Waste Management in Higher Education Institutions: A State-of-the-art Overview

Danieli Braun Vargas and Lucila Maria de Souza Campos
Department of Production Engineering and Systems
Federal University of Santa Catarina
danieli.v@ufsc.br, lucila.campos@ufsc.br

Abstract

Sustainable waste management is a central theme of circular economy, which has received global attention due to dealing with the transition from the linear consumption model to a circular economy perspective by increasing resource efficiency and harmonizing the relationship between society, environment, and economy. Higher Education Institutions (HEIs) are known as university cities assignable to their size and daily flow of people. They have an essential role in innovation and knowledge diffusion, acting as an agent of change in society. Moreover, they have a critical role in sustainable development because they prepare professionals not only for the market but also for society as citizens. One of the key factors that HEIs should use to their advantage is the potential for academic community to engage themselves and provide improvement through teaching, research and outreach to make the campus as a living laboratory to building the culture of sustainability. Therefore, this research aims at analyzing waste management in HEI, by a bibliometric and content analysis, using the Systematic Search Flow, as well as verify the most applied waste management practices in HEIs and lastly suggest drivers for the adoption of good practices.

Keywords
Waste Management; Higher Education Institution; Sustainability; Circular Economy; Systematic Literature Review.

1. Introduction

Society has been increasingly concerned about waste production and consumption growth. Currently, the consumption model adopts a liner process - extraction, production, consumption, and disposal - that there is an increase in resource usage rate (Tangwanichagapong et al., 2017) and raw material depletion. Alves and Farina (2018) highlight that the more technological development and social progress happen, the higher demand for resources, and consequently, the damage is going to be greater to the environment and society.

This paper's main contribution is offering a systematic review of existing literature on waste management in Higher Education Institutions (HEI), through the Systematic search flow (Ferenhof and Fernandes, 2016). The paper aims to also contribute by indicating opportunities for sustainable practices for HEI, as well as to add literature information in future research on that area, according to Drahein et al. (2019) there is an incipient study on the context of environmental sustainability.

Universities have an essential role in innovation and knowledge diffusion, they are agents of improvement in society (Tangwanichagapong et al., 2017). They have a critical role in sustainable development (Hugé et al., 2018) because they have prepared professionals not only for the market but also for society. Thus, it is important that teach by giving example and awareness of a suitable way to manage waste.

Due to the size of universities, they are considered as university cities. Inside them, there are hospital, restaurants, banks, offices, classrooms, and places for events, among others, for this reason, there is a wide diversity of waste produced by HEIs, including construction and demolition waste, electronic waste, office waste, lamp, furniture, metal, hospital waste, and others.

This paper is structured, in addition to the introduction, as follows. Section 2 presents the research methodology. Section 3 approaches the findings with the discussion presented in section 4. Next, section 5 describes the drivers for the best practices in HEIs, and finally section 6 closes the paper presenting conclusions and future research opportunities.

2. Research methodology

The literature review was prepared based on a systematic proceeding named Systematic Search Flow (SSF) proposed by Ferenhof and Fernandes (2016). The systematization of the method was adapted according to research's needs to better analyze the obtained data. According to the authors, the systematic search is a method of scientific investigation whose purpose is to synthesize the research results about a specific theme following a protocol orderly. Furthermore, the method supports to deepen knowledge, eliminate bias, and to direct future research strategies in the area defined by the subject.

The systematic search proposed by the SSF method is divided into four steps, I - Research protocol definition, II – Analysis, III – Synthesis, and IV – Write. Figure 1 shows the research protocol followed to prepare this article. The knowledge matrix was elaborated in the II e III steps according to Table 2, which includes author and year, amount of citation, journals, research country, Human Developing Index (HDI) level of the country, research method and design, and the main topic of every paper. Finally, a full reading of the articles was performed for content analysis.

Due to the bibliometric and content analysis to be a systematic, clear, and replicable method, in the next sections, the method will be explained in detail, justifying the keywords and database chosen, among others, and after that, the content analysis of all the paper selected will be shown.

2.1 Defining the appropriate search terms

The strategy to choose the keywords and the logical operators started verifying the most aligned combination to attend the research purpose. Thereby, the first keywords tested were ("higher education *" OR university OR campus) AND ("waste management" OR "waste disposal" OR "reverse logistics") AND (sustainab*). When the authors made a brief reading of the papers, they realize that the articles were more related to reverse logistics than waste management, thus, the second combination of keywords was tested without the term reverse logistics.

Hence, a second keyword arrangement ("higher education*" OR university) AND ("waste management" OR "waste disposal") AND (sustainab*) was elaborated. However, it was concluded that the keyword waste disposal guided the results to articles directly related to waste storage in suitable containers. So, the most assertive combination of keywords tested was ("higher education*" OR university OR campus) AND ("waste management") AND (sustainab*), which resulted in 462 paper.

The search strategy purpose was based on including possible synonyms for universities ("higher education *" OR university OR campus), besides expanding the results since some read papers approaches higher education and in others higher education institution, as well as university or even campus. In addition, the keyword most associated with solid waste management was waste management, being wider than solid waste. At last, sustainab* was included to limit the results to documents addressed sustainable, sustainability, sustainable development, among others.

2.2 Initial search results

The search keywords were selected through the Scopus database due to it is the largest abstract and citation database of peer-reviewed research literature in many areas, moreover, it covers more papers than Web of Science, including more than 20,000 peer-reviewed journals (Fahimnia et al., 2015).

After defining the combination of keywords and checking the database, the results were refined. Limiting the parameters to "title, abstract, keywords", articles published between 2014 e 2019 (this research was made in May 2019), final and in press articles, journals, English language, subject areas as social science, engineering, energy, agricultural and biological sciences, earth and planetary sciences, business, management and accounting, economics, econometrics and finance, chemical engineering, materials science, multidisciplinary e decision sciences, was conducted the research refinement.

As soon as the material refinement, 131 papers related to search parameters were selected as mentioned above. Despite deep search 6 papers were not found. 33 documents were aligned to the paper's purpose from the total amount of articles, although 4 of them were excluded after the complete reading, finally, 29 articles were selected to elaborate the content analysis, according to Table 1.

Database	N° of papers
01 - Scopus	131
Filter	
02 – Available	125
03 – Related (title, abs, key)	33
04 – Resulting portfolio	29

Table 1. Material refinement

2.3 Refinement of the search results

Following the SSF method, the authors established the paper organization and selection. The RIS data from Scopus was imported to Endnote X8 bibliography software. Despite deep search 6 papers were not found. Eliminating duplicated articles, reading the title, abstract and keywords leaves 33 unique papers. The filter "related (title, abs, key)" on Table 1 was filled by paper related to meeting the objective of this article, but after reading, 4 of them were excluded from the portfolio.

Many selected articles in the filter "available" were not included at the filter "related' because the keyword "university" was at the end of the abstract as a university's logo which authors were linked, such as Yale University. In the same way, some results showed paper with the keyword "waste management and sustainab*" although they were not associated with universities. These are the main reasons for the high percentage of excluded articles when the title, abstract and keyword were read.

Figure 1 summarizes the research protocol, as well as it shows all the criteria to include the papers in the portfolio and present the results of the first step of the SSF method.
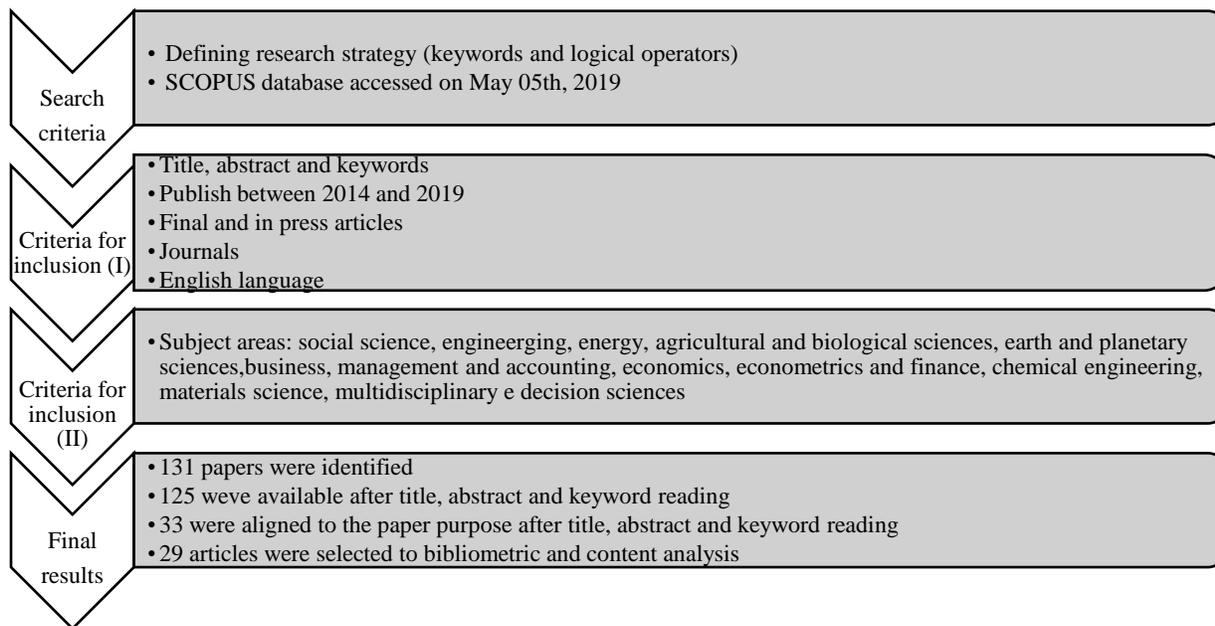
Search criteria
- Defining research strategy (keywords and logical operators)
- SCOPUS database accessed on May 05th, 2019

Criteria for inclusion (I)
- Title, abstract and keywords
- Publish between 2014 and 2019
- Final and in press articles
- Journals
- English language

Criteria for inclusion (II)
- Subject areas: social science, engineerging, energy, agricultural and biological sciences, earth and planetary sciences,business, management and accounting, economics, econometrics and finance, chemical engineering, materials science, multidisciplinary e decision sciences

Final results
- 131 papers were identified
- 125 weve available after title, abstract and keyword reading
- 33 were aligned to the paper purpose after title, abstract and keyword reading
- 29 articles were selected to bibliometric and content analysis

Figure 1. Flowchart of search criteria for material selection and refinement

2.4 Developing the knowledge matrix

In order to meet the research objective, the knowledge matrix (Table 2) was prepared including relevant data to bibliometric analysis, such as author and year, amount of citation, journals, research country, HDI level of the country, research method and design and the main topic of every paper.

After performing the study by deductive approach, bibliometrics and content analysis were made from the resulting portfolio, which will be accessed in the next section. Based on the above explanation, the present study of waste management in HEI is categorized according to time distribution of publications, number of citations per paper, ranking of journals by number of publications, research method and design and geography of papers.

	Author and year	N° of citation	Journal	Country	Research design	Research method	HDI	Focus subject
1	Adeniran, et al. (2017)	8	Waste Management	Nigeria	Empirical	Case study	Low	Solid waste characterization
2	Agamuthu, et al. (2015)	10	Resources, Conservation and Recycling	Malaysia	Empirical	Case study	Very High	Eletronic waste management
3	Alves and Farina, (2018)	0	European Business Review	Brazil	Empirical	Case study	High	Disposal of eletronic waste
4	Aristizábal-Alzate and González-Manosalva, (2018)	0	DYNA	Colombia	Empirical	Case study	High	Calculation of carbono footprint
5	Ayob, et al. (2017)	0	Facilities	Malaysia	Empirical	Interview + survey	Very High	Key determinants of waste separation
6	Baki, et al. (2015)	1	Journal of Sustainability Science and Management	Malaysia	Empirical	Simulation	Very High	Composting
7	Barua et al. (2014)	0	International Journal of Applied Engineering Research	Bangladesh	Theoretical	Conceptual	Médio	Reusing paper
8	Cleverdon, et al. (2017)	1	Resources	United Kingdon	Empirical	Interview + survey	Very High	Engagement of students in sustainability projects
9	Drahein et al. (2019)	1	Journal of Cleaner Production	Brazil	Empirical	Interview + survey	High	Evaluate the adoption of sustainable practices
10	Ebrahimi and North, (2017)	1	International Journal of Sustainability in Higher Education	United States	Empirical	Interview + survey	Very High	Identify main practices in waste management
11	Gallo et al. (2017)	0	Economics and Policy of Energy and the Environment	Italy	Empirical	Case study	Very High	Approach circular economy to mitigate CO_2 emission
12	Gebreeyessus et al. (2018)	0	International Journal of Environmental Science and Technology	Ethiopia	Empirical	Case study	Low	Solid waste characterization and final dispose
13	Hugé, et al. (2018)	3	Journal of Cleaner Production	United States	Empirical	Interview	Very High	Organization chance process focusing on sustainability
14	Ifegbesan et al. (2017)	2	International Journal of Sustainability in Higher Education	Nigeria	Empirical	Interview + survey + documents analysis	Low	Student's atitudes to waste management
15	Kamyab et al. (2015)	6	Jurnal Teknologi	Malaysia	Theoretical	Case study	Very High	Calculate greenhouse gas emission through composting
16	Moqbel, S., (2018)	0	Environmental Research, Engineering and Management	Jordan	Empirical	Case study	High	Solid waste characterization and final dispose
17	Moreira et al. (2018	0	Waste Management	Brazil	Empirical + Theoretical	Survey	High	Definition of waste management index
18	Mu et al. (2017)	15	Waste Management	United States	Empirical	Case study	Very High	Composting

19	Oladejo et al. (2018)	0	International Journal of Civil Engineering and Technology	Nigeria	Empirical	Case study	Low	Solid waste characterization and final dispose
20	Pereira et al. (2014)	7	International Journal of Sustainability in Higher Education	Brazil	Empirical + Theoretical	Interview	High	Relationship between environmental management practices and organizational culture
21	Pinto et al. (2018)	2	Waste Management	Portugal	Empirical	Case study	High	Awareness campaign to promote food waste reduction
22	Ramírez Lara et al. (2017)	4	Journal of Cleaner Production	Mexico	Empirical	Case study	High	Hazardous waste management
23	Ryan-Fogarty et al. (2016)	15	Journal of Cleaner Production	Ireland	Empirical	Case study	Very High	Environmental programm at a hospital
24	Tangwanichagapong, et al. (2017)	12	International Journal of Sustainability in Higher Education	Thailand	Empirical	Interview + survey + documents analysis	High	Describe the effects of 3R's in waste management
25	Tu et al. (2015)	12	Waste Management	United States	Empirical	Case study	Very High	Converting waste into energy
26	Waliczek, et al. (2016)	3	HortTechnology	United States	Empirical	Survey	Very High	Engagement of students in composting project
27	Wong et al. (2017)	3	Chemical Engineering Transactions	Malaysia	Empirical	Case study	Very High	Assess the potential of composting in mitigation greenhouse gas emission
28	Yeung et al. (2017)	2	International Journal of Sustainability in Higher Education	China	Empirical	Interview + survey	High	Environmental teaching through gaming simulation
29	Zen et al. (2019)	12	Journal of Cleaner Production	Malaysia	Empirical	Case study	Very High	Solid waste characterization

Table 2. Knowledge matrix

3. Findings

The following subsections are addressed the analysis of selected papers from meeting the inclusion criteria described in Figure 1. Tables and figures summarized the results.

3.1 Time distribution of publications

The distribution of articles over the year is shown in Figure 2. According to the Figure 2, there was an increasing of publication between 2017 and 2018 which represent 65.5% of the total selected articles. Since the research was made in the first semester of 2019, only one paper was found in this year. Growing interest of research towards waste management in universities due to the general topic of waste is being widely debated in the most areas, moreover universities are known as university cities assignable to their size and daily flow of people, and as a result they produced a large variety of waste including paper even demolition waste.
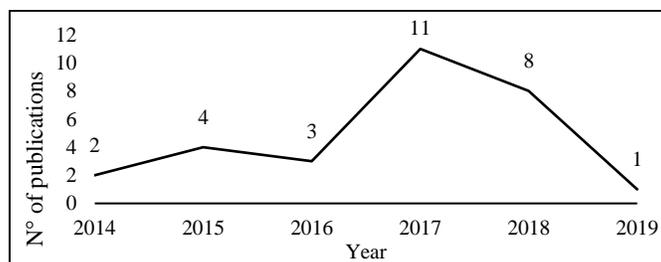

Figure 2. Time distribution of publications

3.2 Citation analysis

In accordance with Figure 3, nine papers did not have any citations, from the total selected articles, according to Scopus database when the research was done. There is no paper with 5, 9, 11, 13 or 15 citations. Two papers were

cited 15 times, both of them are case studies carried out in the United States, besides one of them emphasizes systems composting, which is a topic that has been widely debated and studied recently. Analyzing the 6 most cited papers (15, 12 and 10 citation), only one of them is not a case study in a high HDI level country, it means the remaining 5 papers are empirical case studies in a country with a high level of HDI.
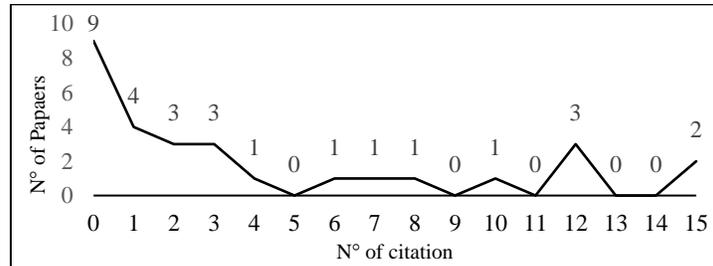

Figure 3. Number of citations per paper

3.3 Ranking of journals by the number of publications

Table 3 lists the journals in which articles on waste management in HEI are published. The journals with the highest number of articles published are Waste Management and Cleaner Production, both from Elsevier, and International Journal of Sustainability in Higher Education from Emerald. Each of them published 5 articles aligned to the topic of this research, representing 17.2% of the total. Another 14 journals also published articles, however as they collaborated only with one article, they were grouped as "others" Table 3 representing 48.3% of the total articles' portfolio.

Journal	Contribution percentage
Waste Management	17,2%
Journal of Cleaner Production	17,2%
International Journal of Sustainability in Higher Education	17,2%
Others*	48,3%

*journals with only 1 paper published

Table 3. Ranking of journals by number of publications

3.4 Research method

Reading the articles, in the content analysis step, we did the research method classification by adapting the concepts used by Ansari and Kant (2017), according to the following concepts:

- Case study: in-depth study for a real problem;
- Interview: semi-structured interviews, structured interviews or focus group;
- Survey: online or paper survey;
- Documents analysis: reading and evaluation physical or electronic documents;
- Conceptual: model based on concepts and theory;
- Simulation: testing a real case;
- Interview + survey: combination of the two types;
- Interview + survey + documents analysis: combination of the three types.

According to Table 4, more than 50% of the selected articles used case study research method. Approximately 20% used a joint interview method and a questionnaire. Both methods stood out as more promising in the research area when compared to other methods, such as interviews or questionnaires applied apart.

Research method	Contribution percentage
Case study	55,2%
Interview + survey	17,2%
Interview	6,9%

Interview + survey + documents analysis	6,9%
Survey	6,9%
Conceptual	3,4%
Simulation	3,4%

Table 4. Research design

3.5 Research design

The research design was divided into three groups - empirical, theoretical and both kinds. Table 5 shows that most of all papers were conducted by empirical research. The empirical kind includes both qualitative and quantitative research, which consist of practical experiments or observations to check the results. Since most studies were elaborated by the case study method, it was expected that the highlighted research was empirical studies.

Research design	Contribution percentage
Empirical	86,2%
Theoretical	6,9%
Empirical + Theoretical	6,9%

Table 5. Research design

3.6 Geography of papers

In order to elaborate Table 6 and Figure 4, the portfolio data were compiled. The analysis shows Malaysia, United States and Brazil are the most prolific countries in the research subject. In Figure 4, the countries which have collaborated with scientific research in the area of the present paper are highlighted in yellow. It shows emerging economies countries, such as China, have been taking place on the sustainability subject.

Figure 4. (Color online) Geographical locations of publications.

Malaysia contributed with 6 articles, followed by the United States with 5 papers and Brazil with 4 papers. Almost 50% of the articles dealt with studies carried out in countries with an HDI index classified as very high, according to the Human Development Indices and Indicators (2018), there is also countries with a low index included in this research, but no article is from a country classified as a very low index.

Country	Contribution percentage
Malaysia	20,7%
United States	17,2%
Brazil	13,8%
Nigeria	10,3%
Bangladesh	3,4%

China	3,4%
Colombia	3,4%
Ethiopia	3,4%
Ireland	3,4%
Italy	3,4%
Jordan	3,4%
Mexico	3,4%
Portugal	3,4%
United Kingdom	3,4%
Thailand	3,4%

Table 6. Geography of papers

4. Discussions

This study adopted the concept of sustainability proposed by Elkington (1994), who considers sustainability as the balance between environmental, economic and social factors, a term known as Triple Bottom Line. Equally important is the definition of sustainable development as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission). Besides, Higher Education Institutions (HEIs) is defined as colleges, university centers or universities as proposed by the Ministry of Education (MEC).

In reference to waste management concept, the meaning is suggested by Law 12,305/2010 related to National Policy on Solid Waste (NPSW), which is defined as "solid waste management: a group of actions performed, directly or indirectly, in collection, transportation, transshipment, treatment and final disposal step environmentally appropriated, in accordance with the municipal plan for integrated management of solid waste, as required of this Law".

One of the key issues that Higher Education Institutions can apply to take advantage is the academic community potential to engage themselves and improve the scenario through teaching, research and outreach in several fields of study (Moreira et al., 2018), in order to making the campus as a living laboratory to building culture of sustainability (Gallo et al., 2017). In addition, HEIs can form linkages between knowledge and dissemination in the Community (Tangwanichagapong et al., 2017). Moreover, they have a critical role in sustainable development (Hugé et al., 2018) by education professionals not only to get a good job but also for the society. Therefore, it is important that teach by giving example and awareness of the suitable way to manage waste.

Higher Education Institutions (HEIs) are known as university cities assignable to their size and daily flow of people. Inside them, there are hospital, restaurants, banks, offices, classrooms and places for events, among others, for this reason, there is a wide diversity of waste produced by HEIs, including construction and demolition waste, electronic waste, office waste, lamp, furniture, metal, hospital waste, and others. Furthermore, according to Gallo et al. (2017) sustainable waste management is a central subject for circular economy, which has received global attention due to dealing with the transition from the linear consumption model to a circular economy model by increasing resource efficiency and harmonizing the relationship between society, environment, and economy.

When the university community awareness about waste management, conscious consuming, correct disposal of garbage, etc., it disseminates knowledge everywhere, including acting as a good influencer in where it lives (Moqbel, 2018). However, a survey made by Drahein et al. (2019) in a university suggests lack of concern about waste management in students, teachers and employees. By the way, there was a consensus among the interviewed students that educational programs do not orientate learning towards sustainability issues, creating knowledge barriers.

Therefore, the authors Hugé et al. (2018) and Moreira et al. (2018) suggest that a curriculum restructuring in the universities in order to introduce environmental subjects, since it is a multidisciplinary issue and fits in the most under graduation. In doing so, students could meet the market demand for skills focused on sustainability (Lohn et al., 2016), in addition they can become better and more qualified to get jobs.

According to Hugé et al. (2018), sustainability in HEI is substantially connected with sustainability in the private sector, due to the interrelationships between them. Tangwanichagapong et al. (2017) reported the effects of making campaigns aimed at meeting the 3R's (reduce, reuse and recycle) in waste management initiatives on campus. Their study suggested that promoting 3R's practices had a positive effect on a person's attitudes about resources, it means that simple initiative can bring positive impact on people behavior. In this way, the paper published by Ebrahimi and North (2017) indicates that low-cost initiatives can positively influence the improper waste disposal, such as supply waste bins for selective waste collection on campus.

Managers from 7 Brazilian HEIs (Drahein et al., 2019) identified the sustainable development as a way to reducing water and energy consumption and enhancing waste management. Besides, those interviewed by et al. (2018) debated about cases which students realize improvements in HEI's waste management and carried out a project in partnership with the university. Hereby, these authors also approach how important is financial incentive in sustainable projects by sponsors such as government, private sector, philanthropic institutions and even the community, in order to encourage culture for sustainability.

The characterization of solid waste in HEI, as the main subject, was discussed in 5 of the research portfolio Moqbel (2018), Gebreeyessus et al. (2018), Oladejo et al. (2018), Adeniran et al. (2017) and Zen et al. (2016). Both papers agreed that HEI have potential for initiatives aimed at recycling, whereas the largest amount of generated waste is recyclable or organic waste, which could be composted to produce valuable products as energy or fertilizers (Kamyab et al., 2015; (Mu et al., 2017). In general, it is essential characterize the waste to propose waste management initiatives.

One of the barriers discussed by Drahein et al. (2019) was that university employees have a much work daily further they have to add more activities in their routine to deal with waste management issues. Due to overload, they prefer to make obligatory activities to take care of "garbage". With this in mind, it is important to encourage and raise awareness the university community, professors, students and the external community about this problem to act as auditors and spread good sustainable practices (Ebrahimi and North, 2017);

The more technological development and social progress happen, the higher demand for resources, and consequently, the damage is going to be greater for the environment and society (Alves and Farina, 2018). Hence, regarding this topic, if electronic waste is improperly disposed, it can severely damage the environment due to toxic and hazardous materials, and also can raise disease. Alves and Farina (2018) studied sustainable disposability and reuse of electronic equipment in HEIs. Their paper suggests to create a website or a specific portal to answer questions and to enlighten population, as well as internal exchange of idle materials to encourage reuse or disassembly. Thus, the life cycle of products would be increased trough reuse and refurbish because innovation in electronics area has had a high sales demand and, consequently, obsolescence is also increasing (Agamuthu et al., 2015).

Gallo et al. (2017) suggested, as an opportunity, to make the HEI as a living laboratory, by using research laboratories from the university to study subjects aligned to waste management and even to treat the waste generated by them, aiming at engage everyone. In addition, they have an essential role in innovation and knowledge diffusion, acting as an agent of change in society (Hugé et al., 2018). However, HEIs must be innovative organizations, disseminators of knowledge, they are often conservative and resistant to changes (Hugé et al., 2018).

5. Drivers of good practices in HEI

From the content analysis, a list of good practices suggested by the paper's authors was done. In this section, the improvement opportunities in waste management in HEI will be listed. Although each HEI has specific characteristics, the drivers were highlighted to aim for application in any case. The authors approached the importance of financial incentive by sponsors as government, private sector, philanthropic institutions and even the community in sustainability projects to achieve successful in this subject.

I. Implementing sustainability in HEIs by adding environmental subjects in undergraduate and graduate courses (Drahein et al., 2019; Moreira et al., 2018);
II. Inviting funding arrangements for sustainability projects (Hugé et al., 2018);
III. Enhancing exchange knowledge between the university managers and the university community (Zen et al., 2016);
IV. Encourage the university community to audit waste management practices (Ebrahimi and North, 2017);
V. Hiring professionals to work specifically with waste management (Drahein et al., 2019);

VI. Establishing a green office as a model office to the university (Zen et al., 2016);
VII. Engaging the community (students, researchers, and staff) in waste management activities based on sustainability principles (Hugé et al., 2018; Moreira et al., 2018);
VIII. Reporting green initiatives and its achieved goals (Tangwanichagapong et al., 2017);
IX. Disseminating guidelines for proper waste discard (Tangwanichagapong et al., 2017);
X. Carrying out management and final disposal of hazardous waste from research laboratories (Moreira et al., 2018);
XI. Reuse in social programs, proper disposal and recycling of obsolete electronic equipment (Alves and Farina, 2018);
XII. Treating the university as a living lab using its own capabilities to solve environmental issues (Gallo et al., 2017).
XIII. Creating database on waste management to monitor key performance indicator in HEI (Moreira et al., 2018);
XIV. Allocating different types of bins strategically to enhance recycling waste segregation (Oladejo et al., 2018; Zen et al., 2016; Drahein et al., 2019; Ebrahimi and North, 2017);
XV. Awareness the campus community about waste management focusing on recovery, recycling and reuse through campaign, pushing them for a transition to circular economy (Gallo et al., 2017).

6. Conclusions and future research opportunities

This study aimed at analyzing waste management in HEI focusing on sustainability, by a bibliometric and content analysis, using the Systematic Search Flow. There was a discrepancy between found paper with the keyword "waste management" and the definition of solid waste by the National Solid Waste Policy because the NSWP embraces gases and liquids. This verification alerts to future researches focusing on Brazilian Universities because documents that are not aligned with research objective can be obtained.

The time distribution of publications showed an increasing of publication between 2017 and 2018, which represent 65.5% of the total selected articles. A total of 9 papers, from resulting portfolio, were not cited by other authors, according to Scopus database. Two papers were cited 15 times, both of them are case studies carried out in the United States. Analyzing the 6 most cited papers (15, 12 and 10 citation), only one of them is not a case study in a high HDI level country, it means the remaining 5 papers are empirical case studies in a country with high level of HDI.

The bibliometric analysis also showed the most prolific journals in Higher Education Institutions subject were Waste Management and Cleaner Production, both from Elsevier, and International Journal of Sustainability in Higher Education from Emerald. Besides, the most research method applied was a case study, presented in 55.2% of the articles, followed by an interview + questionnaire (17.2%). Almost 90% of papers were carried out by the case study method. The geography papers identified almost 50% of the articles dealt with studies managed in countries with an HDI index classified as very high, not mention that Malaysia, United States and Brazil have had a higher proportion of publications.

From the content analysis, a list of good practices could be suggested, such as implementing sustainability in HEIs by adding environmental subjects in undergraduate and graduate courses; engaging the community (students, researchers, and staff) in waste management activities based on sustainability principles; awareness the campus community about waste management focusing on recovery; recycling and reuse through campaign, pushing them for a transition to circular economy; creating database on waste management to monitor key performance indicator in HEI; disseminating guidelines to proper waste discard, among others.

Regarding study's limitations, it is noteworthy. First, the results are limited to the resulting portfolio, it undermines any generalization to other periods of time, keywords and logical operators. Thus, to provide a more holistic perspective, future research should expand the criteria for inclusion paper on the portfolio as increasing the time interval, search keywords in other databases such as Web of Science and Science Direct, in addition to review the keywords chosen to enhance the results.

However, the HEIs are inside in different contexts, the main university's role is the same. They develop their students in a perspective of looking at life and build opinions, preparing professionals not only for the market but also for society as citizens. Further, the universities are able to drive the progress of society in a way of sustainable development. Nevertheless, there is not only one path to greening the campus. A significant effort should be done to break barrier and improve the community awareness about waste management in HEIs.

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Acknowledgements

Biographies

Danieli Braun Vargas attending master's degree in Production Engineering at the Federal University of Santa Catarina (UFSC) in Brazil, in the research line of Management and Operations (2019-2021). She holds a bachelor degree in Chemical Engineering at Federal University of Rio Grande (FURG), MBA in Project Management and specialization course in Production Engineering. She is also Administrative Assistant in the Department of Production and Systems Engineering of the Federal University of Santa Catarina (UFSC), Florianopolis, Brazil. She is interested in waste management, urban mining, and circular economy.

Lucila M. S. Campos is an Associate Professor at the Department of Production Engineering and Systems Engineering of the Federal University of Santa Catarina (UFSC) in Brazil. She holds a PhD and Master in Production Engineering from Graduate Program in Production Engineering (PPGEP) at UFSC and Bachelor in Production Engineer (1993) by Federal University of São Carlos (UFSCar). She was also a former Visiting Scholar at Royal Holloway, University of London (2015-2016), in UK, in Sustainability area. Her industrial experience include working as EH&S Manager and Environmental Auditing. Her current research interests include environmental management, sustainability, GSCM and circular economy.