisa	E2: Number of students involved in research projects in the field of sustainability (social)	Number of students involved in research projects in the field of sustainability		Semiannual
Pesquisa	E3: Number of professors involved in research projects in the field of sustainability (social)	Number of professors involved in research projects in the field of sustainability (social)		Semiannual
Community Extension	F1: Number of extension projects approaching sustainability (social and environmental)	Number of extension projects approaching sustainability	Report from the Office of Extension	Semiannual
Community Extension	F2: Number of events about sustainability involving the community (social and environmental)	events about sustainability involving the community		Semiannual

Source: Elaborated by the authors

It is noteworthy that these indicators were selected as being useful for the evaluation and monitoring of sustainability in Institutions of Higher Education. Thus, each aspect selected to compose this set of indicators was chosen considering the most relevant aspects of the previously proposed tools, outlining the aspects and dimensions of sustainability. It should be noted that the periodicity for data collection is important so that Institutions of Higher Education can monitor their performance, annually conducting their sustainability report, while noting the possibilities of frequencies in which data should be collected, this will contribute, as well, as a comparative feasibility between different institutions.

It should be mentioned that the choice for this group of indicators considered characteristics such as: relevance of data, representativeness, quality, measurability, importance, decision support, and ambiguity (Shiriberg, 2002). The indicators observed in the literature (Cole, 2003, Drahein, 2016, Freitas, 2013, Lozano, 2006, Madeira, 2008 and Oliveira, 2015) were also highlighted and inserted whenever possible in the aspects outlined for this proposal: administrative, operations and services, teaching, research and extension; and, according to feasibility of obtaining the data.

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It should be noted that according to the particularities of each institution, in consonance with the dimensions proposed, other criteria were evaluated for this study such as: the relevance of the indicator in at least one of the dimensions of sustainability; integration of indicators into two or more dimensions, so that each aspect can be contemplated in different dimensions; easiness to apply and measure; and intelligible data collection, mainly for the managers, or decision makers in the political formulations.

Therefore, it should be noted that, based on a review of the literature, this study aims to contribute to indicators applicable to Institutions of Higher Education, which are aligned with the sustainability tripod, considering that most of the proposals did not consider the three dimensions of sustainability: social, environmental and economic. However, these instruments were analyzed at the moment of the proposal presented here, modifying whenever possible for tool.

By analyzing the works, we could not only infer that, through the plurality of indicators and the complexity of the data, those that would be most relevant in terms of policy decision and practical results for Institutions of Higher Education were considered but they also are significant in at least one (social, environmental and economic) of the dimensions of sustainability. It is also important to note that the analysis of the data specialists in the institution was fundamental to outline the aspects and indicators proposed.

In this sense, a tool with the following differential is presented, all the indicators chosen in this work are measurable and easy to understand, according to previous studies and based on the diagnosis of the specialists. It addresses at least one of the dimensions of sustainability, so that the outlined tool contemplates the three dimensions (social, environmental and economic). With this, the tool contributes to evaluate the socio-environmental performance of institutions, monitoring their practices and providing improvements, as well as being a holistic tool, measurable in any Institution of Higher Education, also serving as a parameter between different institutions.

Therefore, it is observed that, this proposal contemplates the activities developed in Institutions of Higher [teaching, research, extension]. These three aspects bring together a set of eight indicators that will serve to demonstrate the level of awareness of the university in aligning its practices with sustainability. In the case of the teaching aspect, courses and subjects offered in the Institution were proposed; in research, sustainability is analyzed in the investigations of teachers and students; and in extension, it is suggested that the projects and events that involve the internal and external community and that deal with sustainability be assessed.

The indicators related to the university public consider academic and administrative aspects. These two aspects add up to a total of fifteen indicators, and are relevant as not only did they present the staff of the university, but also the proportions among students, teachers, technical-administrative and outsourced. Likewise, the institutional policies for the promotion of quality of life and occupational health are noted.

The aspect, operations and services, are mainly related to the activities of the institution to attend the academic community and in general. Most of the thirteen indicators is related to environmental aspects. However, some expenses are made to address some demands, therefore being considered economic, and, sometimes, social. Hence, data about water and power consumption; transport; waste production, and information on the bidding policy for construction and sustainable products acquisition.

In summary, the 37 indicators proposed in this article will contribute to the monitoring of sustainability in HEIs. The proposal does not intend to exhaust the possibilities of measuring socio-environmental aspects in Institutions of Higher Education. However, it is a proposal based on international and national studies, presenting improvements in the sense of bringing measurable indicators capable of presenting a diagnosis of the practical reality in the Institutions

of Higher Education researched Thus, besides imbibing the three dimensions of sustainability, it can be described as a holistic tool, applicable in any Institution of Higher Education, also serving as a parameter between them.

5.   FINAL CONSIDERATIONS

The objective of this article was to review the literature and propose a model of indicators to evaluate the sustainability of Institutions of Higher Education. Considering that sustainable development has been the subject of much debate among organizations, government and society, it is also necessary that universities are aligned with this proposal.

Thus, the literature has researched mechanisms for measuring and analyzing sustainable practices in private and public entities. Thus, sustainability indicators are thought of as appropriate tools for mapping the base of information about the environment. In addition, they provide assistance in formulating public policies, making studies and reports simpler, and comparing different local and regional realities.

The proposal developed in this study was based on a literature review aiming to develop a tool that contemplated the three dimensions of sustainability, which included indicators of easy measurement, data relevance, representativeness, quality, measurability, importance, decision support and ambiguity. For this, we also considered the peculiarities inherent in the reality of Institutions of Higher Education, including teaching, research and extension activities.

Reflecting on the role of the University was fundamental in the construction of this proposal, since the activities carried out in university campuses, are academic, administrative, and should offer quality services to the internal and external community. Therefore, each indicator is capable of giving information the institutional reality, contributing to the improvement of the practices and policies adopted.

The 37 indicators proposed in this article will contribute to the monitoring of sustainability in Institutions of Higher Education. It is a proposal based on international and national studies, presenting improvements to bring measurable indicators, capable of presenting a diagnosis of the practical reality in the surveyed institutions, and serving as a parameter between different Institutions of Higher Education. It is important to present an annual report to monitor the advances and weak spots presented by these institutions in socio-environmental management.

Another point to be highlighted by the tool is that it is based on the three dimensions of sustainability (social, environmental and economic). The proposal stresses that indicators are significant in at least one of the dimensions of sustainability, but also observe the interconnection [of indicators] in two or more dimensions, so that each aspect can be seen in different dimensions. Twelve indicators were proposed in the social dimension, 9 indicators in the environmental dimension and five indicators in the economic dimension, noting that some indicators are configured in different dimensions, 10 being social and environmental, and one environmental and economic.

This study is limited to the proposal of sustainability indicators for Institutions of Higher Education, although the proposal brings a holistic and applicable tool to any university in Brazil. In this way, it is pointed out that the proposal does not exhaust the possibilities related to the matter raised. However, future studies can be conducted, complementing the model with other indicators to be applied, as well as the practical application of the model in various institutions, to analyze their levels of sustainability. Finally, the importance of sustainable thinking for universities is emphasized for the construction of a more just and egalitarian society.

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