The International Journal of Management Education 18 (2020) 100360

Contents lists available at ScienceDirect

The International Journal of Management Education

journal homepage: www.elsevier.com/locate/ijme

Morphological box for ESD – landmark for universities implementing education for sustainable development (ESD)

Ralf Isenmann[a,*], Sabine Landwehr-Zloch[b], Sascha Zinn[c]

[a] Wilhelm Büchner Hochschule – Mobile University of Technology (WBH), University of Bremen, Eberswalde University for Sustainable Development (HNEE), Germany

[b] Wilhelm Büchner Hochschule – Mobile University of Technology (WBH), Germany

[c] Munich University for Applied Sciences (MUAS), Center for Innovation in Teaching and Higher Education, ZUG – Fit for the Future, Germany[1]

ARTICLE INFO

Keywords:
Education for sustainable development (ESD)
Morphological box
Responsible management education
Wilhelm büchner hochschule
Mobile university of technology (WBH)
Munich university of applied research (MUAS)

ABSTRACT

Universities have various options to implement higher education for sustainable development (ESD) into curricula and syllabi, and incorporate sustainability into students' daily routine and life on campus. Despite considerable progress they have made in the last years, a comprehensive system for ESD that goes beyond good practice examples is still missing. This gap becomes obvious in surveys applying a systems approach to ESD, describing emerging research areas, mapping opportunities of responsible management education or identifying future trends for ESD.

Seeking to close the gap, the opportunities of how to implement ESD into universities' curricula and syllabi are arranged to a comprehensive system covering all possible options: the so-called "morphological box for ESD". The methodology applied to develop the morphological box for ESD is the morphological approach. The morphological approach provides a powerful heuristic tool for creative problem solving, used to investigate the totality of realizations of multi-dimensional, non-quantifiable phenomena, like ESD implementation. The morphological box for ESD provides more than 70 million opportunities to implement ESD. Universities may use this morphological box for ESD to find out their unique profile and develop proper ways to implement ESD. The morphological box for ESD is the first of its kind.

1. Education for sustainable development: implementing sustainability in teaching and learning

Education for sustainable development (ESD) is key for all stakeholders or interested parties in higher education who want to move forward in terms of sustainability. No matter how universities may structure main fields of actions - like research, teaching, transfer as so-called "third mission", governance, and operation management - ESD undeniably represents the core of implementing sustainability at universities (e.g. netzwerk n; Virtuelle Akademie Nachhaltigkeit n.d.; sneep, Weitblick, & netzwerk, 2018).

ESD is seen as the spearhead of a dynamic global movement (e.g. Haertle, Parkes, Murray, & Hayes, 2017). And there is broad consensus that ESD is needed, at the latest since the United Nations Decade of Education for Sustainable Development (DUK 2011a), the United Nations Global Compact's launch of the Principles for Responsible Management Education (PRME, Parkes et al., 2017) and the United Nations World Action Programme on Education for Sustainable Development (DUK 2013a) at international level. These

* Corresponding author.
E-mail addresses: Ralf.Isenmann@wb-fernstudium.de (R. Isenmann), Sabine.Landwehr-Zloch@wb-fernstudium.de (S. Landwehr-Zloch), sascha.zinn@hm.edu (S. Zinn).

[1] grant number FKZ: 01PL11025.

https://doi.org/10.1016/j.ijme.2019.100360
Received 11 February 2019; Received in revised form 24 October 2019; Accepted 18 November 2019

international efforts are mirrored in Germany in a prominent and highly-ranked manner, e.g. by: (i) the Federal Government's National Sustainable Development Strategy, (ii) the National Action Plan ESD for Germany (Nationale Plattform Bildung für nachhaltige Entwicklung 2017) and (iii) the Declaration of the German Rectors' Conference (HRK 2011), supported by activities of (iv) the German Council for Sustainable Development (RNE 2014) and (v) the Federal Ministry of Education and Research (BMBF), like through a symposium series "Nachhaltigkeit in der Wissenschaft - Sustainability in Sciences (SISI)" in 2013, 2014, 2016 and 2018 (https://www.fona.de/de/nachhaltigkeit-in-der-wissenschaft-sisi-19788.html).

Despite these agenda setting efforts at political, governmental, and higher education system's level and notwithstanding considerable progression universities have made in certain areas to "implement sustainability as the new normal" (Kolb et al., 2017) and establishing ESD (e.g. Sammalisto et al., 2016; Stubbs and Schapper 2011; Velazquez et al., 2006; Capdevila, Bruno, & Jofre, 2002; Desha, Hargroves, & Smith, 2009; Geli & Leal Filho, 2006; netzwerk n; Virtuelle Akademie Nachhaltigkeit n.d.) however, ESD still seems to be in its infancy in the entire higher education system (National Platform Education for Sustainable Development 2017; Mader et al., 2014). For example, the various brochures released by the German Commission for UNESCO (DUK 2011a, b, 2013a, b, 2014) and the good-practice collection "Zukunftsfähige Hochschulen gestalten" (German, equals: "shaping sustainable universities"; netzwerk n; Virtuelle Akademie Nachhaltigkeit n.d.) provide stimulating examples how universities may implement sustainability in teaching and learning, how they could establish ESD in curricula and syllabi, and how they actually could institutionalize these efforts even in a long-term perspective. This is true in Germany or in other countries (e.g. Galea, 2004, 2007; ISCN 2017; Johnstone 2007; Starik et al., 2010).

As valuable and helpful such good-practice examples might be for inspiration, best-design, and implementation of ESD, a number of crucial questions remain unanswered for decision-makers and other stakeholders in universities, among them: How could universities deal with the challenge of ESD in a systematically and strategically planned manner, the opposite way around to a merely short-term and simple "pick-and-mix-procedure", i.e. in an accountable, binding, and written long-term perspective, like in a university development plan with the ministry of education involved, with clear planning horizon and agreed objectives? What formats are available and what is possible to implement ESD, even beyond popular case studies and their supposedly laborious transfer to other universities? Are there any systematic orientation, robust concepts, and methodologically sound instruments available that could be used to build a comprehensive overview for ESD? Given the freedom to implement ESD according to universities' missions, how could they build specific development paths, tailoring their unique ESD profiles?

There are many ways at university level to implement ESD into curricula, courses and syllabi, and further to incorporate sustainability into students' daily routine and life on campus (e.g. Bacon et al., 2011; Geli & Leal Filho, 2006; Grindsted, 2011; Johnstone 2007; Shepard 2007; Starik et al., 2010; Stubbs & Schapper 2011; Wals & Jickling 2002; Zinn & Isenmann 2017). According to experience made and first-hand insights gained in various different universities in the last decade, there are two approaches to implement ESD: One approach is trying to implement ESD by distinct scientific disciplines and certain academic cultures. Another approach is starting to implement ESD through different levels of action (Zinn and Isenmann 2016), as teaching and learning at universities is usually structured in faculties or departments.

Following the first approach, a distinction is made between basic scientific approaches dealing with sustainability issues in teaching and research (e.g. Isenmann and Zollner 2014; Zinn and Isenmann 2017):

- *monodisciplinary* means that sustainability issues are seen from the very specific professional perspective of a single academic discipline, e.g. business administration, natural sciences, computer science or architecture;
- *multidisciplinary* means that sustainability issues are understood as a parallel interplay of different individual academic disciplines still standing side-by-side and rather separately;
- *interdisciplinary* means that sustainability issues are treated also reflecting the paradigms – the usually hidden background assumptions - and certain methodological characteristics of individual disciplines;
- *transdisciplinary* means that sustainability issues are viewed from a broad perspective overcoming the iron-cage of pure scientific academia, also actively involving actors of the so-called "Lebenswelt" (Husserl 1954) and working on socially relevant solutions, perhaps addressing the global agenda of Grand Challenges until 2030, i.e. the Sustainable Development Goals (SDGs, UN 2015).

This "x-disciplinary" distinction between mono-, multi-, inter-, and transdisciplinarity has its roots in the realm of philosophy of science (e.g. Mittelstraß 1992). Following the second approach five basic levels of action could be applied for implementing ESD on which teaching at universities is usually organized (e.g. Zinn and Isenmann 2016):

- *Specific study programs* at faculty and department level include ESD teaching and learning formats for specially defined study programs in the form of individual modules. For example "sustainable technopreneurship" is a module for students in the master study program at MUAS "business entrepreneurship and digital technology management". "Energy efficiency and sustainability" is a module for students in the "energy economics and management" in the bachelor study program at WBH.
- *Faculty and department related opportunities* are focusing on ESD teaching and learning formats all students in a faculty or department could choose. For example "sustainable management" is a course open for all students in the faculty of business administration at MUAS, no matter which certain course of study or specialization students have chosen. "Seminar" is an example for all bachelor students in the faculty of industrial engineering and technology management (IETM) at WBH.
- *Inter-faculty or cross-department* opportunities comprise ESD teaching and learning formats offered by two or more faculties or departments. Such joint formats are equally intended and relevant for students of "neighbouring" faculties or departments. For example "sustainable management" is open for both, students of business administration as well as for students of industrial

engineering at MUAS. “Project work” is a corresponding example implemented in all faculties of WBH.
- *University-wide* courses contain ESD format of teaching and learning open for students of all faculties or departments. Such examples are usually provided by studium generale or studium integrale resp. MUAS is in the comfortable position to have a discrete and peculiar faculty of general and interdisciplinary study. The example “the art of sustainable decision making” represents a corresponding university-wide ESD format.
- *Cross-university* ESD formats describe all efforts of teaching and learning with two or more universities jointly involved. The course of study “industrial ecology” is an example of an ongoing cooperation between MUAS and University of Bremen, offered through the Virtual Academy of Sustainability (www.va-bne.de).

When combining just these two approaches, there is a vast number of opportunities to implement ESD at universities. But there are much more possible options. Perhaps some are not even considered. At the same time, there is a substantial lack of robust concepts and sound methodologies providing guidance and delivering orientation on how universities and other higher education institutions may develop their specific ESD profile. Particularly beyond pick-and-mix-procedures and further to transfer of good-practice examples. This gap becomes obvious in comprehensive studies on ESD (e.g. Littledyke et al., 2013), research maps on ESD (e.g. Adomβent et al., 2014; Storey et al., 2017) and outlooks how the future of ESD might develop (e.g. Leicht et al., 2018). Addressing this gap, specific light is shed to develop a morphological box for ESD. Such a morphological box delivers universities a hands-on tool for implementing ESD, based on a sound methodology. This morphological box for ESD could be used threefold:

- first, to analyze the current state of implementing ESD, i.e. to take stock and provide an update overview where ESD is actually implemented and where not;
- second - based on the analysis above - to fine tune and tailor course development considering ESD on different levels of action, e.g. for faculties and departments;
- third - when taking a “whole-institutional” perspective for the entire university - to develop a unique and coherent university-specific ESD profile.

2. Comprehensive system to implement ESD - morphological box for ESD

A morphological box for ESD provides a comprehensive system covering all possible opportunities implementing ESD. Generally, a morphological box comprises the full range of conceivable characteristics of complex phenomena (e.g. Zwicky 1967, 1969, 1989; Müller-Merbach 1976; Ritchey 2011), here in particular for ESD implementation at universities (for applications of the morphological box e.g. Isenmann and Warkotsch 1999a, 1999b; Isenmann and Lenz 2002, for the complex character of ESD e.g. Landorf et al., 2008).

A morphological box for ESD is proposed as a landmark providing orientation for universities while delivering a hands-on tool for ESD implementation. Its development is explained and its unique benefits are described by examples from MUAS – representing a large public university of applied sciences - and by WBH – representing a private distance and online learning university of applied sciences focused on technology, both located in Germany.

The methodology applied to develop the comprehensive system for ESD is the morphological approach. The morphological approach has its roots in fundamental research methods of systematization and creative problem solving (Ritchey 2018; Arciszewski, 2018; Zwicky 1967, 1969, 1989). The morphological approach offers a powerful heuristic in creative problem solving for so-called wicked problems (Müller-Merbach 1976; Ritchey 2018, 2011). It is particularly applied to investigate the totality of realizations of multi-dimensional, non-quantifiable phenomena. The development of the morphological box is based on a process-related model of negation and construction along three steps:

- Step 1: analysis of the “ESD” construct with identification of appropriate criteria. In total, the criteria are describing the very “nature” of the construct.
- Step 2: collection of characteristics corresponding to criteria (identified in step 1). The characteristics are representing all possible realizations of the criteria.
- Step 3: combination of characteristics (identified in step 2) to certain profiles.

As a result, the morphological box for ESD provides a systematically developed, full-range (German “feldüberdeckend”) overview covering all possible opportunities implementing ESD, in light of relevant criteria and corresponding characteristics (=realizations) previously considered of relevance (Fig. 1).

The morphological box for ESD includes a total of 14 criteria. These 14 criteria and their corresponding characteristics have been identified as relevant. In sum they describe the very nature of the complex ESD construct:

- *level of action* (1) at which ESD formats are provided,
- *type of knowledge* (2) and *competences* (3) targeted by ESD, like technical knowledge (know-how) and orientation knowledge (know-why and know-what-for; e.g. with corresponding personal competence, social competence, leadership competence, methodological competence, technical competence and “Gestaltungskompetenz”),
- degree programs addressed at *bachelor's and master's* level (4),
- *sustainability dimensions* (5) like economy, ecology, society - as a metaphor for the various “pillars” of sustainability,

Causa	Criteria	Characteristics (= realizations)						
Finalis	Operational level	Cross university	University wide	Bridging faculties	Faculty specific	Course of study specific		…
	Type of knowledge	Know-how			Know-why and Know-what-for			…
	Competence	Personal competence	Social competence	Leadership competence	Methodological competence	Professional competence	Gestaltungs-kompetenz	…
		Social competence			Professional competence (skills and knowledge)		Self-reliance	..
	Degree programme	Bachelor	Master		Advanced training / MBA			…
	…							…
Materialis	Sustainability dimension	Economy	Ecology		Society	Combinations		…
	Resources	Materials	Energy	Environ. media: air, water, soil	Finance & Money	Space		…
	Sphere of activity	Living	Labor & employment	Leisure	Traffic	Food		…
	…							…
Formalis	Curriculum integration	Obligatory		Compulsory elective		Elective		…
	Credit system	Without certificate (common course achievement)			With Certificate			…
	Course format	Lecture	Seminar	Game & simluation	Project	Excursion		…
	Course methodology	Problem based learning	Project based learning		Research oriented learning	Just-in-time-teaching-learning		…
	Learning type	Presence	Blended Learning		Online			…
	…							…
Efficiens	Teacher	Docent	Group of docents		Team teaching - simultaneous - alternating			…
	Disciplinarity	Monodisciplinarity	Multidisciplinarity		Interdisciplinarity	Transdisciplinarity		…
	…	…						…

Fig. 1. Morphological box for education for sustainable development (ESD).

- *finite and scarce resources* (6) which need to be managed in a sustainable manner, e.g. renewable and non-renewable energy, materials, information, water, air, soil as so-called "environmental media", money and space,
- *fields of action* (7) in which sustainability-related challenges are obvious and particularly emerge in a near-, mid-, and long-perspective including mobility, housing, construction, transport, and leisure,
- anchoring in *curricula* and *syllabi* (8) like as compulsory, elective or compulsory elective courses,
- *credit system* (9) e.g. whether the course is included as regular course achievement with certain credit points or perhaps it is considered as voluntary additional achievement like a certificate,
- *learning format* (10), such as lecture, exercise, seminar, simulation game and project,
- corresponding *learning methods* (11) like lecture-based learning, problem-based learning, experimental learning, project learning, and research-based learning,
- *media* (12) applied, be it pure presence learning, online and distance learning, or blended learning as a mixture,
- *role and background of teachers* (13) e.g. individual lecturer, group of lecturers, team teaching models, taken by professor, assistant, other academic staff members, and/or partners from business, public authorities and NGOs,
- *disciplinary approach* (14), with its four x-disciplinary characteristics covering mono-, multi-, inter-, and transdisciplinarity.

The total of 14 criteria and their corresponding characteristics is the result of a literature review (Fig. 2). Criteria and characteristics have been identified and then extracted from relevant literature. The literature analysis covers selected academic journals and other publications in the field (e.g. Disterheft, Ferreira da Silva Caeiro, Ramos, & Miranda Azeiteiro, 2012; Grindsted, 2011):

- all 206 of the International Journal of Sustainability in Higher Education (IJSHE) published between 2011 and 2017
- all 149 papers of the International Journal of Management Education (IJME) published between 2012 and 2017, and
- all 28 papers of the IJME special issue 2017 (Parkes et al., 2017) "The Principles for Responsible Management Education (PRME): The first decade - what has been achieved? The next decade - Responsible Management Education's challenge for the Sustainable

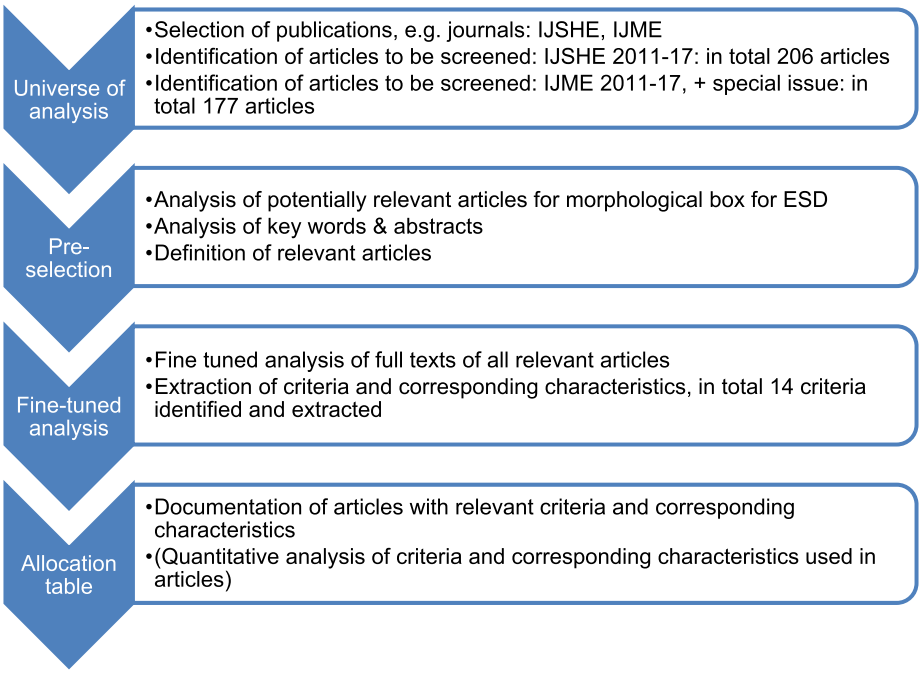

Fig. 2. Procedure applied to identify criteria and corresponding characteristics (adapted from Okoli and Schabram 2010; Denyer & Tranfield, 2009; Borrego, Foster, & Froyd, 2014).

Development Goals (SDGs).

Based on this pool of literature for ESD, relevant criteria and corresponding characteristics have been identified and then extracted (Fig. 3, references right column). Further, the three authors evaluated identified criteria and corresponding characteristics in terms of practical relevance and thus validated them against the background of practical work experience. The authors' practical work experience includes:

- ESD representative of MUAS between 2013 and 2016, responsible for ESD development at any level of action and applying all x-disciplinary approaches;
- expert in education science with focus in ESD, working as distinguished advisor at MUAS in the government-funded project "ZUG - Für die Zukunft gerüstet" (German, "future proof") and in the staff department "innovative teaching" (German, "Innovative Lehre ");
- dean of the faculty of industrial engineering and technology management at WBH, in charge for study course development tasks.

Combining the 14 characteristics purely according to combinatorial analysis, i.e. without substracting any contradictions and conflicting relationships and without further reassessments, there are more than 70 million opportunities to implement ESD at universities (5*2*6*3*4*5*5*3*2*5*4*3*3*4 = 77.760.000). It is important to note that contradictions and conflicting relationships are not necessarily completely irrelevant. On the contrary, these could fuel inspiration to question usually hidden assumptions helping to create particularly new formats for ESD that have not been implemented so far, or even considered.

In order to group the 14 characteristics, a second heuristic is applied, i.e. "four causae" proposed by Aristotle (Müller-Merbach 1995, 210 ff.). Aristotle differentiated between "causa materialis", "causa formalis", "causa efficiens", and "causa finalis" (Lear, 1995). Causa materialis describes what a thing is made of, what it becomes and what it persists in being in the sense of contents or substance. Causa formalis indicates the form and design as such, or the logos of the essence which can be observed. Causa efficiens addresses the origin of the existence of a thing or construct. And causa finalis refers to the underlying purpose, end, or main reason for the existence of something, or for the sake of which something is done. The heuristic of the four causae helps to obtain order in the obvious disorder of negation:

- causa finalis represents goal and purpose of ESD;
- causa materialis represents contents, themes, issues of ESD;
- causa formalis represents form, design, and further layout of ESD;
- causa efficiens represents origin and processes along ESD.

In addition to the new structure provided, the four causae underline the complexity of the ESD construct.

Causa	Criteria	Characteristics (=realizations)						References e.g. IJSHE, IJME
Finalis	Operational level	Cross university	University wide	Bridging faculties	Faculty specific	Course of study specific		Stubbs and Schapper 2011; Savelyeva and Mc Kenna 2011
	Type of knowledge	Know-how			Know-why and Know-what-for			Mittelstraß 1992; Delors 1996; Isenmann 2008; Thompson Klein 2013
	Competence	Personal competence	Social competence	Leadership competence	Methodological competence	Professional competence	Gestaltungs-kompetenz	Haan de 2010; Lozano et al. 2017; Zinn and Isenmann 2018; Wiek et al. 2011; Rieckmann 2012; Zinn 2018
		Social competence			Professional competence (skills and knowledge)		Self-reliance	AK DQR 2012
	Degree programme	Bachelor	Master		Advanced training / MBA			Bootsma and Vermeulen 2011; Jiji et al. 2015; Björnberg et al. 2015
	…							
Materialis	Sustainability dimension	Economy	Ecology		Society	Combinations		Deutscher Bundestag 1998; Kevin et al. 2012; Filho et al. 2015
	Resources	Materials	Energy	Environmental media: air, water, soil	Finance & Money	Space		Deutscher Bundestag 1998; UNESCO 2007a, 2007b; Landrum and Ohsowski 2017
	Sphere of activity	Living	Labor & Employment	Leisure	Traffic	Food		Deutscher Bundestag 1998; Bacon et al. 2011
	…							…
Formalis	Curriculum integration	Obligatory		Compulsory elective		Elective		Stubbs and Schapper 2011;
	Credit system	Without certificate (common course achievement)			With Certificate			
	Course format	Lecture	Seminar	Game & Simluation	Project	Excursion		Stubbs and Schapper 2011; Blizzard et al. 2012; Jiji et al. 2015; Lean et al. 2015
	Course methodology	Problem based learning	Project based learning		Research oriented learning	Just-in-time-teaching-learning		Dobson and Tomkinson 2012; Cörvers et al. 2016; Carriger 2016;
	Learning type	Presence	Blended Learning		Online			Caird et al. 2015; Habron et al. 2012; Benson (2015)
	…							…
Efficiens	Teacher	Docent	Group of docents		Team teaching - simultaneous - alternating			Fredriksson and Persson 2011; Stubbs and Schapper 2011; Caird et al. 2015
	Disciplinarity	Monodisciplinarity	Multidisciplinarity		Interdisciplinarity	Transdisciplinarity		Isenmann and Zollner 2014; Zinn and Isenmann 2017; Clark and Button 2011; Annan-Diab, Molinari 2017
	…	…						…

Fig. 3. Morphological box for education for sustainable development (references right column). (Savelyeva and McKenna, 2011; Delors et al., 1996; Isenmann, 2008; Thompson Klein, 2013; Haan de, 2010; Lozano et al., 2017; Wiek et al., 2011; Rieckmann, 2012; Jiji et al., 2015; Björnberg et al., 2015; Deutscher Bundestag, 1998; Landrum and Ohsowski, 2017; Blizzard et al., 2012; Lean et al., 2015; Dobson and Tomkinson, 2012; Cörvers et al., 2016; Carriger, 2016; Caird et al., 2015; Habron et al., 2012; Benson and Kolsaker, 2015; Irwin, 2013; Fredriksson and Persson, 2011; Clark and Button, 2011; Rasche et al., 2013; Bootsma and vermeulen, 2011)

3. Use and benefits of the morphological box for ESD

The morphological box offers a wide range of applications in the field of ESD. It comprises the identificiation and development of new ESD profiles as well as the communication and evaluation of existing ESD profiles. At the example of two oppositional universities the opportunities and constraints from applying the morph box approach can be figured out.

The first university presented in 3.1 is an old-established state university of applied sciences located in Munich and already profiled in ESD. The second example (3.2) is a younger private university of applied sciences with blended learning approaches and targeting at employed students. This university is currently on its way to identify and develop the right and suitable ESD profile.

3.1. Examples from Munich University of Applied Sciences (MUAS)

3.1.1. Profile of the Munich University of Applied Sciences (MUAS)

With around 18,000 students registered, MUAS is one of the largest universities of applied sciences in Germany. MUAS has 14 faculties, offering 85 bachelor's and master's programmes. The programmes include MINT subjects, business administration, social and health sciences as well as architecture and design. MUAS is located in a leading European economic metropolis, embedded in a unique natural environment. Its size and location offer various excellent opportunities. At the same time however, this outstanding location factor demands institutional responsibility in industrial, economic, ecological and social contexts.

MUAS offers degree courses and active academic collaboration in the MINT subjects (mathematics, computer science, natural sciences and engineering), economics, the social sciences and public health as well as in architecture and design. The MUAS department of general and interdisciplinary studies is unique in providing every student with a cross-disciplinary education and in developing their personal skills. It is especially important for MUAS to nurture graduates' characters: besides well-founded professional skills, students should stand out by thinking and acting in a sustainable, entrepreneurial, and intercultural way. With these additional core qualifications which reach beyond the students' specialist fields, MUAS seeks to prepare them to contribute to society and to approach their careers with foresight, creativity, and a sense of responsibility.

3.1.2. Sustainability at the Munich University of Applied Sciences

MUAS takes care of professional higher education. Further, MUAS also emphasizes students' and thus its graduates' personality development. In that sense, MUAS has elevated "sustainable" - alongside "entrepreneurial" and "international" - to one of three crucial graduate profile characteristics and key educational objectives. This anchor for ESD is not just a further label for smart polishing "sustainability". It actually has been incorporated as a strategic issue, in the MUAS university development plan (HEP 2010) and in the MUAS target agreements with the Bavarian State Ministry for Education and Culture, Science and the Arts (StMBKWK ZV 2014). Regarding the graduate profile characteristic "sustainable", graduates of MUAS do not only distinguish themselves at the labor market through a professional study-specific qualification profile, but also through creative competence for responsibly designing the future (Zinn und Isenmann 2018).

3.1.3. Examples of ESD at Munich University of Applied Sciences

With its 14 faculties, 85 study programmes and roughly 500 professors, ca. 1500 lecturers and academic and administration staff, MUAS stands for cross-disciplinary diversity. As developing solutions of sustainability is closely linked to the ability of cross-disciplinary cooperation, MUAS is systematically developing and implementing teaching and learning formats for ESD along the whole area of x-disciplinary teaching (Zinn and Isenmann 2017).

3.1.3.1. Monodisciplinary approach: course "sustainability management". Integrating sustainability into a disciplinary structured system of faculties with specific teaching and learning elements necessarily leads to reconsider the common "canon of subjects". An unorthodox look with fresh stimuli provides the course "sustainability management" (Fig. 4). The course is offered by the faculty of business administration. On the one hand, students learn that sustainability is an integral part of business administration and management. There is no need at all to "import" sustainability from outside. Rather, sustainability issues are already inside the domain of doing business. They are going hand in hand with entrepreneurial considerations. And they are of relevance for companies' competitiveness, be it driven by market, government or general public and its corresponding stakeholders and issues. On the other hand, students understand that doing business may produce so-called negative external effects like to employees (human), society

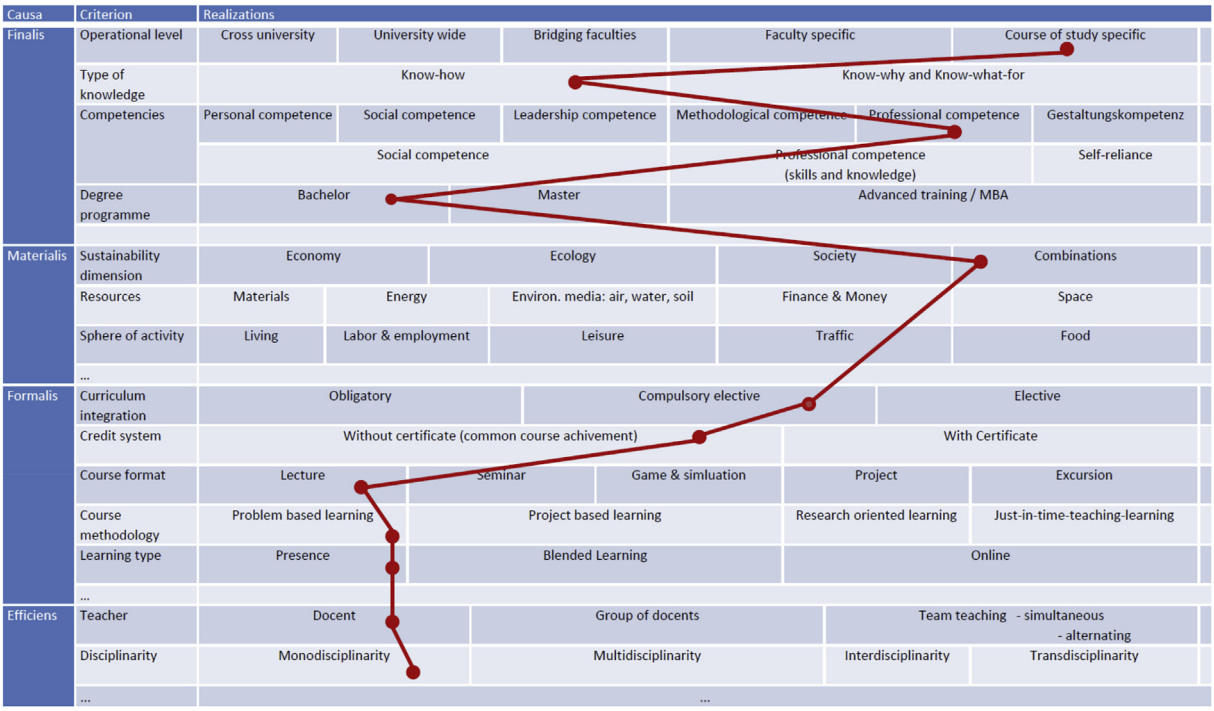

Fig. 4. Morphological box for education for sustainable development with examples of MUAS, based on monodisciplinary approach (continuous line).

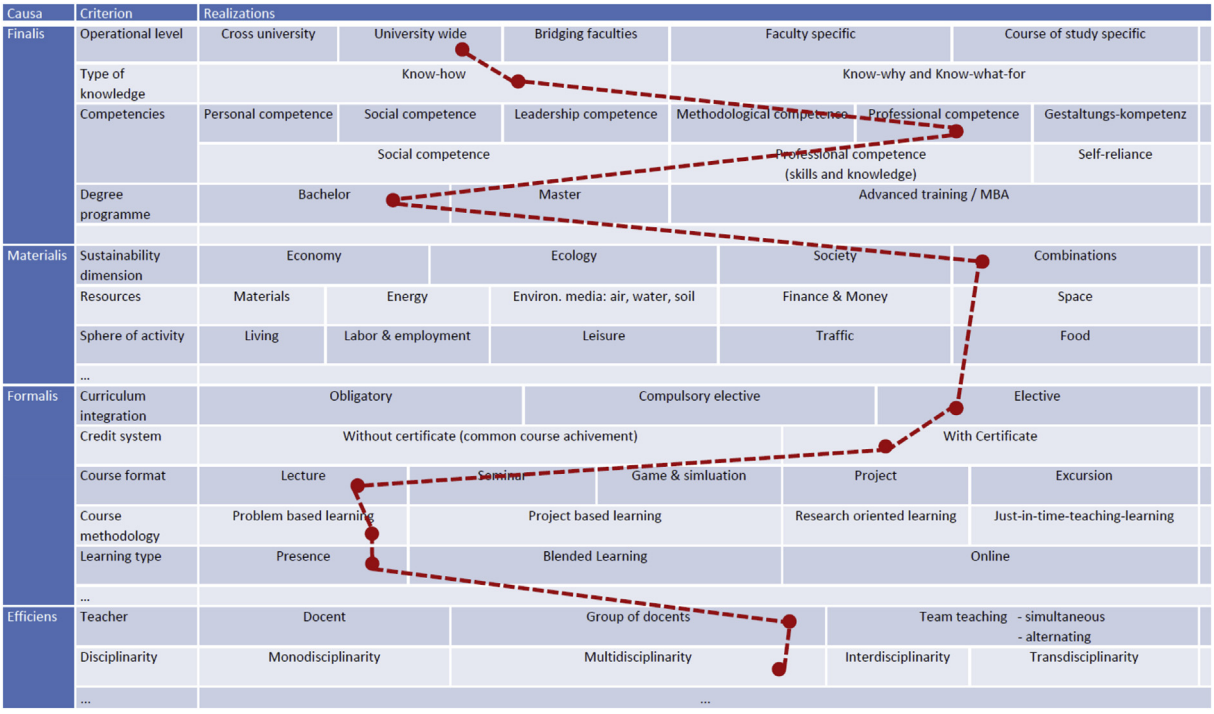

Fig. 5. Morphological box for education for sustainable development with examples of MUAS, based on interdisciplinary approach (dashed line).

(social), and environment (nature), further and along to its positive effects like creating jobs, securing lining, and provision of high-quality products and services. Students learn how these effects could be assessed, evaluated, and managed. As future decision-makers students are enabled to fully integrate sustainability to corporate strategies, processes and products.

3.1.3.2. Multidisciplinary approach: course "lecture series". Multidisciplinary teaching and learning formats correspond with the vertical structure of higher education institutions, mirroring the disciplinary order in faculties or departments. The most prominent example of multidisciplinary ESD at MUAS is the lecture series. In the lecture series subject experts from different backgrounds provide a lecture to an overarching framework topic. Due to different perspectives, all subject experts are sheding specific light to the framework topic. The result is a valuable and broad picture of the framework topic with many facets to be considered.

In order to increase the potential multidisciplinarity might have on the way to inter- and even transdisciplinarity, MUAS considers to launch the preparation of a sustainability report as a multidisciplinary teaching and learning format, open for different study programmes. The basic idea is to rise awareness for sustainable development issues, using the example of MUAS itself, i.e. making sustainability issues tangible. Due to the phenomenon of curricula overload and competition with new topics emerged from business practice like digitalization, it is rather difficult for faculties to adequately and promptly reflect such globally relevant cross-sectional topics like sustainability in module handbooks.

3.1.3.3. Interdisciplinary approach: course "the art of sustainable decision-making". MUAS has a faculty specialized in general and interdisciplinary studies. This faculty offers opportunities to study beyond certain subject area, open for students from all other faculties. The faculty offers a wide range for implementing ESD. An example is the course "the art of sustainable decision-making". In a sense, it is representative to various other ESD teaching and learning formats (Fig. 5).

"The art of sustainable decision-making" aims to foster systemic thinking, closely related towards sustainability. The goal is that students understand "inter-disciplinary" patterns of explanations and academic backgrounds so that they finally can deal appropriate. Along this course, a number of different formats are included, like simulation game, role play, action learning, and dilemma discussions. Such a mixture helps to provoke students. Usual patterns of experience are disrupted which students learned so far in mono- and multidisciplinary approaches. As an intended result, students are actively encouraged to take different perspectives and to acknowledge various views as legitimate and valuable.

3.1.3.4. Transdisciplinary approach: course "ZukunftGestalten@MUAS". Transdisciplinary teaching and learning formats for ESD are currently discussed under the term "Reallabor" (living lab) (NPZ 2014; RNE 2014; Schneidewind 2014). In an orthodox understanding universities take responsibility for sustainable development through research (knowledge production) and teaching (knowledge dissemination). Quite new is the universities' so-called third mission: mutual knowledge transfer with stakeholders outside the university (Schneidewind 2016). Teaching and learning formats applying a transdisciplinary approach are described here

as “flagship courses” on ESD. An example is the course “ZukunftGestalten@MUAS” (Isenmann et al., 2016).

“ZukunftGestalten@MUAS” is open to all MUAS students. On average, more than half of the 14 faculties actively participate in this teaching and learning format. While the cooperation with stakeholders outside MUAS in 2015 exclusively focused the department of urban planning and building regulation of the City of Munich, the number has now increased up to six different partners. Furthermore, the framework theme varies from year to year, sometimes linked to the Science Year proclaimed by the BMBF. In 2015 it was “Future City”, in 2016 it was “Mobility”, in 2017 “Future Energy”, and in 2018 the format closely relates to “Resources” (https://www.hm.edu/allgemein/hochschule_muenchen/nachhaltigkeit_1/lehre_1/zuzukunftgestalten/).

For “ZukunftGestalten@MUAS” it is particular that students work in faculty-mixed teams of five participants. Out of the teams of five participants, students from at least three faculties need to be represented. Each student team is supervised by two teachers. These so-called “coaches” are from different faculties, too. The mix of teachers for supervision intends to promote interdisciplinary cooperation both, between teachers as well as between teachers and students. Further, this tandem of supervision is an element of a team-teaching approach. In total, “ZukunftGestalten@MUAS” thus offers an opportunity to expand the usually disciplinary approach through supervised, guided, and self-experiencing reflection on subject-specific principles of perception and action, linking them to sustainability.

3.2. Examples of Wilhelm Büchner Hochschule | Mobile University of Technology

3.2.1. Profile of Wilhelm Büchner Hochschule | Mobile University of Technology

WBH is the leading private distance and online learning university for technology and technology management in Germany. WBH offers extra-occupational degree programmes at bachelor's and master's level. Hence, students are usually employed. Founded in 1996, WBH now comprises four faculties: (i) computer science, (ii) engineering sciences, (iii) energy, environmental and process technology as well as (iv) industrial engineering and technology management (IETM). Currently, more than 6000 students have registered. The faculty of IETM offers six bachelor's and seven master's degree programmes, all focused at the interface between technology and management & business studies. The following courses of study are examples from the faculty of IETM: (i) industrial engineering, (ii) innovation and technology management, (iii) energy economics and management, and (iv) industrial engineering and energy technology. According to its focus on distance and online learning, all WBH curricula and syllabi include merely a limited number of compulsory courses where students need to attend. Such clear focus for distance and online learning exactly offers flexibility needed for students embedded in business while at the same time developing personal career prospects.

3.2.2. Sustainability at Wilhelm Büchner Hochschule | Mobile University of Technology

Due to its mission as distance and online learning university for employed students, WBH has particular potentials in terms of sustainability, compared to common universities: On the one hand, energy consumption and production of carbon dioxid might be much less, due to the really low proportion students need to attend at the campus (e.g. Little and Cordero 2014; Roy et al., 2008). These potentials are of relevance for environmental performance. On the other hand, the independence from place and time enables “lifelong learning”, especially for those groups for whom attending universities actually would not be feasible or a realistic option. In addition to people with disabilities for example, one might also think of single parent, mothers or fathers resp. with small children, residents of structurally weak regions where a university is far away, just employed persons and - surely no less important - other professionals willing to participate in higher education at academic level, completing their degree courses alongside work at a rhythm that suits them. These potentials are of importance for social performance. It is particularly this unique social participation of certain groups in “lifelong learning” that is usually recognized and thus acknowledged in accreditation and re-accreditation procedures at WBH.

Further to potentials of sustainability specific for this certain type of university, WBH is striving to implement ESD, according to the United Nations decade for ESD and in line with the “Principles for Responsible Management Education”. In order to emphasize its commitment to ESD and to make efforts visible to all stakeholders, in 2018 WBH joined “HOCH-N”, the networking platform dedicated to “sustainability at higher education institutions: develop - network – report” (www.hochn.uni-hamburg.de). HOCH-N is funded by the German Ministry of Education and Research (BMBF). Target groups are entire institutions, single researchers, teachers, administrative staff as well as students. As a new network partner WBH benefits from peer learning, case studies, and good practice examples. Another event dedicated to ESD is the WBH “Wissenschaftsforum 2019” (https://www.wb-fernstudium.de/ueber-uns/forschung/wissenschaftsforum.html). The 2019 conference WBH is hosting explicitly addresses “academic distance and online learning for sustainability”. It is open for experts from various backgrounds, be it from academia or from practice.

The following examples of ESD are already established formats at WBH, they have been implemented, and hence may represent good common practice. They may serve as stimuli for other universities considering how to implement ESD in curricula and syllabi, not necessarily merely for distance and online learning formats.

3.2.3. Examples of ESD at Wilhelm Büchner university

3.2.3.1. Monodisciplinary approach: module “energy efficiency and sustainability”. The compulsory module “energy efficiency and sustainability” is part of the bachelor's programme in energy economics and management (B.Sc.) in the fifth semester. The module provides 6 ECTS (European Credit Transfer System), and it has a corresponding workload of 180 h. Four exercise books and study booklets are used as learning matter. They all deal with particular issues of energy efficiency and sustainability. As in most modules of WBH, teaching and learning is performed online. Therefore a web-based teaching and learning platform is used. Further to exercise books and study booklets in printed media, students have access to a pool of well-trained tutors. The tutors are at students' disposal,

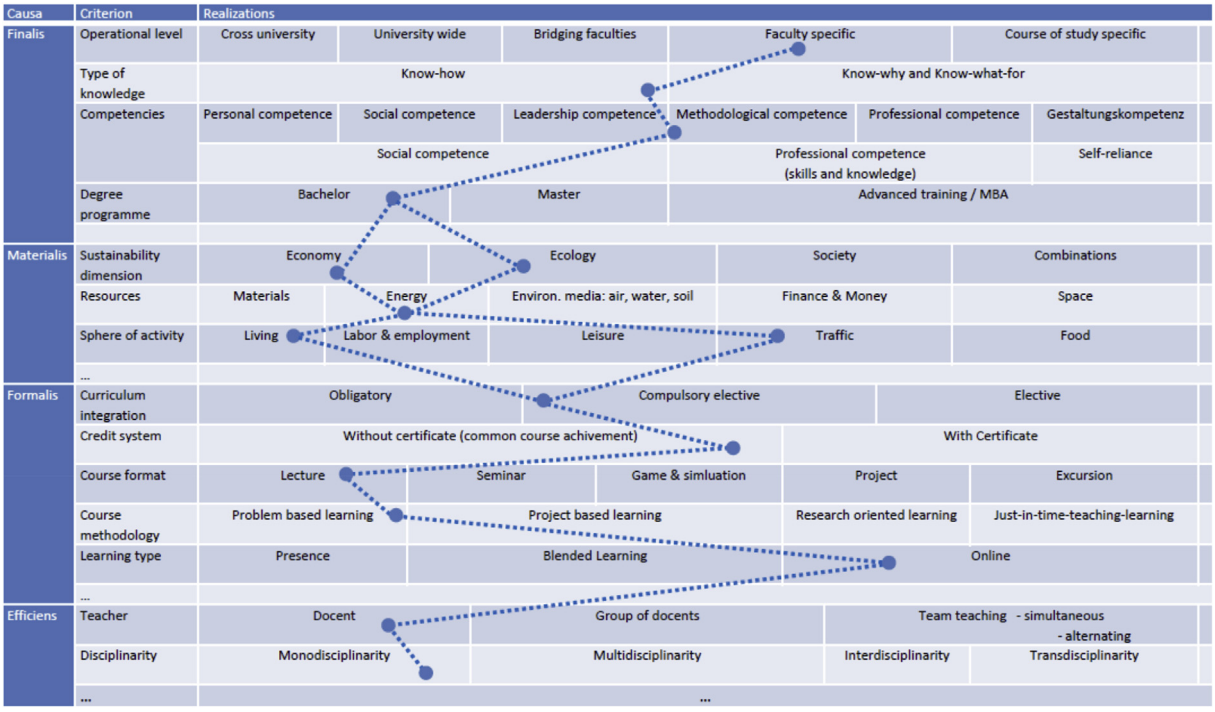

Fig. 6. Morphological box for education for sustainable development with examples of WBH, based on monodisciplinary approach (continuous line).

they provide information, explain phenomena, answer questions, and discuss issues included in exercise books and study booklets and beyond, in a customized and student friendly manner. In terms of developing and improving competences, WBH is applying the "German qualifications framework for lifelong learning" (AK DQR 2011). Accordingly, the module is aimed to primarily broaden and deepen knowledge, here focused to "energy efficiency and sustainability".

Once students have completed the module, they are able to systematically identify and measure energy use in selected applications such as in industry, transport, public sector, or private households. They can evaluate different options to save energy and increase efficiency, and they are then in a position to derive suitable measures to reduce the overall energy consumption. Finally, students have a comprehensive view of drivers influencing energy efficiency along the entire value or process chain resp., from energy generation to certain applications.

3.2.3.2. Multidisciplinary approach: "seminar". All curricula and syllabi of IETM bachelor's programmes include a joint classroom seminar in the fifth semester. The seminar is compulsory. It is an example of the few in-class-lectures where students need to attend. The seminar provides 5 ECTS, and it has a corresponding workload of 150 h. Although the seminar applies a multidisciplinary approach, it remains specific to the faculty IETM. The media applied for teaching and learning in the seminar is characterized as "blended": Along the distance and online part students provide a term paper. The term paper addresses a certain issue within a predefined sustainability framework topic, perhaps from different perspectives that meet students' preferences. The sustainability framework topic could be predefined either by lecturers or by students. Previous seminars are focused e.g. on "increasing energy efficiency in transport", "corporate sustainability management in the energy industry", "Increasing energy efficiency in private housing", or "e-mobility and sustainability". Along the part students need to attend at WBH, they meet physically, e.g. discussing face-to-face. Further, they present highlights of the term papers in the plenum (Fig. 6).

Since all term papers are addressing a common sustainability framework topic, students are able to follow the complexity, and they are able to assess different perspectives from which certain sustainability issues have been carried out. As a further option, keynote speakers e.g. from companies, local administration, standard setting bodies, or non-governmental institutions (NGO) could be involved. Compared to the specific monodisciplinary and thus narrow focus of the module "energy efficiency and sustainability" mentioned above, the seminar offers a much broader view, i.e. approaching ESD by a multidisciplinary approach. The perspectives like industrial engineering, production, energy technology as well as energy economy and management usually stand side by side, but are discussed together in a synopsis, making clear their contribution to the whole picture. Corresponding to the multidisciplinary approach, learning objectives go beyond mere knowledge broadening and deepening. Competences also include the development of instrumental and communicative competences in the sense of "ability". Students completed the seminar are able to apply knowledge to concrete tasks, and they can discuss and defend results in an academic setting.

3.2.3.3. Interdisciplinary approach: "project work". The project work is compulsory for all bachelor's and master's programmes at

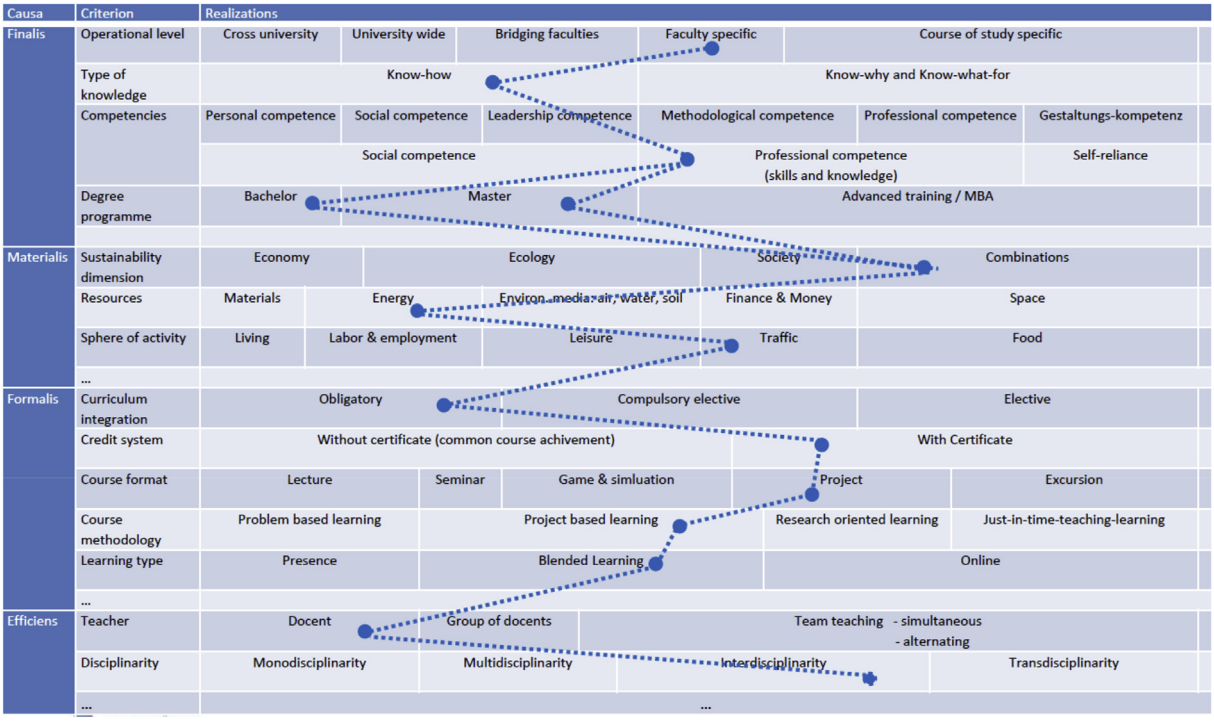

Fig. 7. Morphological box for education for sustainable development with examples of WBH, based on interdisciplinary approach (dashed line).

WBH. It provides 6 resp. 8 ECTS, and it has a corresponding workload of 180 resp. 240 h. It is designed as cross-faculty course of study element. The media applied for teaching and learning along project work is characterized as "blended": At the very beginning students need to attend at WBH for a full one day kick-off meeting. This kick-off meeting is a further example of an in-class-lecture. During the kick-off meeting project teams are formed, and project topics are orchestrated, under supervision of a well-trained lecturer in (virtual) project management. Within a period of three months distance and online learning, students make detailed experience working together in virtual project teams (Fig. 7).

The overall setting along the project work is quite self-organized. A formal requirement is to document project results in a project report standard. Further to the experience of (virtual) project teamwork with labor division, project work, and written exercise, students present main project results to an academic auditorium, including lecturer and other academic WBH representatives. The topics for projects related to sustainability vary. They are broad as students from all four faculties are participating. A current example is dedicated to "intelligent traffic light circuit to reduce CO_2 emissions". In the near future, sustainability issues should explicitly be addressed. All four faculties are encouraged to submit proposals, to make sure that ESDbecomes an integral part in project work. Faculties use such flexibility in making proposals to better link applied research with teaching and learning, in particular in the common research fields like energy, mobility, and housing.

Project work is a core element in the so-called integration part of each curriculum. It primarily serves as a teaching and learning format to develop instrumental, systemic, and communicative competences. During project work students can apply and transfer specialized knowledge in a (virtual) teamwork setting, with clearly defined restrictions in time and limited budget. Students are developing communicative competences while learning to cope with characteristic project situations in a responsible manner, finally identifying proper solutions. Further, students can document progression and results in a straightforward and goal-oriented way.

4. Discussion and limitations

Beyond different principles of disciplinarity for example, universities may consider a number of further criteria illustrating the full range of opportunities to make ESD actually work. Irrespective of organizational structures in faculties and departments, ESD impacts didactics, preferably leading to a competence-based approach (e.g. Zinn 2018). Consequently, in a long-term perspective, ESD might become the norm, no longer the exception (e.g. Kolb et al., 2017).

Today, the window of opportunities for ESD is open: Universities may use the current momentum to provide a clear and convincing profile focused on ESD, in particular when moving beyond the United Nations decade of ESD and applying the Principles for Responsible Management Education (PRME). This is true for common universities as well as for universities specialized in distance and online learning. The latter are trying to exploit their particular potentials in terms of sustainability, e.g. to consume less energy, to reduce carbon dioxid emissions, and - no less important - to provide access to universities and enable long-life academic learning in particular for those who are not able to attend common universities. Finally, it does not matter what certain type of university, be it a

private or public one, may it strive for academic excellence or for applied sciences: despite considerable progression universities have made in the incorporation of ESD in curricula and syllabi in the last years, there is a clear lack of effort in providing an overall comprehensive system for ESD that goes beyond good practice examples, actually illustrating the whole picture of all possible opportunities to implement ESD.

This lack becomes obvious even in current surveys applying a systems approach to ESD, describing emerging research areas, mapping opportunities of responsible management education, or identifying future trends for ESD. Seeking to close this gap, the various opportunities of how to implement ESD into universities' curricula and syllabi are here arranged to a comprehensive system covering all possible opportunities: the so-called "morphological box for ESD". This morphological box provides more than 70 million opportunities to implement ESD at universities.

The morphological box for ESD is the first methodologically sound proposal that delivers a systematic and field-covering overview of how universities could implement ESD. Even if the morphological box for ESD offers a powerful heuristic and even its development is based on a comprehensive and straightforward process model, nevertheless its design depends on a number of selection processes and further assumptions. Hence it is subject to limitations. Such careful reflections are not just standard criteria of academic consideration and in particular part of authors' honesty and transparency. Disclosing and discussing limitations in particular prevent from exorbitant expectations and inadequate generalizations.

A crucial limitation of the morphological box for ESD in terms of generalization lies in the underlying starting point, i.e. in the pool of literature, thatrelevant criteria and corresponding characteristicshave been derived and extracted from. The structure of the morphological box for ESD presented here is the result of a detailed content analysis of more than 383 journal articles. Quality and quantity of the pool of literature - and consequently the identified criteria and extracted corresponding characteristics of the morphological box - determine both, intended comprehensiveness and completeness as a conceptual element on the one hand, and on the other the numerical number of opportunities offered to implement ESD as an element for decision maker in practice. So there might be a certain bias due to the methodology applied, i.e. the morphological approach (e.g. Reunamo & Pipere 2011). In terms of further developments, it might be desirable to expand the pool of literature step-by-step, perhaps to include other eligible journals, finally to consolidate the morphological box for ESD and make it more robust.

5. Conclusions

Powered by the United Nations decade for ESD in the period 2005–2014 (UNESCO 2005) and further pushed by the United Nations global action program on ESD as its follow-up after 2014 (UNESCO 2014), ESD undeniably has become one of the most noticeable issues for universities' development in the last years (e.g. Beynaghi et al., 2016; Leal Filho et al., 2015), even in the context of the United Nations SDGs (UN 2015). While more and more universities are taking up ESD as an integral part of a "whole institution approach" with strategic relevance (e.g. Zinn and Isenmann 2016, 2017), many are still seeking for guidance on how to develop a suitable profile for ESD implementation. This is also the case for business schools and other higher education institutions committed to the PRME.

A decade after the United Nations Global Compact's launch of PRME, the window of opportunities for implementing ESD is now open. Universities may use the momentum applying the morphological box for ESD to find out their unique profile, developing proper ways to implement ESD. There are in particular three corresponding ways to make use of the morphological box for ESD and to exploit its benefits:

- One way is to use the morphological box for ESD to analyze the current state of implementing ESD at a certain level of action like at faculty or department level. Using the morphological box for ESD helps to take stock and to provide an update overview where ESD is actually implemented and where not and further how ESD is actually provided.
- Another way is to use the morphological box for ESD to fine tune and tailor course development related to ESD on different levels of action, e.g. for faculties and departments.
- A furtherway goes beyond the lense of certain faculties and departments. The morphological box for ESD helps taking a "whole-institution" perspective for the entire university and to develop a unique and coherent university-specific ESD profile of a piece.

The morphological box for ESD is the first of its kind. Its development is based on a sound methodology: the so-called "morphological approach". This morphological approach provides a powerful heuristic tool for creative problem solving. Here, it is used to investigate the totality of realizations of ESD implementation. The ESD implementation itself represents a multi-dimensional, non-quantifiable phenomenon.

The morphological box for ESD contributes to fulfilling the SDGs. And it particularly provides a hands-on tool to mapping the various opportunities of ESD implementation for responsible management education (Leal Filho et al. 2019a, 2019b; Storey et al., 2017). For example, it is possible to explicitly introduce the 17 SDGs into the morphological box for ESD, e.g. to further specify contents in terms of sustainability (causa materialis). The SDGs for human, earth or planet, prosperity, peace, and partnership could thus be explicitly addressed, as single items or properly grouped, in their mutual relationships, but also in terms of possible or actual competitive relationships and trade-offs (Annan-Diab & Molinari, 2017; Hauff, Schulz, & Wagner, 2018, pp. 135–148).

References

sneep, Weitblick, & netzwerk, n (2018). Was bildet ihr uns ein? *Positions- und Forderungspapier Nachhaltigkeit und Ethik an Hochschulen. Initiative für Nachhaltigkeit und*

Ethik an Hochschulen(2nd ed.). (Berlin).
Adomßent, M., Fischer, D., Godemann, J., Herzig, C., Otte, I., Rieckmann, M., et al. (2014). Emerging areas in research on higher education for sustainable development - management education, sustainable consumption and perspectives from Central and Eastern Europe. *Journal of Cleaner Production, 61*, 1–7. https://doi.org/10.1016/j.jclepro.2013.09.045.
AK DQR – Arbeitskreis Deutscher Qualifikationsrahmen (2011). *Deutscher Qualifikationsrahmen für lebenslanges Lernen (German qualifications framework for lifelong learning).* (Berlin).
Annan-Diab, F., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the sustainable development goals. *International Journal of Management in Education, 15*, 73–83. https://doi.org/10.1016/j.ijme.2017.03.006.
Arciszewski, T. (2018). Morphological analysis in inventive engineering. *Technological Forecasting and Social Change, 126*, 92–101. https://doi.org/10.1016/j.techfore.2017.10.013.
Bacon, C. M., Mulvaney, D., Ball, T. B., DuPuis, E. M., Gliessman, S. R., Lipschutz, R. D., et al. (2011). The creation of an integrated sustainability curriculum and student praxis projects. *International Journal of Sustainability in Higher Education, 12*, 193–208. https://doi.org/10.1108/14676371111118237.
Benson, V., & Kolsaker, A. (2015). Instructor approaches to blended learning: A tale of two business schools. *International Journal of Management in Education, 13*, 316–325. https://doi.org/10.1016/j.ijme.2015.10.001.
Beynaghi, A., Trencher, G., Moztarzadeh, F., Mozafari, M., Maknoon, R., & Leal Filho, W. (2016). Future sustainability scenarios for universities: Moving beyond the united Nations decade of education for sustainable development. *Journal of Cleaner Production, 112*, 3464–3478. https://doi.org/10.1016/j.jclepro.2015.10.117.
Björnberg, K. E., Skogh, I.-B., & Strömberg, E. (2015). Integrating social sustainability in engineering education at the KTH Royal Institute of Technology. *International Journal of Sustainability in Higher Education, 16*, 639–649. https://doi.org/10.1108/IJSHE-01-2014-0010.
Blizzard, J., Klotz, L., Pradhan, A., & Dukes, M. (2012). Introducing whole-systems design to first year engineering students with case studies. *International Journal of Sustainability in Higher Education, 13*, 177–196. https://doi.org/10.1108/14676371211211854.
Bootsma, M. C., & Vermeulen, W. J. V. (2011). Experiences of environmental professionals in practice. *International Journal of Sustainability in Higher Education, 12*, 163–176. https://doi.org/10.1108/14676371111118219.
Borrego, M., Foster, M. J., & Froyd, J. E. (2014). Systematic literature reviews in engineering education and other developing interdisciplinary fields. *Journal of Engineering Education, 103*, 45–76. https://doi.org/10.1002/jee.20038.
Caird, S., Lane, A., Swithenby, E., Roy, R., & Potter, S. (2015). Design of higher education teaching models and carbon impacts. *International Journal of Sustainability in Higher Education, 16*, 96–111. https://doi.org/10.1108/IJSHE-06-2013-0065.
Capdevila, I., Bruno, J., & Jofre, L. (2002). Curriculum greening and environmental research co-ordination at the technical university of catalonia, Barcelona. *Journal of Cleaner Production, 10*, 25–31. https://doi.org/10.1108/14676370410512580.
Carriger, M. S. (2016). What is the best way to develop new managers? Problem-based learning vs. lecture-based instruction. *International Journal of Management in Education, 14*, 92–101. https://doi.org/10.1016/j.ijme.2016.02.003.
Clark, B., & Button, C. (2011). Sustainability transdisciplinary education model: Interface of arts, science, and community (STEM). *International Journal of Sustainability in Higher Education, 12*, 41–54. https://doi.org/10.1108/14676371111098294.
Görvers, R., Wiek, A., Kraker de, J., Lang, D., & Martens, P. (2016). Problem-based and project-based learning for sustainable development. In H. Heinrichs, P. Martens, G. Michelsen, & A. Wiek (Eds.). *Sustainability science - an introduction* (pp. 349–358). Berlin: Springer.
Delors, J., et al. (1996). *Learning the treasure within.* Paris: Report to UNESCO of the International Commission on Education for the Twenty-first Century. UNESCO.
Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In D. A. Buchanan, & A. Bryman (Eds.). *The Sage handbook of organizational research methods* (pp. 671–689). Thousand Oaks, CA: Sage.
Desha, C. J., Hargroves, K., & Smith, M. H. (2009). Addressing the time lag dilemma in curriculum renewal towards engineering education for sustainable development. *International Journal of Sustainability in Higher Education, 10*, 184–199. https://doi.org/10.1108/14676370910949356.
Deutscher Bundestag (1998). *Final report of the 13th German Bundestag's Enquete Commission on the "Protection of humanity and the Environment: Objectives and general conditions of sustainable development"*Bonn: Economica.
Disterheft, A., Ferreira da Silva Caeiro, S., Ramos, M. S., & Miranda Azeiteiro, U. M. (2012). Environmental Management System (EMS) implementation processes and practices in European higher education institutions - top down versus participatory approaches. *Journal of Cleaner Production, 31*, 80–90. https://doi.org/10.1016/j.jclepro.2012.02.034.
Dobson, H. E., & Tomkinson, C. B. (2012). Creating sustainable development change agents through problem-based learning: Designing appropriate student PBL projects. *International Journal of Sustainability in Higher Education, 13*, 263–278. https://doi.org/10.1108/14676371211242571.
DUK – Deutsche UNESCO-Kommission e.V. (2011). *Hochschulen für eine nachhaltige Entwicklung. Nachhaltigkeit in Forschung, Lehre und Betrieb einer Hochschule.* Bonn: VAS.
DUK – Deutsche UNESCO-Kommission e.V. (2013). *Vorschlag für ein Weltaktionsprogramm „Bildung für nachhaltige Entwicklung" als Folgeaktivität der UN-Dekade „Bildung für nachhaltige Entwicklung" nach 2014*Paris: Vorläufige Arbeitsübersetzung der Deutschen UNESCO-Kommission Version vom 31. Juli 2013, UNESCO-Exekutivrat, Board 192 EX/6.
DUK – Deutsche-UNESCO-Kommission e.V. (2011). *UN-Dekade „Bildung für nachhaltige Entwicklung" 2005-2014. Nationaler Aktionsplan für Deutschland.* Bonn: VAS.
DUK – Deutsche-UNESCO-Kommission e.V. (2013). *Hochschulen für eine nachhaltige Entwicklung. Ideen zur Institutionalisierung und Implementierung.* Bonn: VAS.
DUK – Deutsche-UNESCO-Kommission e.V. (2014). *Hochschulen für eine nachhaltige Entwicklung.* Bonn: VAS: Netzwerke fördern, Bewusstsein verbreiten.
Fredriksson, P., & Persson, M. (2011). Integrating sustainable development into operations management courses. *International Journal of Sustainability in Higher Education, 12*, 236–249. https://doi.org/10.1108/14676371111148027.
Galea, C. (Vol. Ed.), (2004). *From theory to practice: . Vol. 1.* Sheffield: Greenleaf.
Galea, C. (Vol. Ed.), (2007). *cases, simulations and experimental approaches: . Vol. 2.* London, New York: Routledge.
Geli, A., & Leal Filho, W. (2006). Education for sustainability in university studies: Experiences from a project involving European and Latin American universities. *International Journal of Sustainability in Higher Education, 7*, 81–93. https://doi.org/10.1108/14676370610639263.
Grindsted, T. (2011). Sustainable universities - from declarations on sustainability in higher education to national law. *Environmental Economics, 2*, 29–35. https://doi.org/10.2139/ssrn.2697465.
Haan de, G. (2010). The development of ESD-related competencies in supportive institutional frameworks. *International Review Of Education, 56*, 315–328. https://doi.org/10.1007/s11159-010-9157-9.
Habron, G., Goralnik, L., & Thorp, L. (2012). Embracing the learning paradigm to foster systems thinking. *International Journal of Sustainability in Higher Education, 13*, 378–393. https://doi.org/10.1108/14676371211262326.
Haertle, J., Parkes, C., Murray, A., & Hayes, R. (2017). PRME: Building a global movement on responsible management education. *International Journal of Management in Education, 15*, 66–72. https://doi.org/10.1016/j.ijme.2017.05.002.
Hauff, M. von, Schulz, R., & Wagner, R. (2018). *Deutschlands nachhaltigkeitsstrategie.* Konstanz: UVK.
Hochschulentwicklungsplan (HEP) (2010). *Internal strategy paper of Munich.* München: University of Applied Sciences (MUAS).
HRK – Hochschulrektorenkonferenz, & Deutsche UNESCO-Kommission (DUK) (2011). *Hochschulen für eine nachhaltige Entwicklung. Erklärung der Hochschulrektorenkonferenz (HRK) und der Deutsche UNESCO Kommission (DUK) zur Hochschulbildung für nachhaltige Entwicklung – Ein Beitrag zur UN-Dekade „Bildung für nachhaltige Entwicklung" vom 22.01.2010.* (Bonn).
Husserl, E. (1954). *Die Krisis der europäischen Wissenschaften und die transzendentale Phänomenologie. Husserliana Band VI.* Den Haag: Martinus Nijhoff.
Irwin, S. D. B. (2013). Using e-learning for student sustainability literacy: Framework and review. *International Journal of Sustainability in Higher Education, 14*, 338–348. https://doi.org/10.1108/IJSHE-09-2011-0060.
ISCN Secretariat, & Educating for Sustainability (2017). *Sustainable campus best practices from ISCN and GULF Universities.* Boston, MA: International Sustainable Campus Network (ISCN).
Isenmann, R. (2008). Sustainable information society. In M. Quigley (Ed.). *Encyclopedia of information ethics and security* (pp. 622–630). Hershey (PA: IGI Global.

Isenmann, R., & Lenz, C. (2002). Internet use for corporate environmental reporting: Current challenges - technical benefits - practical guidance. *Business Strategy and the Environment, 11*, 181–202. https://doi.org/10.1002/bse.329.

Isenmann, R., & Warkotsch, N. (1999a). Morphologie und Standardisierung betrieblicher Umweltberichterstattung (1. Teil). *Zeitschrift für Angewandte Umweltforschung (ZAU), 12*, 356–367.

Isenmann, R., & Warkotsch, N. (1999b). Morphologie und Standardisierung betrieblicher Umweltberichterstattung (2. Teil). *Zeitschrift für Angewandte Umweltforschung (ZAU), 12*, 542–552.

Isenmann, R., Zinn, S., Kreulich, K., & Peter, A. (2016). ZukunftGestalten@HM - future City. Transdisciplinary approach combining higher education for sustainable development and designing the future of the city of Munich in an urban real lab case. In W. Leal Filho, & L. Brandli (Eds.). *Engaging stakeholders in education for sustainable development at university level* (pp. 317–333). Berlin: Springer.

Isenmann, R., & Zollner, G. (2014). Nachhaltigkeit in der x-disziplinären Lehre. Beispiele zum Einbezug von Nachhaltigkeitsthemen in die Betriebswirtschaftslehre mit Erfahrungen an der Hochschule München. In C. Schier, & E. Schwinger (Eds.). *Interdisziplinarität und Transdisziplinarität als Herausforderung akademischer Bildung. Innovative Konzepte für die Lehre an Hochschulen und Universitäten* (pp. 123–137). (Bielefeld: Transcript).

Jiji, L. M., Irvin, S., Schonfeld, G., & Smith, A. (2015). Capstone interdisciplinary team project: A requirement for the MS in sustainability degree. *International Journal of Sustainability in Higher Education, 16*, 187–199. https://doi.org/10.1108/IJSHE-02-2013-0015.

Johnstone, A. (2007). *Higher education for sustainable development: Final report of international action research project*Paris: The Organization for Economic Co-operation and Development (OECD).

Kolb, M., Fröhlich, L., & Schmidpeter, R. (2017). Implementing sustainability as the new normal: Responsible management education: From a private business school's perspective. *International Journal of Management in Education, 15*, 280–292. https://doi.org/10.1016/j.ijme.2017.03.009.

Landorf, H., Doscher, S., & Rocco, T. (2008). Education for sustainable human development: Towards a definition. *Theory and Research in Education, 6*, 221–236. https://doi.org/10.1177/1477878508091114.

Landrum, N. E., & Ohsowski, B. (2017). Content trends in sustainable business education: An analysis of introductory courses in the USA. *International Journal of Sustainability in Higher Education, 18*, 385–414. https://doi.org/10.1108/IJSHE-07-2016-0135.

Leal Filho, W., et al. (2019a). The role of planning in implementing sustainable development in a higher education context. *Journal of Cleaner Production, 235*, 678–687. https://doi.org/10.1016/j.jclepro.2019.06.322.

Leal Filho, W., et al. (2019b). Sustainable development goals and sustainability teaching at universities: Falling behind or getting ahead of the pack? *Journal of Cleaner Production, 232*, 285–294. https://doi.org/10.1016/j.jclepro.2019.05.309.

Leal Filho, W., Manolas, E., & Pace, P. (2015). The future we want. *International Journal of Sustainability in Higher Education, 16*, 112–129. https://doi.org/10.1108/IJSHE-03-2014-0036.

Lean, J., Moizer, J., & Warren, M. (2015). Editorial: The use and impact of simulations in management education. Special Issue. *International Journal of Management in Education, 13*. https://doi.org/10.1016/j.ijme.2015.11.001 349-349.

Lear, J. (1995). *Aristotle – the desire to understand.* Cambridge: Cambridge University Press.

Little, M., & Cordero, E. (2014). Modeling the relationship between transportation-related carbon dioxide emissions and hybrid-online courses at a large urban university. *International Journal of Sustainability in Higher Education, 15*, 270–279. https://doi.org/10.1108/IJSHE-11-2012-0100.

Littledyke, M., Manolas, E., & Littledyke, R. A. (2013). A systems approach to education for sustainability in higher education. *International Journal of Sustainability in Higher Education, 14*, 367–383. https://doi.org/10.1108/IJSHE-01-2012-0011.

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability, 9*. https://doi.org/10.3390/su9101889 1889-1889.

Mittelstraß, J. (1992). *Leonardo-Welt: Über Wissenschaft, Forschung und Verantwortung.* Frankfurt am Main: Suhrkamp.

Müller-Merbach, H. (1976). The use of morphological techniques for OR-approaches to problems. *Operations research. Vol. 75. Operations research* (pp. 127–139). Amsterdam et al: North-Holland Publishing.

Müller-Merbach, H. (1995). Philosophie-Splitter für das Management. 16 praktische Handreichungen für Führungskräfte. *Bad homburg, DIE*(2nd ed.). .

Nachhaltigkeit in der Wissenschaft - Sustainability in Sciences (SISI) in 2013, 2014, 2016 and 2018. Accessed 25 November 2019 https://www.fona.de/de/nachhaltigkeit-in-der-wissenschaft-sisi-19788.html.

Nationale Plattform Bildung für nachhaltige Entwicklung (2017). *Nationaler Aktionsplan Bildung für nachhaltige Entwicklung*. Frankfurt: Zarbock: Der deutsche Beitrag zum UNESCO-Weltaktionsprogramm.

Netzwerk n (network n); Virtuelle Akademie Nachhaltigkeit (virtual Academy of sustainability) (Eds.): Zukunftsfähige Hochschulen gestalten. Beispiele des Gelingens aus Lehre, Governance, Betrieb und Forschung. Berlin: Oktoberdruck.

NPZ – Nationale Plattform Zukunftsstadt (2014). NPZ-Konferenz–Session 11: Reallabore für Forschung und Umsetzung. Accessed 14 February 2015 http://www.nationale-plattform-zukunftsstadt.de/.

Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research. Sprouts: Working Papers on Information Systems. Accessed 20 May 2019 https://pdfs.semanticscholar.org/31dc/753345d5230e421ea817dd7dcdd352e87ea2.pdf/.

Parkes, C., Buono, A. F., & Howaidy, G. (2017). The principles for responsible management education (PRME): The first decade - what has been achieved? The next decade responsible management Education's challenge for the sustainable development goals (SDGs). *International Journal of Management in Education, 15*, 61–65. https://doi.org/10.1016/j.ijme.2017.05.003.

Rasche, A., Gilbert, D. U., & Schedel, I. (2013). Cross-disciplinary ethics education in MBA programs: Rhetoric or reality? *The Academy of Management Learning and Education, 12*, 71–85. https://doi.org/10.5465/amle.2011.0016A.

Reunamo, J., & Pipere, A. (2011). Doing research on education for sustainable development. *International Journal of Sustainability in Higher Education, 12*, 110–124. https://doi.org/10.1108/14676371111118183.

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures, 44*, 127–135. https://doi.org/10.1016/j.futures.2011.09.005.

Ritchey, T. (2011). *Wicked problems - social messes: Decision support modelling with morphological analysis.* Berlin: Springer.

Ritchey, T. (2018). General morphological analysis as a basic scientific modelling method. *Technological Forecasting and Social Change, 126*, 81–91. https://doi.org/10.1016/j.techfore.2017.05.027.

RNE – Rat für Nachhaltige Entwicklung (2014). Ergebniszusammenfassung der RNE-Bildungskonferenz „Vom Piloten zum Standard: Nachhaltigkeit in Forschung, Lehre und Betrieb implementieren. Accessed 15 March 2015 www.nachhaltigkeitsrat.de/.

Roy, R., Potter, S., & Karen, Y. (2008). Designing low carbon higher education systems: Environmental impacts of campus and distance learning systems. *International Journal of Sustainability in Higher Education, 9*, 116–130. https://doi.org/10.1108/14676370810856279.

Sammalisto, K., Sundström, A., Hartmann von, H., Holm, T., & Yao, Z. (2016). Learning about sustainability – what influences students' self-perceived sustainability actions after undergraduate education? *Sustainability, 8*. https://doi.org/10.3390/su8060510 510-510.

Savelyeva, T., & McKenna, J. R. (2011). Campus sustainability: Emerging curricula models in higher education. *International Journal of Sustainability in Higher Education, 12*, 55–66. https://doi.org/10.1108/14676371111098302.

Schneidewind, U. (2014). Urbane reallabore - ein Blick in die aktuelle forschungswerkstatt. pnd|online III: 1-7. Accessed 20 May 2019 https://epub.wupperinst.org/frontdoor/deliver/index/docId/5706/file/5706_Schneidewind.pdf/.

Schneidewind, U. (2016). Die „Third Mission“ zur „First Mission“ machen? Die Hochschule 01. Accessed 8 May 2018 http://www.hof.uni-halle.de/journal/texte/16_1/Schneidewind.pdf/.

Shepard, K. (2007). Higher education for sustainability: Seeking affective learning outcomes. *International Journal of Sustainability in Higher Education, 9*, 87–98. https://doi.org/10.1108/14676370810842201.

Starik, M., Rands, G., Marcus, A. A., & Clark, T. S. (Vol. Eds.), (2010). *Search of sustainability in management education. The Academy of Management Learning and Education: Vol. 9*, (pp. 377–383). . https://doi.org/10.5465/amle.9.3.zqr377.

StMBKWK, Z. V. (2014). *Zielvereinbarung der Hochschule München mit dem Bayerischen Staatsministerium für Bildung und Kultus, Wissenschaft und Kunst (StMBKWK). Internal document of MUAS to the agreement on objectives of MUAS with the Bavarian State Ministry of Education, Culture, Science and the Arts.* München.

Storey, M., Killian, S., & O'Regan, P. (2017). Responsible management education: Mapping the field in the context of the SDGs. *International Journal of Management in Education, 15*, 93–103. https://doi.org/10.1016/j.ijme.2017.02.009.

Stubbs, W., & Schapper, J. (2011). Two approaches to curriculum development for educating for sustainability and CSR. *International Journal of Sustainability in Higher Education, 12*, 259–268. https://doi.org/10.1108/14676371111148045.

Thompson Klein, J. (2013). Transdisciplinary Moment(um). *Integral Review, 9*, 189–199.

UE4SD, Mader, M., Tilbury, D., Dlouhá, J., Benayas, J., Michelsen, G., et al. (2014). *Mapping opportunities for professional development of university educators in education for sustainable development: A state of the art report across 33 UE4SD partner countries*Cheltenham: University of Gloucestershire.

UN. Sustainable development goals. (2015). https://sustainabledevelopment.un.org/sdgs/ Accessed 18 April 2016.

UNESCO (2005). *United Nations decade of education for sustainable development 2005–2014. International implementation scheme (IIS).* Paris: UNESCO.

UNESCO (2014). *Roadmap for implementing the global action programme on education for sustainable development.* Paris: UNESCO.

UNESCO (2018). Issues and trends in education for sustainable development. In A. Leicht, J. Heiss, & W. J. Byun (Eds.). *United Nations educational, scientific and cultural organization*. Paris: UNESCO.

Velazquez, L., Munguia, N., Platt, A., & Taddei, J. (2006). Sustainable University: What can be the matter? *Journal of Cleaner Production, 14*, 810–819. https://doi.org/10.1016/j.jclepro.2005.12.008.

Wals, A. E. J., & Jickling, B. (2002). Sustainability in higher education: From doublethink and newspeak to critical thinking and meaningful learning. *International Journal of Sustainability in Higher Education, 3*, 221–232. https://doi.org/10.1108/14676370210434688.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science, 6*, 203–218. https://doi.org/10.1007/s11625-011-0132-6.

Zinn, S. (2018). Nachhaltigkeit durch die partizipative Entwicklung von Kompetenzprofilen implementieren. In W. Leal Filho (Ed.). *Nachhaltigkeit in der Lehre. Eine Herausforderung für Hochschulen* (pp. 127–143). Berlin: Springer Spektrum.

Zinn, S., & Isenmann, R. (2016). Munich University of Applied Sciences towards a "whole institution approach" – illustrations along different levels of action to education for sustainable development. In W. Leal Filho (Ed.). *Training approaches and qualifications in, for and about sustainable development in higher education*Berlin: Springer ((accepted)).

Zinn, S., & Isenmann, R. (2017). Munich University of Applied Sciences towards a "whole institution approach" – illustrations along x-disciplinary perspectives to education for sustainable development. In W. Leal Filho, C. Skanavis, A. do Paço, J. Rogers, O. Kuznetzova, & P. Castro (Vol. Eds.), *Handbook of theory and practice of sustainable development in higher education: Vol. 2*, (pp. 215–230). Cham: Springer International Publishing.

Zinn, S., & Isenmann, R. (2018). ZukunftGestalten@MUAS - designing the future at Munich university of applied science (MUAS). In R. Brinkman, & S. Garren (Eds.). *Handbook of sustainability: Case studies and practical solutions* (pp. 771–785). New York: Palgrave Macmillan.

New methods of thought and procedure. In F. Zwicky (Ed.). *Contributions to the symposium on methodologies*Berlin: Springer Pasadena (California), 22nd-24th March 2000.

Zwicky, F. (1969). *Discovery, invention, research - through the morphological approach.* Toronto, Canada: Macmillan.

Zwicky, F. (1989). *Entdecken, Erfinden, Forschen im Morphologischen Weltbild* (2nd ed.). Switzerland: Baeschlin: Glarus.