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Strategic Environmental Assessment in higher education: Portuguese and Brazilian cases

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ABSTRACT

Environmental Impact Assessment is well established in higher education worldwide, with a history going back to the 1970s. In contrast, the teaching and training of Strategic Environmental Assessment is a relatively novel, less consolidated and implanted, but of growing importance as a decision support tool in planning and policy. Therefore, training needs in this domain have grown accordingly, demanding new answers from higher education institutions. Despite the existence of relevant work on sustainability in higher education, and on impact assessment education, there is a dearth of research on education of environmental assessment approaches for strategic levels of decision making. The goal of this research paper is to characterize the profile of Strategic Environmental Assessment in higher education in two distinct situations; Portugal and Brazil. Surveys were conducted to assess Strategic Environmental Assessment integration in their higher education institutions' curricula. Bachelor and masters' programmes and course curricula were analysed through a content analysis based approach. The main results showed a medium state of integration for Strategic Environmental Assessment, while stressing that it is still an unconsolidated area. These results also emphasized that there is a need to discuss the design of Strategic Environmental Assessment specialized courses that respond to societal needs, rethinking the impact assessment educational initiatives and approaches. The integration of this assessment instrument in curricula could have significant implications for the enhancement of higher education practices for sustainable development, by promoting better assessment and management of strategies, policies, legislation, plans and programmes and the decision-making processes involved.

1. Introduction

Strategic Environmental Assessment (SEA) is an environmental policy tool used to perform a formal, comprehensive assessment of the environmental, economic and social consequences of a policy, plan or programme, and their alternatives, so that any effects/impacts are taken into account in the decision-making process, with the support of stakeholders' participation (Therivel, 2010; Marsden, 2008; Fischer, 2007). Therefore, SEA can support strategic-level decisions and should be complemented with Environmental Impact Assessment (EIA) at project level, where a more in-depth analysis is applied with a narrower scope. Impact Assessment (IA) and Environmental Assessment (EA) are commonly used to refer to different IA instruments, including both EIA and SEA, and also other related instruments, such as health impact assessment or social impact assessment (Morgan et al., 2012; Tetlow and Hanusch, 2012).

List of Acronyms: IA, Impact Assessment; EA, Environmental Assessment; EIA, Environmental Impact Assessment; NEPA, United States National Environmental Policy Act; SD, Sustainable Development; SEA, Strategic Environmental Assessment; HESD, Higher Education for Sustainable Development; HEI, Higher Education Institution; HES, Higher Education System; NGO, Non Governmental Organisation.

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SEA was firstly proposed by the United States National Environmental Policy Act (NEPA) in 1969. This regulation addressed EA of projects, programmes, plans and policies. In the European context, EA was introduced in 1985 by the EU Directive 85/337/EEC with reference to the project level (through EIA), and later, recognising that there was a gap between the planning and the project level, SEA was introduced through Directive 2001/42/EC to assess and integrate environmental aspects into plans and programmes.

Regular practice of SEA in Portugal and Brazil is a recent phenomenon. These two countries' SEA realities are still poorly studied, and despite sharing similar cultural and social values, they reflect different contexts, including their legal and institutional environmental frameworks and Higher Education Systems (HES). In addition, the European regulated SEA perspective, implemented in Portugal, can be analysed in contrast to a non-regulated and growing SEA reality, as represented by a leading South American country, and emerging global economy. SEA was enacted in Portugal through the Decree-Law 242/2007, which transposes the Directive 2001/42/EC, on the assessment of the effects of certain plans and programmes on the environment. Before this legislation, a number of what may be broadly considered as SEA early applications were performed in different contexts, such as large projects or sets of small projects.

Brazil lacks a specific SEA law at the national level. In 2003 a 'project of law' (PL 2072/2003) was proposed to mandate application of SEA for policies, plans and programmes; however, it was filed away by January 2011 (Câmara dos Deputados, 2012). A new project of law has been filed (PL 261/2011), which includes SEA among Brazilian environmental policy tools, but it is difficult to predict the outcome of this process.

Some Brazilian states do have specific legislation that mentions the use of SEA. In São Paulo State, SEA must be used to assess the effectiveness of the State Policy on Climate Change (Law no. 13.798/2009); in the State of Minas Gerais, an inter-departmental group was created to co-ordinate the use of SEA and to integrate this instrument into decision-making. The current practice of SEA in Brazil, requiring this kind of evaluation, relates mainly to the EA of large projects, sets of small projects, and developments financed by the World Bank (Malvestio and Montaño, 2013).

Following the international technical, legal and institutional dynamic, teaching and training of IA professionals have been continuously reported, as reviewed by Stelmack et al. (2005) and Ramos et al. (2008). There is a number of publications focused on general guidelines for IA training (e.g. Wood et al., 1996; Lundström and Olausson, 2004), and on key issues that influence IA education together with national and international case-studies (Stelmack et al., 2005; Ramos et al., 2008; Sánchez, 2010; Sánchez and Morrison-Saunders, 2010). Also, there is research developed in order to understand education as a factor influencing implementation of SEA and, at the same time, the benefits derived from the use of SEA that may help alter deep-seated mind-sets towards Sustainable Development (SD) (Briffett et al., 2003).

Although SEA was conceived to implement SD at a strategic level of decision-making, there are many challenges to its realisation and effectiveness. These challenges can be partially overcome through the development of SEA capacity-building, knowledge and practices, as underpinned by Partidario (2011) and White and Noble (2013). Higher Education Institutions (HEIs) are called on to teach, enhance and promote the spread of SEA practices, by developing and broadening their curricula and research, as a means to integrate sustainability considerations into policies, legislation, plans and programmes. Several authors have previously discussed the role of HEIs in SD (e.g. Cortese, 2003; Lozano, 2006; see also the reviews conducted by Disterheft et al., 2013; Karatzoglou, 2013), including the particular analysis of curricula (e.g. Ceulemans and De Prins, 2010; Lozano and Young, 2013; Pappas et al., 2013), which should lead to multi-disciplinary and trans-disciplinary teaching, research and community engagement (Lozano et al., 2013).

However, although Higher Education for Sustainable Development (HESD) is a growing and emerging field, with a significant array of initiatives on new approaches, concepts, methods and frameworks, or case study applications, as shown by several authors (e.g. Bremer and López-Franco, 2006; Alshuwaikhat and Abubakar, 2008; McCormick et al., 2005), it is still at an early stage of development in many institutions and countries, as emphasized by Lozano et al. (2013) and Mulder et al. (2012). At the same time, IA tools and instruments, and in particular EIA, represent a worldwide-recognised education and research field at HEIs (Gazzola, 2008), mainly pushed by market demand. Professionals with IA skills and competences are required to deal with EIA and SEA specific regulations and their implementation. IA legal requirements are mandatory in many countries (Alshuwaikhat, 2005; Morgan et al., 2012; Tetlow and Hanusch, 2012) or are imposed by international funding agencies (e.g. World Bank). Thus, the market, education and research on IA could represent important drivers to introduce environmental and sustainability related matters into curricula, dedicated environmental programmes, and beyond. Previous research has already shown that programmes non-specifically focused on environmental related matters, such as civil engineering are starting to introduce IA related topics, as identified by Ramos et al. (2008) and Weiland (2012). Areas such as corporate sustainability management, sustainability assessment, including IA related instruments, which cut across several areas of knowledge, could play an important catalytic role in the process of greening curricula. They could also contribute to environmental and sustainability competences, and play a part in the broader goal, as has been pointed out by Lozano et al. (2013), of introducing sustainability issues into all courses and curricula, and throughout all other elements of university and college activities. This includes HEI research activities, campus strategies and operations, and internal and external stakeholder engagement processes, including interaction with local communities, public administration, companies, and non-governmental organizations (NGOs). In addition, HESD should move to integrate strategic competences to solve concrete technical and social problems, as argued by Mulder (2014), where SEA could play a role, and mitigate the lack of a strategy for the integration of environmental and SD in HEI decisions making processes, with consequences on their academic curricula. This should be supplemented with better engagement for societal ethics, justice and responsibilities values of students and educators, and avoid that welfare commitments receive less importance from students' understandings of their professional roles, as emphasized by Cech (2014).

According to Lozano and Lozano (2014) there are five approaches to introducing SD into the curricula that could be synthesized as follows: (i) institute environmental issues and material in an existing module or course; (ii) a tailored SD course; (iii) SD intertwined as a concept in regular disciplinary courses, matching the objectives and scope of each specific course; (iv) SD as a possibility of specialization within the education framework of each faculty, and; (v) developing a specific, integrated curriculum, based on sustainability. SEA inclusion in the curricula of undergraduate or graduate programmes is within the first approach, and could constitute a specific course that covers IA issues. Previous research showed that EA education and training, at the higher education level, is mainly developed as a dedicated course and integrated into undergraduate or graduate programmes (Ramos et al., 2008). There are different academic programme typologies with various specificities and weight/credits for IA courses, which may influence the perception and practice of IA professionals in the community, as

suggested by Morgan et al. (2012). This argument is especially relevant in the case of SEA, given the variety of subjects and methods associated with this tool. In this context it is paramount to understand to what degree SEA is integrated into the academic curricula of undergraduate and graduate programmes.

Therefore, despite significant progress and work developed on SD in higher education, and on IA education, previously mentioned, there is a dearth of research on SEA approaches in higher education, as a part of a whole range of education initiatives to train students in this field and contribute to establishing SD principles and practices, integrating it into strategic instruments. As stressed before, there is a clear need for SEA education and the development of capacity-building of students and professionals working on IA, which may enhance sustainable societies through the development of policies, plans and programmes that take into account SD. As discussed by Lozano et al. (2013) and Mulder et al. (2012), this can be achieved by creating new paradigms with the help of multi-disciplinary and trans-disciplinary research fields.

The main goal of this research was to characterize the profiles of SEA in higher education in two contrasting geographic and socio-economic realities; Portugal and Brazil. To achieve this goal, a content analysis of selected bachelor and master degree programmes was performed, specifically to address the following questions: What is the general level of SEA integration in Portuguese and Brazilian higher education programmes? What is the thematic scope of the programmes that usually cover this subject? How is SEA organized within the programmes: a specific course; intertwined in other environmental/sustainability courses; or as a mandatory or voluntary course?

2. Methods

The education offered at national level was analysed to characterize the profile of SEA in higher education in Portugal and Brazil, comprehending bachelor and master programmes. The selection of these two countries was supported by the following main criteria: (i) cover different education systems; (ii) address distinctive SEA legal and institutional frameworks; (iii) cover different geographic and socio-economic contexts; (iv) cover countries with the same national official language and cultural background, allowing an easier cross-comparison between the documents and data analysed.

Despite different institutional arrangements in each country, similar procedures were adopted when gathering the data from the two national contexts. The raw data collection was conducted in June–July 2012 to Portuguese databases, and in June–July 2013 to Brazilian ones, focussing on courses active at the time. Nevertheless, specific aspects were addressed for the data collection procedures of each country, which will be characterized in the Section 2.1. The research design was built on the previous work by Ramos et al. (2008), and on the methodological approaches of Gazzola (2008), Desha and Hargroves (2010) and Jabbour et al. (2013).

2.1. Document selection and data collection

2.1.1. Portuguese programmes and courses data

The Portuguese HES is in line with the European Union standardised system – the Bologna process (for details of the Bologna process see, for instance, Jha-Thakur (2008)), and the so-called Two-Tiered Study Structures; the Bachelor level ("licenciatura" in Portuguese, BSc, typically 3-year, 180 ECTS[1] graduation programmes), and Master level ("mestrado", MSc, 2-year, 120 ECTS post-graduation programmes). Also, the Portuguese HES has an integrative level, called "mestrado integrado" which combines the BSc and MSc (integrated master: BSc + MSc, 5-year, 300 ECTS programmes).

The search took into account the Portuguese HES and was directed to BSc, MSc and integrated MSc programmes. The main data source for the programme collection was the Internet public-access database of the Portuguese General-Directorate for Higher Education (Direcçao-Geral do Ensino Superior, 2012). The main selection criterion was the presence in the programme title of one of the following expressions: agronomy; environment; architecture; biology; ecology; renewable energy; forestry; geography; land management; landscape; natural resources; and urbanism. The set obtained was considered as the statistical population of the study and all the programmes were included for the analysis. The result was a collection of 101 BSc programmes and 159 MSc or integrated programmes, offered in public Universities and Polytechnic Institutes. All the surveyed population was analysed.

The BSc programmes included: 7 Landscape Architecture; 4 Environmental Science; 17 Environmental Engineering; 7 Geography/Planning; 3 Environmental Management; 20 Biology; 14 Agronomics/Agriculture; 5 Natural Science; 3 Ecology; and 21 other environment-related. The MSc programmes included: 22 Landscape Architecture; 5 Environmental Science; 12 Environmental Engineering; 7 Geography/Planning; 11 Environmental Management; 25 Biology; 12 Agronomics/Agriculture; 3 Natural Science; 12 Ecology; and 50 other environment-related.

The institutional internet sites of each programme were then analysed, and for each programme an inventory was made of courses containing one of the following designations: strategic environmental assessment; environmental impact assessment; sustainability; environmental management; land management; and environmental planning. The inventoried course contents were then analysed for SEA-related topics.

2.1.2. Brazilian programmes and courses data

A search was made of graduation programmes offered in different public institutions, directed to the "bacharelado" modality (BSc, typically 4–5 years). Sampling was made from the database of the Ministry of Education E-MEC System (Ministério da Educação, 2013). Considering only currently active programmes, the search was conducted based on their affinity with EA issues. The result was a collection of 452 graduation programmes: 57 Architecture and Urbanism; 6 Environmental Sciences; 89 Environmental/Sanitary/Water Resources Engineering; 19 Energy Engineering; 50 Agronomics/Agriculture Engineering; 17 Environmental Management; 75 Geography; and 139 Biology/Ecology/Biological Sciences.

In order to obtain a representative sample of the population, the approach proposed by Scheaffer et al. (1996) was conducted. According to the confidence interval for p of finite populations, the sample size n = 203 gives estimates with 90% confidence and margin error about 10% in the most conservative situation.

After this procedure the institutional Internet sites for each selected programme were analysed, and an inventory was made of course designations (Strategic Environmental Assessment, Environmental Impact Assessment, Regional Planning, Environmental Policy, Environmental Management, Environmental Planning) and their specific contents, which were then analysed for SEA-related topics.

2.2. Data analysis

The curriculum documents were analysed through an exploratory content analysis based approach, developed according to the

[1] ECTS is the European Credit Transfer System; 60 ECTS credits are equivalent to one full-time study year.

methodological recommendations of Bardin (1994), Krippendorff (2003) and Neuendorf (2002). The use of a content analysis is justified by the exploratory nature of this research and because this method may be used with qualitative or quantitative data, and permits the use of an inductive or deductive methodology (Elo and Kyngäs, 2008), which allowed, for the purpose of this research, the adoption of a mixed qualitative-quantitative approach. Furthermore, Krippendorff (2003) emphasizes that content analysis allows for replicable and valid inferences from texts.

Despite the existing advantages of applying this method, such as transparency and flexibility (Bryman, 2012), there are also some disadvantages, such as the limits to the inferences drawn and the difficulty of assessing causality, as highlighted by Kondracki et al. (2002), or the quality dependency of the documents analysed (Bryman, 2012), related to their credibility, authenticity, representativeness, and availability. However, as shown by other related work (Karatzoglou, 2013; Barth and Rieckmann, 2012) this approach is appropriate for dealing with the defined research aims.

3. Results and findings

3.1. SEA in Portuguese HEI

Results make clear that IA has a significant presence in higher education programmes in Portuguese HEIs. In all, 63 BSc and MSc programmes include IA as part of the curriculum, representing 24% of the surveyed programmes (Table 1). The presence of IA-related matter is, however, restricted to a few courses, mostly engineering and energy, which are proportionally over-represented in programmes offering IA courses.

Looking at degree level, IA is more frequent in MSc programmes, but also well represented in BSc programmes.

With respect to the SEA component, it is present in 24 out of 66 programmes, but in most cases the fraction of the syllabus dedicated to SEA is rather small (say, one topic out of ten). Also, SEA is sometimes integrated into courses that are not exclusively dedicated to IA, and whose course names does not include any IA related key word, which explains the gap between 63 courses on IA and 66 on SEA.

Results also show that very seldom does SEA appear as an autonomous course. This happens only in 7 cases, 3 being elective courses, and 5 provided by only two universities: Universidade Nova de Lisboa and Universidade Técnica de Lisboa. Most programmes with SEA courses are MSc (Table 2), suggesting that SEA is considered an advanced topic, preferred in more advanced or specialized programmes.

Programmes contemplating SEA are mostly associated with the fields of engineering and energy, followed by geography, planning and urbanism (Table 3). The designations of courses including SEA topics vary widely (Table 4), but the majority are related to IA. The understanding of the different schools about the role of SEA is diverse and often unclear. Even for the institutions that already have a consolidated experience with EIA education, there are no clear indications of the role or relative weight reserved for SEA in the curricula. Often, the syllabus for courses on EIA including a topic on SEA only refers the designation without further detail.

Table 1
Higher education programmes in Portugal with courses on impact assessment.[a]

Programmes with IA courses		Frequency	
		No.	%
Programmes with IA courses	Yes	63	24
	No	197	76
	Total	260	100
Degree of programme with IA courses	BSc	27	43
	MSc	36	57
	Total	63	100

[a] Courses including impact assessment in the title.

Table 2
Higher education programmes in Portugal with autonomous courses or topics on SEA.

Programmes with SEA		Frequency	
		No.	%
Programmes with courses or major topics on SEA	Yes	24	36
	No	42	64
	Total[a]	66	100
Degree of programme with courses on SEA	BSc	7	29
	MSc	17	71
	Total	24	100

[a] This analysis was performed only for programmes that provide detailed course information and which cover the following areas: IA, environmental management, spatial planning, environmental planning and sustainability.

3.2. SEA in Brazilian HEI

The results make clear that IA has a significant presence in higher education programmes in Brazil. In all, 97 graduate programmes include IA courses as part of the curriculum, representing 48% of the programmes surveyed (Table 5). The presence of IA-related matter is mainly restricted to Engineering courses, mostly Environmental Engineering (12 out of 24 courses).

The share of SEA topics is significantly higher in Portugal when compared to Brazil, where the SEA component is only present in 21 out of 97 programmes (Table 6), with just a small fraction of the syllabus dedicated to SEA teaching. However, given the fact that SEA is applied voluntarily in Brazil, it seems promising that 22% of graduate programmes have already included SEA topics in their courses.

SEA appears as an autonomous course in only two programmes (Environmental Sciences at the Universidade de Brasilia, and Environmental Engineering at the Universidade Estadual do Mato Grosso do Sul), one being an elective course. Despite the different structures of graduate programmes in Portugal and Brazil (mainly in terms of the absence of an MSc degree associated to graduate programmes in Brazil), it was verified that SEA is taught mainly in the last two years of the programme, also suggesting that this subject is considered an advanced topic.

Programmes including SEA are mostly associated with the fields of Engineering, followed by Environmental Management and Environmental Sciences. There is a rather small incidence of SEA topics in Geography, Planning and Urbanism, and Biology/Ecology (Table 7). There is some diversity in course designations including SEA topics (Table 8), however with a clear prevalence of EIA courses (12 out of 21 programmes).

Table 3
Fields of higher education programmes that offer courses or topics on SEA in Portugal.

Field of programme	Frequency	
	No.	%
Engineering and energy	10	41.7
Geography, planning and urbanism	6	25.0
Biology and Ecology	3	12.5
Others	5	20.8
Total	24	100

Table 4
Programmes and courses containing SEA in Portugal.

Programme designation	Degree	Course designation
Archaeology and Environment	MSc	Archaeological Heritage – Methods and Techniques for Impact Assessment
Biology	BSc	Environmental Impact
Environmental Citizenship and Participation	MSc	Environmental Management and Systems (elective)
Environmental Science	BSc	Principles of Environmental Impact Assessment
Ecology and Environmental Management	MSc	Environmental Management Systems and Audit (elective)
Marine Ecology	MSc	Environmental Impact (elective)
Renewable Energy, electric conversion and sustainable use	MSc	Environmental Impact Analysis and Studies
Renewable energy and energy efficiency	MSc	Environmental Impact (elective)
Sustainable energy	MSc	Environmental Impact Management and Assessment
Energy and Environmental Engineering	Integrated BSc + MSc	Environmental Impact
Renewable energy Engineering	BSc	Environmental Impact
Environmental Engineering	BSc	Environmental Impact Assessment
Environmental Engineering	Integrated BSc + MSc	Strategic Environmental Assessment (elective)
Environmental Engineering	Integrated BSc + MSc	Environmental Impact Assessment; Strategic Environmental Assessment (branch Territorial Management)
Environmental Engineering	MSc	Environmental Planning; Environmental Impact Assessment (elective)
Territory Engineering	MSc	Strategic Environmental Assessment
Geography	BSc	Environmental Impact Assessment (elective)
Geography and Planning	BSc	Environmental Impact Assessment and Studies
Geography and Regional Planning	BSc	Territory Evaluation and Management
Environmental management	MSc	Strategic Environmental Assessment (elective)
Environmental Management and Policy	MSc	Environmental Assessment
Monitoring of Risk and Environmental Impact	MSc	Strategic Environmental Assessment
Urbanism and Territorial Management	MSc	Strategic Environmental Assessment (elective)
Sustainable Urbanism and Territorial Management	MSc	Strategic Environmental Assessment and Plan Monitoring

4. Discussion and challenges for SEA in higher education

Despite some progress, this is clearly still a young field of study. In 2005–2006, Ramos et al. (2008) found that formal SEA teaching was generally absent from IA higher education in Portugal. At the time the authors called for SEA teaching as a much-needed pathway towards better SEA practice, in line with the recommendations of improving SEA capacity-building and knowledge, as emphasised by Partidario (2011) and White and Noble (2013). Stelmack et al. (2005) also found a lack of specialized courses pertaining to IA in Canada (including SEA, social IA and risk assessment, among others).

The analysis conducted for Portugal and Brazil suggested a similar pattern of SEA teaching at higher education level, despite the identified differences of context, such as the education systems or legal/institutional SEA framework. The research analysis of the two countries also showed a great diversity of course designations and programmes that teach SEA, in line with the previous study on EIA in HEI by Ramos et al. (2008), confirming that SEA education is still at an early stage of development. Gazzola (2008) found a similar diversity for European EA-related Masters programmes, suggesting that there is a possible link between IA or EA practice and education, where the prevailing practices of different countries shape the EA education profile.

SEA is usually only a topic or a small portion of a broader EIA course, and it is the second most frequent type of IA taught. Sánchez and Morrison-Saunders (2010), in their analysis of the results of an international survey on teaching IA, also note that SEA is often taught as one topic integrated into an EIA course. The main survey signs are also convergent with a certain inconsistency or blurred understanding of SEA approaches, with direct implications for its teaching at HEIs, resulting in low consistency of adaptive approaches to integrating SEA into the curricula (Gazzola, 2008; Tetlow and Hanusch, 2012; White and Noble, 2013).

Nevertheless, there are positive signs of an increasing interest in SEA and its presence in different programmes and courses, also identified by Sánchez and Morrison-Saunders (2010), when compared with the previous study on IA education in Portugal (Ramos et al., 2008). At the same time, there is a growing international evidence of SEA importance that has been demonstrated by the publication of transnational reports and guidelines (e.g. UNECE, 2012; European Comission, 2013; UNEP, 2014). These findings could represent an increasing awareness of the need to integrate education on sustainability assessment approaches for strategic levels of decision making, such as policies, legislation, plans or programmes. In addition, the direct and indirect relations of IA, including EIA and SEA, with the market, and associated economic activity development and job creation, can act as the main

Table 5
Higher education programmes in Brazil with courses on impact assessment.

Programmes with IA courses		Frequency	
		No.	%
Programmes with IA courses	Yes	97	48
	No	106	52
	Total	203	100

Table 6
Higher education programmes in Brazil with autonomous courses or topics on SEA.

Programmes with SEA		Frequency	
		No.	%
Programmes with courses or major topics on SEA	Yes	21	22
	No	76	78
	Total	97	100

Table 7
Higher education programmes that offer courses or topics on SEA in Brazil.

Field of programme	Frequency	
	No.	%
Engineering and energy	13	61.9
Environmental Management and Environmental Sciences	4	19.0
Geography, planning and urbanism	2	9.5
Biology and Ecology	2	9.5
Total	21	100

Table 8
Programmes and courses containing SEA in Brazil.

Programme designation	Degree	Course designation
Architecture and Urbanism	B.Sc.	Environmental Planning
Biological Sciences	B.Sc.	Environmental Impact Assessment
Ecology	B.Sc.	Environmental Sustainability
Energy Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Strategic Environmental Assessment – case studies
Environmental Engineering	B.Sc.	Environmental Management
Environmental Engineering	B.Sc.	Environmental Policy Instruments
Environmental Engineering	B.Sc.	Environmental Impact Assessment; Environmental Planning
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Engineering	B.Sc.	Environmental Impact Assessment
Environmental Management	B.Sc.	Environmental Management
Environmental Management	B.Sc.	Environmental Impact Assessment
Environmental Management	B.Sc.	Public Policies and Environment
Environmental Sciences	B.Sc.	Strategic Environmental Assessment
Geography	B.Sc.	Environmental Planning and Management

driver to stimulate HEIs to change their curricula. One of the main goals of SEA education should be training students to have a holistic and strong systemic perspective on sustainability issues, in order to produce *ex ante* evaluations of the foreseen risks and benefits of a given policy or plan, as well as the follow-up and *ex-post* evaluation of those strategic instruments. As concluded for the initiative reported by Bremer and López-Franco (2006), the students should leave SEA courses as empowered 'agents of change', understanding that their actions and practices will have an impact on society, and in particular at the strategic level of the decision-making process.

The process of SEA education should emphasize active, experiential, inquiry-based learning and real decision-making problem evaluation, as broadly discussed by Cortese (2003) for general education processes, suggesting a constructivist approach, as used by Lozano et al. (2015) and Fisk and Ahearn (2006) for the design of sustainable development related courses. Also, Cortese (2003, p19) mentioned "that for long term retention of knowledge, skills, and values, we retain 80 percent of what we do and only 10 to 20 percent of what we hear or read". In this context, SEA education could also have a pedagogical, or even an effective operational role in the governance and management of the HEI. The strategies implemented by education institutions will certainly have relevant positive and negative impacts on sustainability, which could be part of the teaching of SEA using real cases. Also, SEA teaching staff, and students, could contribute to improve the education of HEI decision makers, and raise awareness regarding the need for assessments of university and college strategies, including research and education, campus management, and stakeholder's involvement. The need for a culture of "strategic thinking" and "strategic analysis" in HESD, as explored by Mulder (2014), could be, in some extent empowered by SEA education, as it can provide useful "non-recipe approaches" to think different open pathways for sustainability integration in decision making processes, within and beyond the campus.

As reported by Gazzola (2008), Weiland (2012) and Fischer and Jha-Thakur (2013), IA education is often grounded on the technical aspects, showing the need for improved interconnections between the physical and social sciences to improve and promote the interdisciplinary and systemic learning needed to promote SD. This should be a particular concern for specific technical oriented programmes, e.g. engineering programmes, since SEA should preferably use qualitative approaches for impact predictions and evaluations, as discussed by Fischer (2007). As pointed out by Cech (2014), students with a stronger engagement with public welfare commitments will be more prepared to embrace the sociotechnical complexities and the related social inequalities of a given option or solution. Therefore, to empower future practitioners and produce effective SEAs, higher education, capacity-building and knowledge dissemination must focus not only on technical and scientific know-how, but also on social and communication skills, to ground the evaluation and promote collaborative governance, with planners, evaluators, decision-makers and remaining stakeholders. On the whole, SEA curricular architecture should reflect new sustainability assessment challenges, and be able to respond to societal demands for robust IA results. Future challenges for IA overall could be multi-dimensional, as already discussed in Ramos et al. (2008), and the exploration of salient factors such as how to meta-evaluate SEA performance, or how to include voluntary stakeholders informal assessments to complement the formal SEA (Ramos et al., 2011; Ramos and Caeiro, 2010).

5. Conclusions

The results of this research corroborate findings reported by other authors: IA teaching in higher education is a well-established field, disseminated throughout many programmes, with various designations but often similar content. On the other hand, in most cases SEA is either totally absent, or it is present as a minor topic.

Given the growing support for SEA in the international context, training needs for this type of IA have also been growing commensurately, demanding more and better training from HEIs.

Both in Portugal and Brazil, SEA is being taught in a significant number of programmes, although proportionally it is more prevalent in Portugal than Brazil. This may be related to the fact that, in Portugal, European and national law already demand the execution of a large number of SEAs; a driver as yet absent in Brazil. Taking into account the lack of a professional field bounded by formal requirements to use SEA in Brazil, we could argue that SEA education is even more than a much needed support for best practice, but also a stimulus for the formal introduction of this instrument in decision-making.

In both countries, SEA in higher education is mostly treated as a topic of EIA teaching. This usually entails a superficial analysis of SEA, because both SEA and EIA integrate a wide number of topics relevant for a practitioner or researcher.

Despite the low incidence of SEA courses offered in higher education in Portugal and Brazil, there are signs that this field of study is growing. It is important to ensure that such growth is methodologically sound, and is also flexible enough to incorporate the diversity in geographic, environmental, cultural, economic and institutional contexts where SEA must be applied.

SEA is often an elective course, but taking into account that SEA has just started its journey in HEIs, there is an opportunity to further explore how SEA can support HESD, contributing to a better society, with more sustainable strategies and decision-making processes, and how HESD approaches, concepts or case studies can provide useful insights to improve the SEA education practice.

Further research should seek to follow up on the integration of SEA in Portuguese and Brazilian HEIs and explore other related research areas and approaches. Some of these could include: (i) How the type of programme (e.g. natural and social sciences, or engineering) influences the SEA education approach, i.e. programmes that have a number of specific subjects such as ecology, pollution, social sciences, and planning, *versus* other programmes where these subjects will be partly or totally absent; (ii) What are the minimum skills that students should have to be enrolled in an

SEA course; (iii) How SEA could contribute effectively to improve awareness and competences in sustainability assessment at different decision levels and geographic scales. Educational initiatives for SEA should be ready to exploit rising SEA opportunities and needs, including global decision making impacts, new goals and targets for society and ecosystems, sustainability limit uncertainty, collaborative learning on impact assessment, context tailored approaches, voluntary impact evaluation and monitoring.

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