A Systematic Review of Education for Sustainable Development

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Abstract

Economic questions and procedures have been evaluated with sustainable criteria for some time. Thus sustainability is not only an influence on our economic practices, but also an important factor in the education of economic players. Sustainability as an educational task encompasses a wide range of objectives and issues, which are outlined in the agenda for sustainable development. The central concern of this working paper is the investigation of learning concepts, which want to influence current behavior in the future direction. With the help of a systematic review, learning concepts are tested due to the requirements of the agenda. Discrepancies, congruence and deficits have become clear through frequency and correlation analysis. In particular, there is a research gap in the empirical study of such learning concepts.

Keywords: Education for sustainable development, systematic review, didactics, learning objectives, learning content

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Outline

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1   Introduction

1.1   Motivation

Corporate Social Responsibility, Sustainability Management System, Sustainable Entrepreneurship, Corporate Volunteering are practices that embed sustainable issues at the economic, strategic level of organizations. For this purpose, Sustainability Roadmaps, Eco Efficiency Analysis, Ecosystem Service Valuation, Environmental Footprint Analysis etc. are also available. However, competences of individuals are needed to use the instruments, as well as to conduct the evaluation and interpretation of the results. The basis for these skills is education for sustainable development. Additionally, this is no more and no less an invitation and demand of the state community. Two incomprehensible and partly inherent phenomena are connected: Sustainability defines as a regenerative and generative use of material and immaterial resources, integrating social, ecological and economic objectives. Education defines as a subjective, individual process of development. This link and also problem-solving is constructed under the concept of education for sustainable development [ESD]. Within these, among others, the "Capacity Building and Training" and "Research and Innovation" strategies were launched. In this working paper we follow both strategies and put the contents together. Therefore, we study the education and training concepts of the ESD in the form of didactic analyzes. The results are correspondingly back to the requirements of the ESD. Thus, we are pursuing a pragmatic as well as emancipatory interest: the further development of didactic ESD concepts and their implementation.

We approach this objective through a short terminological view of the ESD as well as the discussion of an analytical framework. In Chapter 2, we present our research process and research results. The data is evaluated separately in general and specific criteria. We consider the requirements of the ESD and its implementation in the concepts.

1.2   Conceptual Framework: ESD

For Goldstein (2012, p. 3), sustainable development represents an ongoing process with systemic approaches that require creativity, flexibility and critical reflection. De Haan and Harenberg (1999, p. 16) define sustainable development as "a collection of positively evaluated conditions and trends across a wide range of environmental, economic and social sectors". Under permanent development, Hauff (1987) describes a growth that allows to respect the limits of environmental resources, preserve the genetic diversity and make optimum use of energy and raw materials. In summary, sustainable development stands for a social model with the aim of improving the economic and social living conditions of individuals without destroying the natural basis of life (De Haan / Herrenberg 1999, p. 16). Education and educational processes play a central role in this future-oriented development (Seitz 2002, p. 1).

> *„Education, including formal education, public awareness-raising and training, is*
> *seen as a process by which people and societies can realize their full potential.*

Education is an indispensable prerequisite for the promotion of sustainable development and the better empowerment of people to deal with environmental and development issues." (Agenda 21 1992, p. 329)[3]

According to Müller (2000, p. 3) the individual in his development is the focus of this process. Education stands for encouragement and accompaniment. Scheunpflug (2006, p. 45) takes an individual look at the functionalities of the learning ability and makes clear that "the learning ability [...] is obviously less of a service for the improvement of society than one's own possibilities of life." This statement implies that ESD is primarily looking for connections to one's own habitat and its effects.

In addition, education is a key component of sustainable development. Due to the large scale of this process, Agenda 21 (1996, p. 329) recommends "reorienting the" Education for Sustainable Development. Thus, ESD deals with economic and social conditions and considers these in its interrelationship with environmental questions. It ensures that "future generations can deal with the processes of globalization, can intervene in a controlling way and can prevent faulty developments or disasters" (Rost 2002, p. 9).

1.3   Analytical Framework: Didactic

We refer to the definition of didactics in which it is called "science of teaching and learning in all forms and at all levels" (Kalfki 1974, p. 60). This contains "systematic as well as occasional teaching and learning, conscious learning and unconscious learning, the "what", that is, the content of teaching and learning, as well as "methods, organizational forms and tools"(Klafki 1974, p. 64 f.). Jongebloed and Twardy (1982) characterize the subject matter of different didactic and curriculum concepts. They point out the four fields of instruction: topics, method, and control, which define the area of the subject. The theme refers to "what is to be taught or learned" (Breßler 2015, p. 12). Thus, they represent the learning content. Methods contain procedures that can be used to intentionally influence the learning of others, the way how to be taught and learned (Schröder 1995, p. 24). The monitoring and evaluation of the learning outcome has a diagnostic function and serves to reveal and evaluate the set-point differences (Nauck 1992, p. 216). Teaching intention is understood as the expression-pedogical intent, which gives every concept of education a meaning and purpose (Breßler 2015, p. 18). "The intentions that are connected with a topic can be formulated as learning objectives" (Gudjons 1993, p. 149). Jongebloed and Twardy (1982) do not explicitly point out learning objectives as the subject area of didactics. At this point, they are shown in addition to the relevance for further work. Learning goals consist of a behavioral part and a content part.

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[3] The United Nations Conference on Environment and Development in Rio de Janeiro drew up Agenda 21 in 1992. Article 36 of the Agenda explicitly mentions the importance of education.

2 Research Process and Results

Furthermore, we analyze the studies and concepts of different authors on the subject of ESD. The data is evaluated by means of a didactic analysis. In addition, the target groups and the learning goal of the respective concepts are determined. This leads to examination questions, which are to be investigated by the empirical analysis (see Table 1). We examine several primary studies and aggregate the findings in order to make general statements (Holzmann 2015, p. 154). Within the subsequent evaluation, the selected data were assigned to the corresponding research category or examination questions. In this already categorized form, the data were evaluated in the third step. We used frequency analyzes, correlation and regression considerations. The subsequent reflection of the results by interpreting the analysis data gathered and categorized in a table served to problematize the research object and to identify research gaps.

Table 1: Examination Question

Examination Question	Didactical Frame
Which actors / groups of actors are addressed in the concepts?	Audience
Which intentions are addressed?	Intention
What specific and general contents are taught in learning situations of the respective ESD?	Theme
Which methods and forms of learning are to convey these contents?	Methodic
Is there are an evaluation of the learning process?	Control
Are the approaches to ESD a conceptualization in the sense of a curriculum?	Conceptualization

The starting point of the collection of data was an online database search. It should be emphasized that a time limitation was made for the years 2012 to 2016. It should also be mentioned that sources should be displayed all over the world. The result was a study sample of 39 relevant contributions from which the respective didactic fields were extracted, for the later data evaluation. However, the collected concepts are first examined with regard to their research methodology.

2.1 Results through Generally Criteria

The research methodology in the investigated concepts is shown in Figure 1. The fewest concepts are based on a quantitative empirical investigation. The following authors include: Resnik (2012); Ali/Sinha (2016); Mbah (2014); Smith/Fitzugh (2013); Hellberg-Rode/Schrüfer (2016); Velasco/Harder (2014); Agut (2013) and Ramzy/Wahieb (2012)
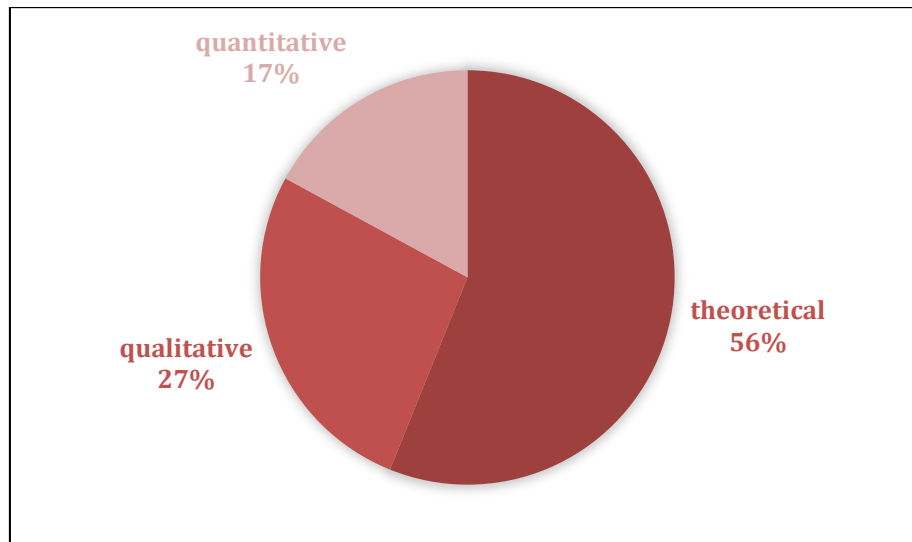
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Figure 1: Research Strategies

We also investigated the keywords of the examined publications (see Figure 2). Of course, the most commonly used term is the term "Education for sustainable development" (189 hits) itself. Also frequently mentioned terms are: Environmental Sciences (51), Geography / Anthropology / Restoration (33), Sustainability (27), Geosciences (16), Higher Education (38), Social Sciences (18) and Curriculum (24).
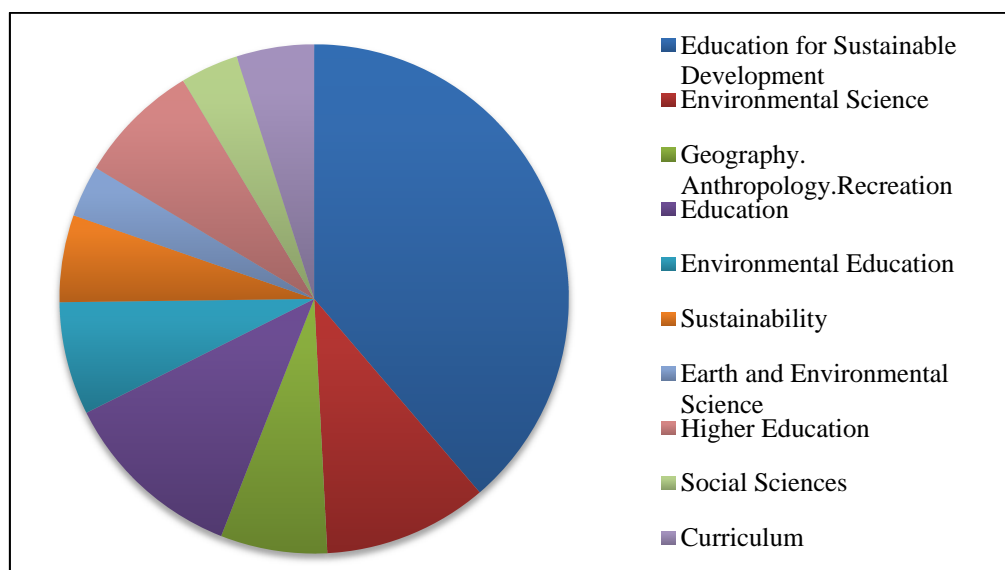

Figure 2: Keywords

So we conclude that ESD allows for many ways of viewing, and thus brings many possibilities for interpretation.

2.2   Research Results through Specific Didactical Criteria

First, we are concerned with the didactic criterion of the thematic. Consequently, we examine what content should be imparted in the ESD concepts. The complexity of the core idea of ESD

suggests a great diversity of topics in the examined concepts. Here, we find supportive evidence (see Figure 3). ESD focuses on concepts such as economics, society, language education, sustainable consumption, fair trade and cultural origin. In most cases, however, the focus is on environmental and scientific aspects of sustainability, such as environmental education, agricultural issues, energy problems or environmental pollution. Less common, but still worth mentioning, are topics of participation, networking and multi-dimensionality. The topics covered are around 25% of the ecological, 20% the social and 14.5% the economic pillar of sustainability.
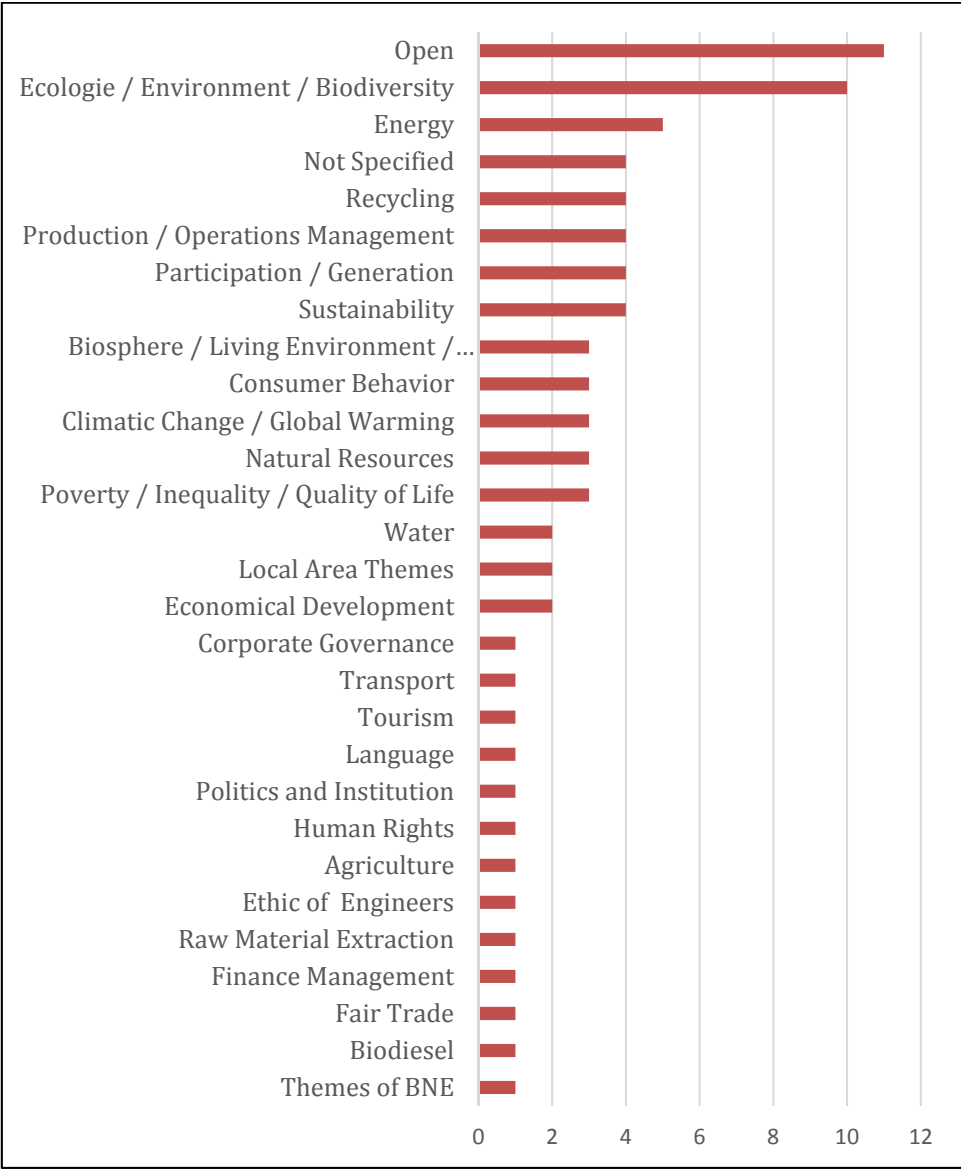

Figure 3: Analysis of the diversity of the ESD

In this section, we present the target groups. The policy requirements for ESN target groups provide for the consideration of the entire education sector. A total of eight different addressee groups can be assigned (see Figure 4).
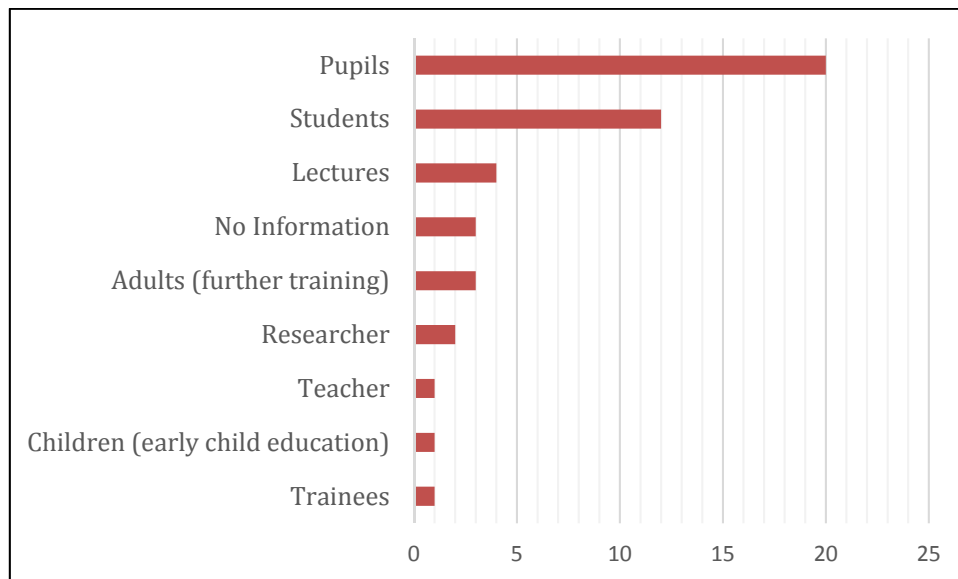

Figure 4: Audience of ESD Concepts

Some concepts address several groups. For example, Zenelaj (2013, p. 229) calls for "education from primary school curricula". The educational understanding of Zygmunt (2016, p. 112) as a "concern of administrators, researchers and educators" is also aimed at several target groups. Three authors only make inaccurate or unclear statements for whom their concept is designed. Students can primarily be identified as an addressee group. The authors localize all age classes and school forms.[4] In the case of university education, it should be noted that almost half of the target group consists of students of the lectureship.[5] The target group of children in the preschool age (early childhood education), trainees, adults and researchers are severely neglected. We found no evidence for adult education. In addition, we conducted correlation analyses to establish a link between the target group and the subject matter and the research methodology. The correlation coefficient for the link between the topic and the target group was 0.10 and between the research methodology and the target group was 0.00.

In the following section, we examine the intentions and learning objectives with ESD. Firstly, the intentions of the studied education concepts are compared. Then, an evaluation of the learning objectives is carried out by a classification into the taxonomy according to Anderson et al. (2001). In principle, there is a consensus that the concepts should bring about a change in the sustainable sense (Zenelaj 2013, p. 229; Sewilam et al. 2014, p. 203; Zygmunt 2016, p. 116). In addition, the acquisition of competences plays a central role. Differences in the concepts usually result from the

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[4] see Resnik (2012), p. 65; Babaci-Wilhite (2013), p. 1994 and Singer-Bodorowski et al. (2014), p.3.
[5] see Hellberg-Rode/Schrüfer (2016), p. 1; Kromp (2016), p. 64; Lindau/Hottenroth/Lindner (2016), p. 138; Krofta et al. (2014), p. 495 and Andersson et al. (2013), p. 5146.

national, regional or local reference. For example, Bakhati (2015, p. 25) intend to identify "local environmental issues" and also Singer-Bodorowski et al. (2014, p. 2) want to promote "local sustainability management and active participation of citizens in local transformation processes". We also found explanations for the fundamental differences between the intentions of the concepts for industrialized countries and for developing countries, which Wulf (2007) already suggested. Central intentions in the sense of ESD for the industries are for example:

- the promotion of "skills in the areas of methodological, social and personnel competence" (Fischer / Freund 2013, p. 15);
- "to create resources that enable collective decision-making" (Lausselet 2013, p. 20) or
- taking a respectful attitude towards others, overcoming prejudices, and also a positive attitude towards heterogeneity (Rauch/Steiner 2013, p. 19).

The intentions of the concepts for emerging and developing countries, such as India or Nigeria, contrast this. Their GNI concepts focus on the protection of human rights, the fight against poverty, on the advance of industrialization and economic growth (Oko-li/Obiajulu/Ella 2013, p. 160ff.; Babaci-Wilhite 2013, p. 2009; 2014, p. 27). The following intentions are addressed in the concepts:

- „produce skilled human resources needed for transformation into national prosperity" (Okoli/Obiajulu/Ella 2013, p. 160)
- „poverty alleviation, increase in productivity and rapid economic growth" (Okoli/Obiajulu/Ella 2013, p. 163)
- „ensure human rights through localizing education in local language and context" (Babaci-Wilhite 2013, p. 2009)
- „reduce unemployment and hence, poverty" (Modebelu 2014, p. 27)

Based on the requirement of Agenda 21 for changes in knowledge and behavior, we arranged the learning targets according to a two-dimensional taxonomy table by Anderson et al. (2001).[6] Accordingly, we carried out frequency analyzes. In this context, we found that primarily procedural and metacognitive knowledge is imparted (see Figure 5). The number of concepts increases with the complexity of cognitive processes. Thus, only two authors, Nwona (2013) and Modebelu (2014), are targeting the behavioral dimension of memory. In comparison to this, ten concepts are intended to evaluate the ability. Accordingly, individuals are to be taught to make judgments based on criteria and standards (Baumgartner 2011, p. 46). This is confirmed by Agenda 21's demand for the analysis and assessment of sustainable development processes. In addition, the design competences were stimulated in some concepts. However, we were unable to make any assumptions about values. This is due, inter alia, to the alignment of our analysis. Accordingly, insights gained in the context of sustainability awareness, attitudes and skills, and thus, ultimately,

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[6] The classification proved to be difficult in some places because nine concepts do not specify learning objectives. The following five concepts have different objectives: Zenelaj (2013), Holzbaur (2012); Krofta et al. (2014), Rauch/Steiner (2013), and Dür (2016). Accordingly, these were classified in several ways.

sustainable behavior in the sense of Breßler (2016) could not be drawn. Furthermore, we examined the correlation between the learning objectives and the target group. We were able to determine a correlation coefficient of 0.12. Accordingly, we do not assume a mutual influence.
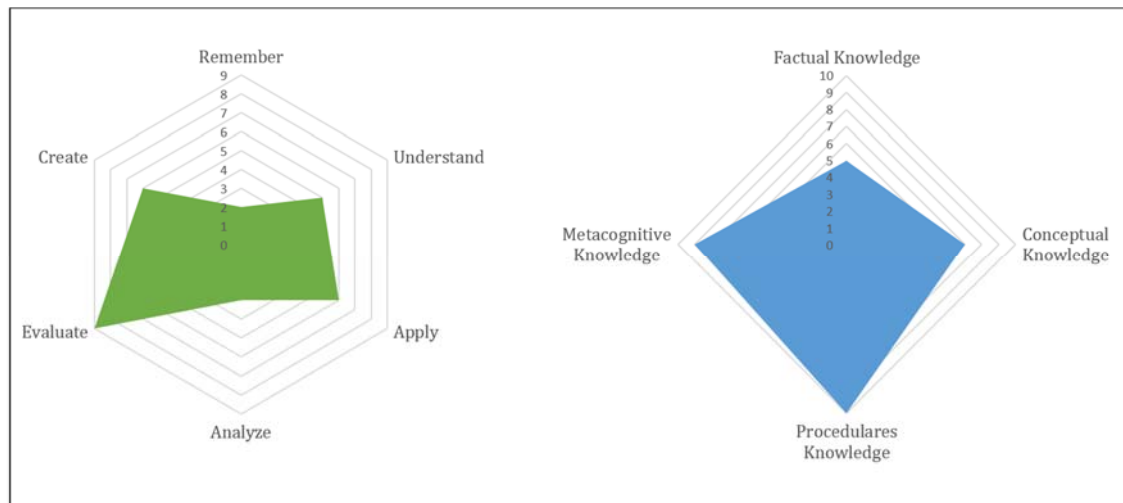

Figure 5: Knowledge and Cognitive Process Dimension of ESD-Concepts

In the following, we examine the imparting methods. We were able to investigate procedures such as the selection of methods or the organization of action and social forms. The concepts are based on a basic canon which calls for "practical training" instead of "theoretical and conceptual analysis" (Zenelaj 2013, p. 323). Furthermore, there are also innovative teaching methods which are intended to change the traditional teaching-learning process (Sewilam et al. 2014; p. 201; Okoli/Obiajulu/Ella 2013, p. 164). The concept of self-organized and project-oriented learning also emerges in the concepts (Michelsen/Rieckmann 2013, p. 120; Fischer 2013, p.4; Singer-Bodorowski et al 2014, p.2). Especially group work, which allows the learners to work and problemoriented work, is a frequently mentioned method in the concepts.[7] In the concept for vocational education and training developed by Heinen/Frenz/Schlick (2014, p. 67), the application of methods also takes place. They propose to recreate concrete action situations in which the interests of all stakeholders have to be worked out under ecological, economic and social aspects. Another action-oriented educational offer was conceived for the university teacher training of Lindau/Hoffenroth/Lindner (2016). Here the participants of a wilderness camp reflect the relationship between man and nature through the linkage of ecological education and the natural experience. The different educational concepts are intended to convey competences, skills or knowledge to a specific target group. Due to the demand within the Agenda 21 for formal and non-formal methods, it was to be expected that the learning methods should be located in the institutional and situational areas. In examining the different concepts according to their methodology, this assumption was supported. In summary, we observed a large repertoire of methods to promote the development of the competencies of the target audience. Through the deliberate design of these concepts,

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[7] see. Bahr (2013), p. 76; Fischer/Nemnich (2012), p. 23; Resnik (2012), p. 70; Pustovalova/Avgusmanova (2016), p. 1; Holzbaur (2012), p. 17: Rauch/Steiner (2013), p. 1; Dür (2016), p. 80 and Agut (2013), p. 10.

whether within or outside an education program, institutional and situational learning situations arise.

We check at this point whether there is a learning control in the concepts. Control as a didactic field provides information on the successful implementation of didactic decisions. Contains a concept, in addition to the didactic fields of the intention, topic and method also the component control, can be derived from a complete curriculum conception. Of 39 analyzed concepts, only 13 indicated how learning control could be designed. This number is problematic for us, as it is possible to improve not only the performance of learners, but also future decision-making. The following authors propose a learning control and therefore offer a complete educational concept for sustainable development: Sewilam et al. (2016), Fischer / Nemnich (2012), Resnik (2012), Pustovalova/Avgusmanova (2016), Ali/Sinha (2016), Holzbaur (2012), Rauch/Steiner (2013), Hellberg-Roder/Schrüfer 2016), Heinen/Frenz/Schlick (2014), Kromp (2016), Dür (2016), Krofta et al. (2014) and Fischer/Freund (2013). Here, we present two selected concepts of the ESD, representing the target groups of pupils and students. These addressees represent the majority of the concepts.

Dür (2016, pp. 80-82) addressed pupils in his concept. He proposes "moderately constructivistically designed learning sessions" (Dür 2016, p. 80), which are intended to encourage the exchange of two schools from different countries via social media in the form of project work. The approach to the topic of sustainability is based on the concept of quality of life. Within the scope of a research project, the pupils were active as researchers and thus designed their learning process in the sense of self-organized learning. The communication platform Facebook has allowed peer-to-peer cooperation across national boundaries. Potential questions and problems could be viewed from "a multi-perspective view" (Dür 2016, p. 89) by "the participatory co-operation of the young people". However, this concept was not only aimed at changing perspectives, the participating pupils also developed competences in the three categories: "Interactive use of media and tools, interviewing in heterogeneous groups, and independent action" (Dür 2016, p. 87). In the project phase, the young people dealt with their own ideas of quality of life in the form of "freewriting". They create videos and questionnaires on the topic of quality of life in smaller groups. By dealing with the perception of one's own environment in comparison to others, the pupils applied complex meta-cognitive knowledge and process dimensioning. "A discussion via Facebook about the results" (Dür 2016, p. 88) reflected the project work. By creating diagrams and interpretations on the part of the pupils, learning control took place. The teachers could use the interpretations to check whether the subject matter was internalized.

The target group of the didactic concept of Holzbaur (2012) was limited to students. He referred to the topics of quality, sustainability, energy and the environment in connection with the method of project work. In addition, students should acquire basic knowledge of research, experimentation and statistical evaluation of science projects. Specific learning objectives were to analyze and carry out surveys to develop concepts. For the methodical approach Holzbaur (2012) suggested

the cooperation with external partners of the praxis. They should encourage the students to actively participate in the project. In addition, this co-operation trained their ability to define goals with customers and project participants. The control of the learning process was preceded by a supervisor, who evaluated the project and gave grades. The results of the project work, in the form of presentations, were also part of the grading.

3   Resümee: Implications for BNE

According to our systematic review, a complete curriculum concept is rarely available for ESD. Most approaches lack control mechanisms. Rather, ESD seems to be an intention and/or a learning goal (see Table 2).

Table 2: Summary of results

Subject Area	Proposition	Finding
Concept of a Curriculum	Presentation of a comprehensive conceptualization with the didactic fields topic, target group, intention, learning objectives, evaluation	partly
Audience/target group	overall	×
Intention	Involvement of local, regional, national actors	×
	Diversity in the concepts for industrializations and developing countries	✓
Learning objective	Change of behavior and knowledge	✓
	Analysis / evaluation and design of sustainable contexts	primarly
	Change of values	outstanding
Methodic	Formal and non-formal	✓

Within the framework of the ESD's demand for application and implication in all areas of education, we were able to identify deficits in the areas of pre-school, vocational training, vocational education and adult education. Most concepts refer to pupil and students. Thus, educational proposals are lacking in professional adult education as well as in early childhood education. Moreover, the intentions of the ESD concepts have local, regional and national links, as requested by Agenda 21. Nevertheless, the actors at these levels are not necessarily involved. It seems as if this is the sole responsibility of the educational organizations. Furthermore, we have found differences in the concepts for industrializations and developmental groups, as was already predicted at Wulf (2007). In the area of learning objectives, we were able to identify the desired changes in knowledge and behavior, as requested by Agenda 21. The behavioral dimensions corresponded in most concepts of expectation to analysis, evaluation and design. Our investigation did not reveal

any results for the imparting of values. The most effective methods of formal and non-formal nature, according to Agenda 21, were also localized in the concepts.

A summary of the previous statements suggests that ESD as a imagination and as a core idea has a instructing character. Consequently, it cannot be fully realized (Wulf 2007, p. 187). However, the breadth of possible addressees and subject areas offers links to the further development of teaching and learning opportunities. ESD is represented not only in school education but also in many areas. This is shown by the 39 investigated examples. However, the manifestation and intentions of the concrete conceptions vary. To be problematized is the commitment in the education practice of vocational education and training. The investigated proposals showed a research gap in this area. A didactic determination of ESD is difficult, but some of the topics and learning objectives are known. These include questions of social, economic and social justice and cultural diversity. Local and regional aspects such as urban development are particularly significant. Interesting for further research would be the review of the application of one of the presented concepts as well as the analysis of practical ESD programs of different target groups.

The educational task of sustainability is, in addition to a call from the community of states, also an intention for a wide range of educational offers. Thereby, the didactic compositions are responsible for the regulatory and normative-functional character of sustainability (Renn et al. 2007).

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