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1 **An Analysis of the Insertion of Sustainability Elements in Undergraduate**
2 **Design courses offered by Brazilian Higher Education Institutions: an**
3 **exploratory study**

4
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7
8
9 **Abstract**

10 When it comes to the perception of sustainability in all of its aspects, Higher Education
11 Institutions (HEIs) worldwide are responsible for preparing students, changing their attitudes,
12 and encouraging them to think about future generations. In this sense, the main objective of
13 this study is to analyze how sustainability has been inserted in undergraduate design courses
14 offered by Brazilian HEIs. For this study, 30 pedagogic projects of the aforementioned courses
15 were analyzed through a content analysis technique. The results demonstrated that the analyzed
16 design undergraduate courses are still at an early stage of considering guidelines that take
17 sustainability into account. The most critical point is the small number of laboratories and
18 research groups dedicated to this subject, as well as the small number of academic events and
19 extension programs associated with this subject. The discussions presented here can greatly
20 contribute to and enhance the debate about improvements in design courses in the context of
21 sustainability.

22
23 **Keywords:** Sustainability; Sustainable Development, Design courses, Transdisciplinarity.

24
25 **1. Introduction**

26
27 The challenges imposed on society regarding negative environmental impacts, a scarcity
28 of resources and increasing inequalities will require a change in professional training standards
29 to align them with sustainability guidelines. In this context, the concept of sustainability is
30 wide-ranging (Barata et al., 2014; Camioto et al., 2017; Cozendey da Silva et al., 2018; Martins
31 et al., 2019b; I.S. Rampasso et al., 2019), but it generally focuses on the idea disseminated by
32 the World Commission on Environment and Development (WCEED), that states that
33 “sustainable development is development that meets the needs of the present without

34 compromising the ability of future generations to meet their own needs” (Brundtland, 1987, p.
35 16).

36 Similarly, in 2015, the United Nations (UN) provided an important contribution to the
37 search for a more sustainable future through the proposition of the 17 Sustainable Development
38 Goals (SDGs), in which 169 targets were presented to be reached until 2030 (D’Amato et al.,
39 2019; V. Martins et al., 2019b; Pohlmann et al., 2019; Sales Moreira, 2018). When focusing
40 specifically on goals SDG #9 and #12, it is possible to identify the relevance of designers for
41 these goals. This is because these professionals are characterized by performing innovative
42 actions, infrastructure improvements, and improving incentives to sustainable consumption
43 and production. The ninth goal highlights the need to establish industrialization according to
44 sustainable guidelines, emphasizing the use of clean technologies in order to make them
45 positively contribute to economic growth, job creation and an efficient use of natural resources.
46 The efficient use and management of natural resources are also mentioned by goal SDG #12,
47 in which the importance of seeking sustainable standards not only in production, but also in
48 consumption is emphasized (UN, 2017).

49 In addition to these goals, the fourth goal of the 17 SDGs focuses specifically on quality
50 education. Among the targets considered within this SDG, education for sustainable
51 development can be highlighted as an important driver of a sustainable future (I. S. Rampasso
52 et al., 2019; UN, 2017; UNESCO, 2017). The literature has also emphasized the key role
53 performed by HEIs in the search for a sustainable future (Benkari, 2013; Boarin et al., 2019;
54 Hoover and Harder, 2015; Sassen et al., 2018; Stephens et al., 2008). In this sense, HEIs
55 worldwide are increasingly responsible for making students aware of themes regarding
56 sustainability, in order to present a focus on an economic growth that also considers social and
57 environmental aspects (Alves et al., 2015; Hamid et al., 2017; Ramísio et al., 2019; Rampasso
58 et al., 2018).

59 To achieve this, a significant training of undergraduate students is required. In recent
60 years, the integration of sustainable development in higher education has been receiving
61 growing attention (Verhulst and Van Doorselaer, 2015). This training needs to go further in
62 technical training, and must emphasize critical thinking, as well as multidisciplinary,
63 transdisciplinarity and others skills (Barba-Sánchez and Atienza-Sahuquillo, 2018; Fan and
64 Yu, 2017; Garbie, 2017; Rampasso et al., 2018; Zeiny, 2012). However, according to Tejedor
65 et al., (2018) there is a long path ahead. These authors argue that in order to train undergraduate
66 students on aspects related to sustainability, it is necessary to identify and discuss the
67 relationship of relevant social problems with the integration of knowledge in the learning

68 processes, thus providing socially robust results that are transferable to practice. Therefore,
69 transdisciplinary approaches can not only be associated with the promotion of a more
70 continuous and critical reasoning, but can also contribute to teachers overcoming
71 monodisciplinarity. In this sense, there will be several challenges faced by HEIs when
72 restructuring their undergraduate course curricula. Proper planning and a constancy of purpose
73 may enable HEIs to obtain satisfactory results that contribute to a better future (Leal Filho et
74 al., 2019; I. S. Rampasso et al., 2019).

75 When specifically analyzing the designer profession, it is possible to note that it performs
76 an important role in the creation and evolution of the built environment (Mustapha et al., 2013).
77 Therefore, it can greatly contribute to sustainable development (Nunes, 2017; Zeiny, 2012). In
78 this regard, HEIs that offer undergraduate design courses should structure their curricula
79 around aspects of ethics and environmental, social and economic development (O’Flaherty and
80 Liddy, 2018; Schneiderman and Freihoefer, 2012).

81 Given this context presented and the importance of the Brazilian economy, it is
82 interesting to draw an overview for how Brazilian HEIs are inserting sustainability in their
83 undergraduate design courses. To do this, this research evaluates the pedagogical projects of
84 undergraduate Design courses from 30 different higher education institutions, in order to better
85 understand this reality. This context was considered in this paper due to the lack of studies
86 related to the teaching of sustainability in undergraduate courses (Disterheft et al., 2015).
87 According to this gap in the literature, the results presented here can greatly contribute to the
88 enhancement of these debates. Moreover, the training of design professionals in sustainability
89 has gained considerable attention recently (Boehm and Kopec, 2016).

90 In addition to this introductory section, this article is structured into four more sections.
91 Section 2 is dedicated to the theoretical framework that served as the foundation for this study’s
92 logic. Section 3 addresses the methodological procedures that were developed. Section 4
93 presents the results and the discussion for this study, considering the literature about the theme.
94 Section 5 sets out the conclusions and proposals for future studies.

95

96 **2. Theoretical background**

97

98 This section presents concepts and debates about critical thinking, transdisciplinarity in
99 higher education, teaching for sustainable development and, finally, the importance of the
100 designer in the search for a better future.

101 According to Meyer et al. (2017), sustainability is an area of knowledge that provides
102 different insights to reflect and address real-life needs. In the current context, sustainability is
103 essential due to the challenges experienced by society in the 21st century. These challenges
104 will only be overcome through disciplinary and institutional integration (Anderson et al., 2015;
105 Kirby, 2019; Remington-Doucette et al., 2013).

106 Biberhofer and Rammel (2017) reinforce the importance of sustainable teaching,
107 highlighting the need of a transdisciplinary scenario between science and society, aiming to
108 develop concrete professional competences aligned with the interests of humanity. Proitz and
109 Wittek (2019) and Schneider et al. (2019) corroborate this view by arguing that
110 transdisciplinarity should serve as a guide to enhance the resolution of real problems. Guerra
111 (2017) conceptualizes transdisciplinarity in higher education as the use of a holistic approach
112 that goes beyond the limits of the areas of knowledge, allowing and facilitating the total
113 integration of different concepts through the interaction of people from different areas.

114 The role of HEIs is to train professionals to be capable of managing economically and
115 socially sustainable productive activities and, furthermore, to develop an education with strong
116 values to promote a fairer society (Novo-Corti et al., 2018; Rodríguez-Solera and Silva-Laya,
117 2017; Sinakou et al., 2018). Franco et al. (2019) emphasize that education has been impacted
118 and strongly shaped by the influence of the global sustainability agenda, highlighting that many
119 HEIs are focused on the formation of future leaders who act towards the goals of sustainable
120 development. In fact, it is always possible to notice a positive correlation; as companies are
121 under pressure from society to comply with sustainable guidelines, HEIs need to shape
122 themselves to qualify a new type of professional, characterized by proactive thinking regarding
123 the use of sustainable elements in the development of their work. Increasingly, these
124 institutions must offer courses that focus not only on normative profit goals, but also on social
125 and environmental competencies. That is, it is important that they are able to promote
126 professional performance by prioritizing and focusing on sustainable development (Hoveskog
127 et al., 2018; Remington-Doucette et al., 2013; Souleles, 2017).

128 Leal Filho et al. (Leal Filho et al., 2019) highlight that the insertion of sustainability in
129 higher education is an important goal for HEIs, however, it demands proper planning.
130 Rampasso et al. (Rampasso et al., 2018) developed a study in which they demonstrated how
131 the difficulties associated with the inclusion of sustainability in engineering education are
132 related, in particular considering the difficulties associated with structure and planning and
133 difficulties observed in didactic practice. Additionally, Rampasso et al. (I. S. Rampasso et al.,
134 2019) developed another study in which they aimed to consider a sample of Brazilian students'

135 perceptions in order to analyze the challenges to insert sustainability into engineering courses.
136 According to their findings, the most evident challenges were: a) sustainable issues were
137 debated only in specific disciplines to a limited extent; b) it is difficult to integrate disciplines
138 for the broad teaching of sustainability; c) there is a lack of practical and real examples of how
139 sustainability can be embedded in the specific context of the course, and; d) the activities and
140 examples presented focused exclusively on environmental issues.

141 More specifically, it is worth highlighting the designer as a professional who can greatly
142 contribute to sustainable development. Wagner et al. (2019) highlight the growing concern of
143 consumers about environmentally sustainable products, thus demonstrating the importance of
144 professionals who consider environmental and social implications at all stages of a product's
145 lifecycle. In this regard, there are tools to support ecological design throughout a product's
146 lifecycle, such as the EcoDesign Strategy Wheel, Life Cycle Design Strategies, spider-web,
147 and Okala impact factors. These tools aim to minimize the negative environmental impacts of
148 products (Doğan et al., 2016). Hurney et al. (2016) argue that students that have subjects related
149 to sustainability tend to have a greater engagement in their professional actions. Despite the
150 importance of these subjects for the training of design professionals, there are institutions that
151 do not provide them for their students.

152 Nevertheless, Hur and Cassidy (2019) show that there is still a lack of consensus and
153 knowledge about the guidelines for sustainable design. Focusing on fashion design, these
154 authors emphasize the potential for designers to reduce the social and environmental negative
155 impacts of the apparel production process and consumption patterns. However, both internal
156 and external challenges need to be overcome for this to occur. Among the internal challenges,
157 there is a need for a proper understanding of sustainable design and a consensus regarding this
158 concept. There is also a difficulty in reconciling a sustainable design with other demands (i.e.
159 costs, trends and product appearance). The complexity level of sustainability subjects is an
160 external challenge, as is the lack of demand driven by sustainable issues and a lack of incentives
161 and/or recognition for companies to be sustainable. Sustainability concerns for the fashion
162 industry are especially important since it is among the most polluting industries in the world
163 (DeLong et al., 2016).

164 Vezzani and Gonzaga (2017) demonstrated through an action research the importance of
165 design professionals in the development of social sustainability projects. The aim of the study
166 was to understand and reflect on how to define an educational model that was capable of
167 preparing future designers to act actively and entrepreneurially towards sustainable goals. The
168 authors pointed out that it is necessary to encourage young people to think about sustainability

169 not only in the context of present challenges, but also considering future needs. Specifically,
170 however, it is emphasized that social sustainability is still a largely neglected area in the training
171 of these professionals.

172 Takala and Korhonen-Yrjanheikki (Takala and Korhonen-Yrjanheikki, 2019) highlight
173 major challenges faced by HEIs when it comes to training designers. These authors argue that
174 the education system was designed to train professionals in specific subjects, in contrast with
175 the transdisciplinary character of sustainability. Ueda (Ueda, 2018) also corroborates this
176 argument. To minimize this issue, Gatti et al. (2019) propose the use of alternative education
177 approaches through active methodologies, such as action and experimental learning by using
178 the simulation game technique.

179 According to O’Rafferty et al. (2014) the difficulty of teaching design students in a
180 transdisciplinary manner is especially relevant when real-world problems are considered, such
181 as, for example, shortages of raw materials, environmental impacts and economic and social
182 inequalities. Therefore, emphasizing the growing need for designers to work with
183 transdisciplinarity is necessary in this recent context (O’Rafferty et al., 2014).

184 In this sense, alternative teaching methods are needed to properly prepare students for
185 the current reality and market demands. Projects conducted in universities should be debated
186 to increase the knowledge about teaching experiences. Ueda (2018) presented a project carried
187 out with industrial design undergraduate students in which students needed to use eco-design
188 for product development. Eco-design is a process that considers environmental aspects with
189 the main objective of designing environments, developing products and executing services that
190 in some way reduce the use of non-renewable resources or minimize their environmental
191 impact during their lifecycle (Köhler et al., 2013; Ueda, 2018; Wagner et al., 2019). Despite
192 students’ interest, several challenges were found by students when it came to using support
193 tools due to their lack of knowledge, skills and experience with them (Ueda, 2018).

194 Focusing on the insertion of social sustainability in design education, Kjøllestad et al.
195 (2014) present a case study conducted in Haiti, with students from Norway. This insertion was
196 made through a project in which students needed to build a bakery for children’s mothers from
197 the school of an NGO. The authors highlight as main outcomes the following items: an increase
198 in students’ ability to solve conflicts; the development of project management skills; a holistic
199 perspective for students; the need for students to evaluate themselves; students understanding
200 the limits of planning due to reality constraints; and contact with a different culture and society.

201 Given the information presented, it is evident that HEIs are facing a great challenge,
202 especially due to the transdisciplinary nature of sustainability. There is a consensus on the

203 importance and contribution of education to the achievement of sustainable development, and
204 it is necessary that these institutions adopt new teaching methods that enhance the critical
205 thinking of future professionals (Sinakou et al., 2019; Vargas et al., 2019). Regarding future
206 designers, the potential that this profession has in the promotion of a better future is obvious,
207 either in the spheres of new product development, projects, fashion or education.

208
209

210 3. Methodological procedures

211

212 For the development of this research, five steps were performed as presented in Figure

213 1.

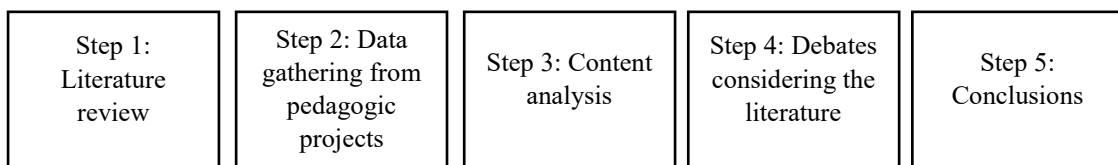
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219

Figure 1. Steps followed to perform the research (Source: Authors)

220

221 As presented in Figure 1, step one was dedicated to the literature review. The literature
222 review aimed to build the theoretical framework on the topics of insertion of sustainability in
223 higher education and, specifically, on the insertion of sustainability in undergraduate Design
224 courses. The scientific databases consulted were: Science Direct, Emerald Insight, Taylor and
225 Francis, Springer and Wiley. The following terms were used in the search: “Transdisciplinarity
226 critical thinking”, “Education for sustainable development”, “Sustainable Design professional”
227 and “Importance professional design”. These terms were also combined with each other.
228 Articles containing links to the the context of this study in their title, summary and keywords
229 were downloaded. The identification and extraction of information from their contents was
230 done by reading each one in full.

231 The search for pedagogical projects (step two) was performed through HEIs' websites,
232 which were publicly available. In this study, the pedagogical project was considered to be the
233 document used by Brazilian HEIs to register and present all of the guidelines and characteristics
234 of a given undergraduate course. This document is composed of the HEIs’ objectives, teaching
235 methods, curriculum, bibliography used, and other information. It is noteworthy that in Brazil,
236 HEIs must present the pedagogical project of each of their courses in order to obtain approval
237 by the relevant bodies. Therefore, it is an important document in the context of Brazilian higher
238 education.

239 The third step was characterized by the content analysis. This analysis of the collected
240 information took place through the content analysis technique, and was performed according
241 to the guidelines proposed by Elo and Kyngäs (2008) and used by Martins et al. (2019a).
242 According to these authors, a content analysis can be performed through four well-defined
243 phases: preparation; organization; the analysis process; and the reporting of results. For this
244 study, the preparation phase (step three) consisted of the collection of pedagogical projects
245 published by HEIs that offer undergraduate courses in Design. These institutions were
246 screened, since they should make publicly available the pedagogical projects and be listed in
247 the Ministry of Education of the Brazilian Government. Using these boundary conditions, 30
248 pedagogical projects of HEI were collected and constituted the units of research analysis.
249 Therefore, the selection criteria for pedagogical projects were effectively the availability of
250 access to these sources via HEI websites. All those considered in this study are from HEIs duly
251 registered by the relevant Brazilian body. After an analysis, 30 different pedagogical projects
252 from thirty different HEIs – both public and private – were considered in this study, with a
253 large flow of students and teachers involved. This sample comprises HEIs from the 5 regions
254 of Brazil.

255 For an inductive analysis of the content presented in the pedagogical projects, according
256 to the guidelines of Elo and Kyngäs (2008), the following steps were performed: open coding,
257 category creation and abstraction. First, in the open coding phase, all material was analyzed,
258 and the categories were created freely. The creation of categories increases the understanding
259 of the studied phenomenon (Elo and Kyngäs, 2008). In this research, during the codification
260 phase, all pedagogical projects were read in full and categories of analysis were created for a
261 better understanding of the whole. These categories are presented in the next paragraph.

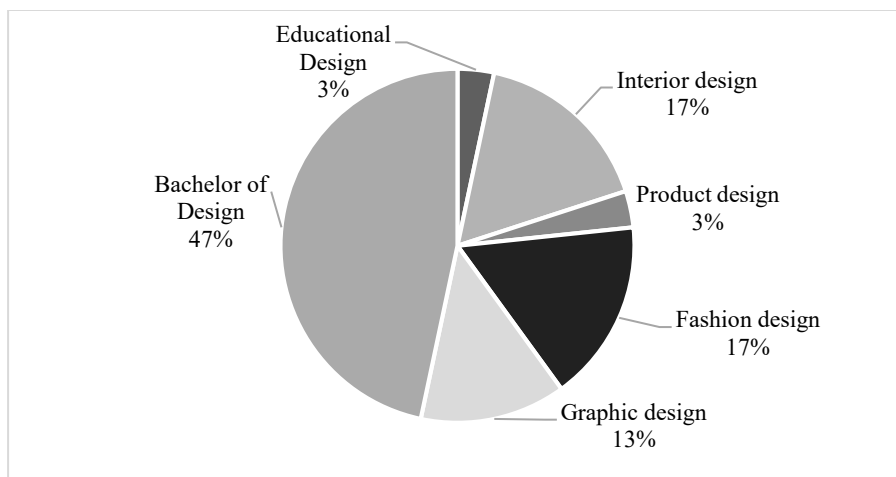
262 The organization phase, recommended by Elo and Kyngäs (2008), was characterized by
263 the definition of the categories to be analyzed in the pedagogical projects, aiming to identify
264 how the insertion of sustainability occurs in design courses offered by the sample HEIs. The
265 categories to be analyzed were: general objectives aimed at the professionals' training;
266 compulsory module titles and optional module titles; academic events; research groups;
267 laboratories; extension programs; and, bibliographies used. These topics were chosen due to
268 their recurrent presence in the pedagogical projects analyzed. Because of this article's scope,
269 all topics were analyzed in the context of sustainability concepts (including social, economic
270 and environmental aspects).

271 The analysis process was conducted through a careful reading of the 30 pedagogical
272 projects collected, aiming to identify information related to the topics mentioned. Through this

273 analysis, it was possible to gather both qualitative and quantitative information about how
274 sustainability has been inserted in Design courses offered in Brazil. At this stage, the main
275 findings were analyzed in light of the literature (step four) and conclusions were drawn. Finally,
276 the results were reported in article form.

277 It is noteworthy that, according to Elo and Kyngäs (2008), content analysis is a major
278 challenge to be conducted. Therefore, it is very important to describe all the steps taken and
279 highlight the limitations of the research. The detailed description of the steps performed in the
280 research and presented in this section had this purpose. Methodological procedures have been
281 detailed, allowing other researchers to replicate the research. The authors of this article
282 carefully checked the information presented and agreed that the results are reliable. The
283 exploratory character of this research is reinforced.

284 In order to better understand the profile of the analyzed HEIs, it is noteworthy that 60%
285 of them are public and 40% are private. Their courses totaled six different modalities in the
286 area of Design, with an emphasis on Bachelor of Design (47%), Interior Design (17%) and
287 Fashion Design (17%). Figure 2 presents all the modalities identified in the sample of the
288 studied courses. It is worth mentioning that one HEI presented a course entitled "Educational
289 Design Technology" and has been included on the graph with the term "Educational Design".
290



291
292 Figure 2. Categories of Design Courses in the sample analyzed (Source: Authors)

293
294 **4. Results and Discussion**

295 The following paragraphs present information gathered through the analysis of the 30
296 selected pedagogical projects, considering the topics presented in section 3. In the general
297 objectives disseminated by the HEI themselves regarding the desired training for Design

298 professionals, 46.66% include aspects of sustainability in these objectives, as shown in Table
 299 1.

300

301 Table 1. General objectives of pedagogic projects presented by HEIs. Source: Authors from
 302 analyzed pedagogic projects

#	Topic: General objectives
1	Economic and sustainable development focusing on technological innovation.
2	Focus on developing sustainable and inclusive products.
3	Promote professional humanistic training contributing to sustainable development.
4	Train professionals able to work in different areas, with innovative and sustainable proposals.
5	Professors debating the principles of sustainability in the use of natural resources.
6	Promote the sustainable development and competitiveness of Brazilian industry.
7	Develop and apply sustainable technologies in the fashion creation process.
8	Sustainability in the actions of the institution, students and staff.
9	Concerns with sustainability and the new options of insertion in productive activities.
10	Constant improvement of environmental, historical, social and economic aspects.
11	Investments in actions that relate to sustainability, considering the cost-benefit ratio.
12	Search for excellence linked to the quality of its social relations to sustainability.
13	Foster equal rights, human dignity, diversity and social and environmental sustainability.
14	Train professionals to extend global sustainability and environmental protections.

303

304 It is possible to say that most HEIs aim for their design students to acquire knowledge
 305 about sustainability. According to Franco et al. (2019), integrating knowledge with other
 306 activities of the designer's professional routine is critical to training a professional who is
 307 aligned with sustainable development guidelines. When analyzing the information presented
 308 in Table 1 in greater detail, the following points can be highlighted: sustainable product
 309 development, innovation, the conscious use of natural resources and social sustainability.
 310 Biberhofer and Rammel (2017) reinforce the importance of content alignment in the formation
 311 of a professional with critical thinking skills when it comes to the sustainability of their
 312 products and projects.

313 Regarding the topics “compulsory module title” and “optional module title”, it was
 314 observed that only 46.66% of the HEIs present module titles related to sustainability in their
 315 curriculum. When these module titles do exist, 71.42% of them are characterized as
 316 compulsory and 28.58% as optional. Table 2 shows the required and optional module titles
 317 offered by the courses to design students.

318

319 Table 2. Compulsory and optional module titles of the HEIs. Source: Authors from analyzed
 320 pedagogic projects

Topic: Compulsory module title		Topic: Optional module title	
(1)	Ethics and citizenship.	(1)	Environmental education.
(2)	Design and Sustainability.	(2)	Sustainable Design.
(3)	Design and Sustainable Development.	(3)	Design for Sustainability.
(4)	Design, Ethics and Sustainability.	(4)	Design and Sustainable Systems.
(5)	Design and Society.		
(6)	Social and political foundations of design.		
(7)	Design and Material Reuse.		
(8)	Ecodesign.		
(9)	Sustainable management.		
(10)	Sustainability.		

321

322 According to Hurney et al. (2016), students who attend subjects in the field of
323 sustainability tend to have greater engagement and become more complete professionals.
324 Despite the importance of these subjects for the training of design professionals, there are
325 institutions that do not have them in their curriculum. Takala and Korhonen-Yrjänheikki
326 (Takala and Korhonen-Yrjänheikki, 2019) argue that several courses are tailored to specific
327 training in a particular area, making it challenging to address cross-disciplinary topics such as
328 sustainability.

329 Regarding the theme "Academic events", only two analyzed undergraduate courses in
330 design have events associated with sustainability. This can be considered critical, as this type
331 of event is important to disseminate knowledge and integrate students and professionals from
332 different areas, an essential factor in training and sustainable thinking. Another possibility for
333 improvement identified in pedagogical projects is related to the number of research groups and
334 / or laboratories focused on aspects of sustainability. There are few institutions with them. The
335 content analysis carried out identified only two laboratories in the analyzed institutions that
336 were related to sustainability. That is, only 6.6% of HEIs have laboratories focused on
337 sustainability. In addition, it is also found that there are few activities related to extension
338 programs. In the analyzed sample, only two HEIs presented these activities. Table 3 provides
339 more information on the topics mentioned in this paragraph.

340

341 Table 3. Academic events, research groups, laboratories and extension programs. Source:

342 Authors from analyzed pedagogic projects.

343

Topic: Academic event	
(1)	Integrated Journey of the Environment.
(2)	Week of sustainability.
Topic: Research group	
(1)	Product Development with Amazonian Materials.
(2)	Product Design and Sustainable Development Research Group.
Topic: Laboratory	

(1)	Design and Sustainability Center.
(2)	Model office on sustainability projects.
Topic: Extension programs	
(1)	Sustainability and Environment Campaigns.
(2)	Trade Bazaar titled "Ciranda de Moda".

344

345 The last topic analyzed corresponded to the survey of the main bibliographies used to
 346 insert sustainability in the design courses offered by Brazilian HEIs. Table 4 lists the main
 347 bibliographies used by these institutions.

348

349 Table 4. Main bibliographies used in the design courses offered by Brazilian HEIs for
 350 sustainability education. Source: Authors from analyzed pedagogic projects.

	Topic: Bibliographies	References
(1)	System design for sustainability: theory, methods and tools for sustainable design.	(Vezzoli, 2010)
(2)	Paths for sustainable development.	(Sachs, 2006)
(3)	The basic guide to sustainability.	(Edwards, 2009)
(4)	Design for social innovation and sustainability.	(Ezio Manzini, 2006)
(5)	The development of sustainable products.	(Manzini et al., 2002)
(6)	Sustainability in interior design.	(Siân Moxon, 2012)
(7)	There will be age for light things: design and sustainable development.	(Kazazian, 2005)
(8)	Environmental Sustainability and Systemic Complexity in Industrial Product Design.	(Pereira, 2003)
(9)	Ecohouse: the environmentally sustainable house.	(Roaf et al., 2006)
(10)	Ecological literacy: children's education for a sustainable world.	(Siqueira-Batista and Rôças, 2009)
(11)	Sustainable graphic design.	(BETTONI, 2011)
(12)	Fashion & sustainability: design for change.	(Fletcher and Lynda, 2012)
(13)	The hidden connections: science for a sustainable life.	(Capra, 2002)
(14)	Environmental Education and sustainability.	(Junior and Focesi, 2005)
(15)	To think about sustainable development.	(Bursztyn, 1994)
(16)	Development: inclusive, sustainable, sustained.	(Sachs, 2004)
(17)	The myth of sustainable development: environment and social costs.	(Montibeller-Filho, 2004)
(18)	Sustainability: What it is and What it is not.	(Boff, 2012)
(19)	Sustainability and production: theory and practice for sustainable management.	(Neto, 2011)
(20)	Knowledge and sustainability: science, technology and innovation policies in contemporary Brazil.	(Baumgarten, 2008)
(21)	Sustainable design: virtuous paths.	(PELTIER et al., 2006)

351

352 Considering the books titles used by the HEIs in their design courses, it is possible to
 353 identify a trend for the transdisciplinarity of the topics covered. For Proitz and Wittek (2019),
 354 transdisciplinarity enhances professional training and the ability to solve real problems in
 355 society. Additionally, O'Rafferty et al. (O'Rafferty et al., 2014) highlight that the designer
 356 profession is becoming increasingly transdisciplinary due to changes in the current reality.
 357 Additionally, Guerra (2017) argues that a holistic approach can cover different areas of
 358 knowledge together, allowing for the integration of different concepts through the perception
 359 of people from different areas.

360 Based on the results presented, it is possible to draw the following overview for the
 361 design courses offered by the analyzed institutions. Almost half of the HEIs aim to train
 362 designers in line with the objectives of sustainable development, even though they still have
 363 deficiencies in the insertion of this theme in their curriculum matrices. The range of module

364 titles associated with sustainability is still small and in some HEIs there are no subjects
365 associated with it. Academic events, laboratories or research groups and extension programs
366 for sustainable development are characterized as the most critical issue identified. Regarding
367 the set of bibliographies used, their content is interesting and can enable a proper training of
368 design students.

369 Considering the overview previously presented and the importance of designers to meet
370 sustainability goals, Wagner et al. (2019) highlight the increasing pressure from consumers for
371 sustainable products and services. This pressure forces professionals to meet the targets that
372 largely compose SDGs #9 and #12, since they are directly related to sustainable production and
373 consumption. Similarly, Van Poeck et al. (2018) highlight that the SDGs will soon be the basis
374 of professional training worldwide. This point of view is corroborated by Li and Krasny (2019),
375 who argue that professional development programs can foster innovation and consolidate
376 changes towards sustainable guidelines.

377

378 **5. Conclusions**

379 The main objective of this article was characterized by an analysis of sustainability
380 insertion in undergraduate design courses offered by Brazilian Higher Education Institutions.
381 Based on the results presented, it can be concluded that the proposed objectives were achieved,
382 even if they were only exploratory at this stage. From the data presented through the
383 pedagogical projects of 30 HEIs that offer undergraduate design courses, it was possible to
384 gather information about the general objectives of the HEIs' professional training; compulsory
385 module titles and optional module titles; academic events, research groups, laboratories,
386 extension programs; and the bibliographies used.

387 As a general conclusion, it can be observed that the design undergraduate courses offered
388 by the HEIs of the studied sample are, generally, at an early stage of sustainability insertion in
389 their curriculum matrices. On the positive side, it should be noted that half of the institutions
390 aim to train designers in line with sustainable development guidelines. On the other hand, there
391 was a low number of laboratories and research groups dedicated to sustainability issues, as well
392 as a low number of university events and extension projects.

393 As a research limitation, it is worth highlighting the fact that a content analysis was
394 performed on information made publicly available by the institutions. However, this
395 information may not always be up to date and consistent with the realities of the courses. This
396 is a potential limitation of this study. The discussions presented here can greatly contribute to

397 the evolution of the debate about the insertion of sustainability in the training of design
398 professionals.

399 As for theoretical implications, it can be highlighted that the findings and debates
400 presented here contribute to the literature in the area of sustainability and sustainable education.
401 This text specifically fosters discussion aimed at improving the development of training for
402 design professionals that is focused on meeting sustainability guidelines. Regarding the
403 practical implications of this work, the debate presented in this article can contribute to those
404 responsible for the coordination of undergraduate design courses in the definition of teaching
405 and learning strategies, especially considering the attendance and development of sustainability
406 themes. This is in order to prepare design students to be more prepared professionals to meet
407 sustainable challenges, as presented in the UN 17 SDGs.

408 These implications generate several proposals for possible future studies: a) An analysis
409 of the use of active methodologies in order to enhance the theme of sustainable development
410 in design courses by conducting multiple case studies and surveys; and b) A proposal of a set
411 of specific guidelines for the inclusion of sustainability in design courses, especially
412 considering their specificities. This is in addition to considering the use of sustainable
413 indicators to analyze the landscape of design courses, highlighting their contributions to
414 sustainable development.

415

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