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Are We More Sustainable Yet? Results of a Longitudinal Curriculum Study by Means of Topic-Based Indicators

Sind wir schon nachhaltiger? Eine Längsschnittstudie von BNE-Implementierung in Curricula auf der Grundlage von BNE-Themen-Indikatoren

¿Somos sostenibles? Resultados de un estudio longitudinal del curriculum mediante indicadores temáticos

Péter Bagoly-Simó ✉, **Johanna Hartmann**

Zusammenfassung Die Entwicklung von Indikatoren zur Messung der BNE-Implementierung in die formelle Bildung prägt spätestens seit der UN-Dekade BNE die Debatte um die Erfolge politischer Vorhaben. Dieser Beitrag wendet die vier Indikatoren von Bagoly-Simó (2013a, 2013b, 2014a) auf den 2017 in Kraft getretenen Bayerischen Realschullehrplan, um die Tiefe und Breite der BNE-Implementierung im Zuge der Lehrplanreform zu messen. Die Ergebnisse zeigen neben einer oberflächlichen Implementierung auch eine fortschreitende Spezialisierung auf wenige Fächer. Neben der Geographie und Biologie leisten die technischen Fächer den stärksten Beitrag zu einer BNE. Zwar müssen BNE-Themen einer kontinuierlichen Überpürfung unterzogen werden, dennoch bilden sie einen geeigneten Indokator zur Messung der Verknüpfung von BNE und Fachwissen.

Schlüsselwörter Bildung für nachhaltige Entwicklung (BNE), Indikatoren, Implementierung, Lehrplan/Curriculum, Sekundarstufe I, Geographie

Abstract In the context of ongoing efforts to measure the implementation of ESD into formal education, this paper aims to explore change pattern in implementation during curricular reform. Revisiting Bagoly-Simó's (2013a, 2013b, 2014a) four indicators measuring depth and breadth of implementation, this study analyzed the 2017 Bavarian curriculum for Realschule. The results indicate a persisting trend of specialization and superficial ESD implementation with Geography, Science, and a few vocational subjects showing a more profound implementation. While shifts in ESD discourses require a continuous revision of ESD-topics, they remain of crucial in diagnosing the links between ESD and each school subject's core knowledge.

Keywords Education for Sustainable Development (ESD), indicator, implementation, curriculum, lower secondary education, Geography

Resumen En el contexto de los esfuerzos en curso para medir la implementación de la EDS en la educación formal, este documento tiene como objetivo explorar el patrón de cambio en la implementación durante la reforma curricular. Revisando los cuatro indicadores de Bagoly-Simó (2013a, 2013b, 2014a) que miden la profundidad y la amplitud de la implementación, este estudio analiza el plan de estudios de Baviera de 2017 para la Realschule. Los resultados indican una tendencia persistente a la especialización y a la aplicación superficial de la EDS, mientras que la geografía, la ciencia y algunas asignaturas de formación profesional muestran una aplicación más profunda. Aunque los cambios en los discursos de la EDS requieren una revisión continua de los temas de la EDS, siguen siendo cruciales para diagnosticar los vínculos entre la EDS y los conocimientos básicos de cada asignatura escolar.

Palabras clave Educación para el Desarrollo Sostenible (EDS), indicador, aplicación, plan de estudios, primer ciclo de secundaria, geografía

1. Introduction

For almost three decades, shaping a more sustainable future has been continuously on the agenda of governments, schools, communities, and individuals. Both the United Nations (UN) Decade of Education for Sustainable Development (DESD, 2005-2014) and the subsequent World Action Program (2015-2019) and ESD for 2030 aimed to stress the role of education and increase its contribution to achieving sustainable development's goals. Naturally, these initiatives required the development of suitable indicators to measure their achievements. However, most indicators measuring the implementation of Education for Sustainable Development (ESD) into formal education remained eclectic, generic, and rooted in the national curricular and ESD discourses of their origin (for a detailed discussion of this matter see Bagoly-Simó 2013a, 2014a). Studies exploring whole curricula, adopting an (international) comparative perspective, or connecting ESD to specific topics continue to remain an exception (Bagoly-Simó 2013a, 2014a). Therefore, the aim of this paper is to explore how ESD implementation changed in time by contrasting the results obtained through Bagoly-Simó's (2013a, 2014a) four indicators for the 2001 and the reformed 2017 Bavarian curriculum for lower secondary education. The revised 2017 curriculum is particularly interesting as it entails ESD as mandatory cross-curricular objective. Consequently, this paper first turns to a multidisciplinary theoretical framework to subsequently explore the sample and research methods, and present the results. The subsequent section turns to the results' discussion, followed by concluding thoughts.

2. Theoretical Framework

Exploring, constructing, and evaluating indicators aimed to measure the ESD implementation into formal education requires, on the one hand, the conceptualization of sustainable development and ESD. On the other hand, indicator development for ESD in formal education constitutes the grounds to evaluate topic-based approaches. Therefore, this section first turns to the concept of sustainable development underlying this study. Subsequently, it proceeds to conceptualize ESD. Finally, the theoretical framework concludes by exploring indicator development for ESD.

2.1 Sustainable Development

While sustainable development is hardly a novel concept, the 1987 Brundtland Report moved it at the forefront of academic, political, and broader social discourse. Subsequently, sustainable development underwent multiple (re)conceptualizations with Dobson (1996) counting over 300 definitions as early as four years after the 1992 Earth Summit in Rio de Janeiro. Despite their prolific conceptualization history, understandings of sustainable development generally revolve around two main models (Bagoly-Simó 2013b). On the one hand, definitions conserve the core outline in the Brundtland Report and focus on sustainable development in terms of generational equity and justice. On the other hand, sustainable development often appears as divided in an arbitrary number of poles, pillars, or components (i.e., ecologic, economic, social, cultural, and political).

This paper rests on Tremmel's (2003) analytical model that connects three poles of sustainable development, namely ecological, financial, and social sustainability, with matters of equity and justice both in intragenerational or global and intergenerational terms (Fig. 1). As previously outlined (Bagoly-Simó 2013a, 2013b, 2014a), the two main reasons for choosing Tremmel's (2003) analytical model were its meta-analytical character covering multiple disciplinary and linguistic traditions and its concurrent focus on both dimensions covering sustainable development's subfields as well as equity and justice matters connected to sustainable development.

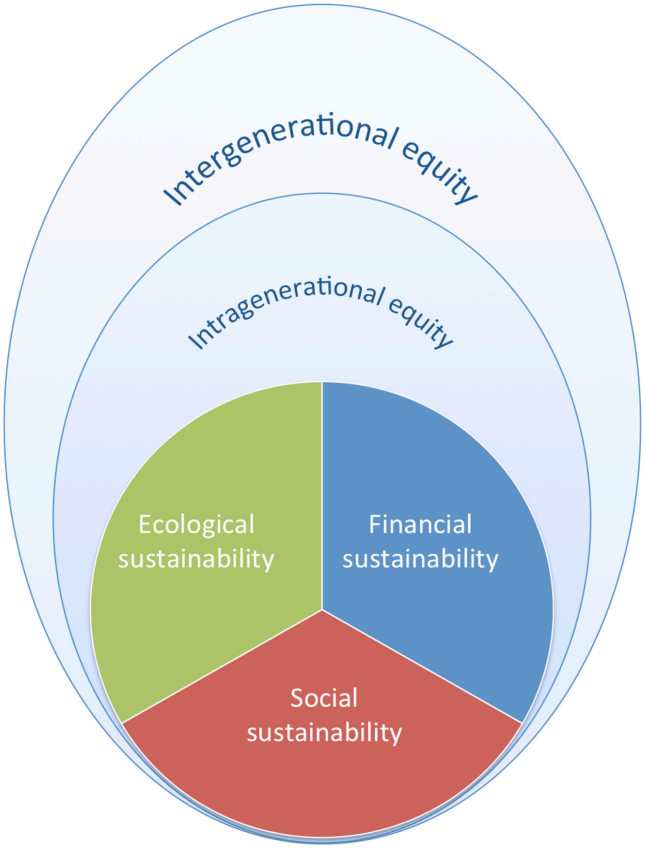


Fig. 1. Tremmel's (2003) analytical model of sustainable development (Source: Bagoly-Simó 2014a, p. 223)

2.2 Education for Sustainable Development

Similar to the concept of sustainable development, over the years, a variety of ESD conceptualizations emerged both from disciplinary and multidisciplinary contexts. While intension and extension of ESD remains at the heart of multiple conceptualizations, definitory practices also juxtaposed it to other adjectival educations, such as Environmental or Sustainability Education (cf. Bagoly-Simó 2013a, 2013b, 2014a). However, as Jucker (2011, p. 45) argues, „[i]t is not fertile to discuss whether ESD should be ESC (education for sustainable consumption) or ECC (education for climate change) or if we should stick with EE (environmental education) or EGC (education for global citizenship). All of these are sectoral, subject-specific and reductionist approaches which miss the whole point of ESD".

The concept of Gestaltungskompetenz coined by de Haan (2008) constitutes the fundament of this paper's ESD conceptualization. While subscribed to a constructivist and skill-oriented paradigm, Gestaltungskompetenz with its twelve skills continues to stand alone as the most specific competence model to be achieved through ESD.

2.3 Indicators Measuring ESD Implementation

Following the increased interest in matters of sustainable development in the aftermath of the 1992 Earth Summit in Rio de Janeiro, the United Nations (UN) emphasized the importance of education for shaping a more sustainable future by announcing the Decade of Education for Sustainable Development (DESD, 2005-2014). While targeting all forms of education, mandatory formal education constituted DESD's central pillar as it "[...] recognise[d] the importance of teaching ESD and [sought] to influence governments [...] to revise the curricula in all learning spheres" (Mulà & Tilbury 2009, p. 90). Thereby, curricula play an essential role: "Given that so many nations, provinces, states and school districts have mandated curriculum, it is important to analyse existing curriculum to see how it includes or neglects knowledge, principles, issues, skills, values, etc. related to sustainable development. Such an analysis could form a basis for curriculum revisions" (McKeown 2007, p. 94).

Indeed, the United Nations Educational, Scientific and Cultural Organization (UNESCO) prioritized curricular research, in Paden and

Chhokar's (2007) reading, to facilitate the implementation of the sustainable development concept along with ESD. Mid-DESD reports (Wals 2009, pp. 198-199) concluded that "ESD is mainly integrated in national educational policies and curricula, especially in primary and secondary education". However, "[...] ESD may be interpreted in many different ways, reflecting a country's particular tradition in governance or by other challenges faced by a country or region. For example, a country might adopt a more pedagogical orientation towards ESD, emphasising (social) learning, participation and capacity building or a more instrumental one emphasising changing people's behaviour".

Stakeholders offered different perspectives on aims, ways, and finality of ESD implementation into formal education. In Jucker's (2011, p. 43) reading, "[...] successful learning only takes place in everyday practice (i.e., through living in the territory or real world) […] [where] [...] real people [are] engaging together and supporting each other in change processes". Similarly, McKeown and Hopkins (2007, p. 22) emphasized that "[...] sustainability is lived as well as taught. The buildings and the policies model sustainability, which is a powerful reinforcement of concepts taught in the classroom". Nevertheless, achieving this objective requires a whole-institution approach replacing an understanding of ESD "[...] envisioned solely as a discipline or a sum of several disciplines". As myriad perspectives on ESD implementation emerged, the academic community called for systematic and comprehensive studies on ESD implementation in formal education and beyond (cf. Sollart 2005; Reid et al. 2006; Paden & Chhokar 2007; Hak et al. 2007; Tilbury 2007; McKeown 2007; Wals 2009; Cruz López 2011).

Apart from systematic and comprehensive studies on ESD implementation, Selby and Kagawa (2010) also called for critical studies. Following a review of previously published work (Roorda 2004; Rode 2006; Tilbury et al. 2007; Tilbury & Janousek 2007; Jickling & Wals 2008; Stibbe 2009), the authors concluded that "[...] most proponents of ESD seem to have found a space where they feel they can more or less shrug off the need for deep critical reflection. In this untroubled state, there has been a preoccupation with the instrumental and pragmatic task of embedding ESD in institutions and systems through developing and establishing benchmarks, indicators and checklists; devising skills taxonomies; refining auditing and monitoring tools; drawing up performance league tables; and other potential mechanisms for targeting, standardisation, measurement and control" (Selby & Kagawa 2010, pp. 39-40).

While critical perspectives remained the exception (e.g., Hamborg 2017), with the progress of the Decade, indicator development to measure its success became a central aim. Endeavors targeting the construction of (new) indicators followed up previous work (cf. OECD 2003; Reid et al. 2006; Hak et al. 2007; UNESCO 2009) and aimed for indicators that were able to both diagnose the functionality of systems and offer insights into hidden and invisible processes and structures inherent to them (cf. UNECE 2005a, 2005b). Podger et al. (2010, p. 299) characterized this process as a quest to measure "[...] the goals of humanity's efforts for sustainability, which include wellbeing, quality of life and happiness" (cf. Meadows 1998; European Union 2007; Stiglitz et al. 2009; OECD 2009) rather than individually measuring one or more of its artificially constructed dimensions (e.g., ecological, economic, or social elements).

However, developing indicators for ESD implementation was far from a global effort. As Cruz López (2011, p. 168) established, regional differences and interests colored the finality of indicator development heterogeneous: "[While] European representatives considered the importance of defining indicators (qualitative and quantitative) to assess integration of ESD", the "[...] Latin American and Caribbean participants discussed introduction of sustainability issues in the transversal curricula, institutional diversity and a diagnostic to contextualise the change of paradigm about ESD in the region from reductionism to holism". As a result, DESD's initiatives produced indicators mainly focused on arbitrarily selected subjects of national curricula (UNECE 2008; Michelsen et al. 2011; Adomssent et al. 2012) keeping international comparative perspectives (Rieckmann 2010) or exhaustive analyses of national curricula (Bagoly-Simó 2013a, 2013b, 2014a) an exception.

Nevertheless, DESD's initiatives also contributed to an increased awareness of the role of certain ESD-topics (Jucker 2011), such as pollution, poverty, consumption, biodiversity

loss, or energy. Bagoly-Simó (2013a, 2014a) argued that ESD implementation requires a topic-based approach that links sustainable development to each subject's core knowledge. In his work, four indicators served to explore the ESD-topic-based depth (number of segments per subject and number of topics per subject) and breadth (number of segments per topic and number of subjects per topic) of ESD implementation in the Bavarian, Romanian, and Mexican lower secondary curriculum.

The World Action Program (2015-2019) continued with DESD's tradition and followed the objective to even better implement ESD into all forms of education. Naturally, ESD indicators continued to enjoy a central role. Also, as Cruz López (2011) already described for the DESD, regional differences continued to shape indicator construction. For example, Austria, Germany, and Switzerland continued with the tradition of their jointly developed ESD reporting framework (Di Giulio et al. 2011), which, concerning formal education, relied on Michelsen an colleagues' (2011) indicators. Germany's National Action Program (NAP 2017) outlined a multitude of measures, some of which focused on curricula when exploring ESD implementation into formal education. Nevertheless, measuring ESD implementation was also extended to teacher continuous education (cf. Waltner et al. 2017; Waltner et al. 2018) and initial teacher education (Siegmund & Jahn 2014; Brock 2018). Overall, indicator development followed the international standards based on the SMART (Tilbury et al. 2007; Wismar et al. 2008; Angelstam et al. 2013) and the European Union's RACER criteria (DEVCO 2016). However, only selected indicators became part of the regularly published German education report (e.g., Autorengruppe Bildungsberichterstattung 2020), none of which emphasized ESD-topics–the key to link ESD to subject-specific knowledge.

Therefore, this paper revisits Bagoly-Simó's (2013a, 2013b, 2014a) four indicators aimed to measure ESD implementation into formal education based on ESD-topics and uses them to explore how ESD implementation changed in time. Thereby, the implementation concept this paper rests on follows the paper implementation rooted in Hernández and Hodges' (2003) recorded theory of change. According to the authors, paper implementation rests on a normative process often tied to legislative acts aiming for a different impact compared to informal patterns of implementation. In contrast to other theories, paper implementation is both aware of its normative nature and actively reflects on how the norm itself sustains and shapes the implementation process. Extensive work (cf. Rogers 2003; Rogers et al. 2004; Fixsen et al. 2005; McDermott 2006) explored how paper implementation depends of factors, such as institutional frameworks at various scales and individuals involved in the implementation process. Overall, the studies found that paper implementation into normative documents, such as curricula, represents an essential prerequisite for change; however, a direct link between paper implementation and its impact on different stakeholders in various settings–in our case, ESD-topics and school subjects–may not rest on a universally valid causality. Within the German framework of formal education, Schöps (2017) used paper implementation to explore how educational standards permeated Geography curricula and, in doing so, contributed to closing the research gap on implementation in curriculum studies (cf. Vandenberghe 1987, for Germany Raines 2008).

3. Method and Sample

A two-step content analysis served to measure ESD implementation into the 2001 and 2017 Bavarian lower secondary curriculum. Overall, the operationalization replicated the steps outlined in Bagoly-Simó (2013a, 2013b, 2014a).

While the set of 46 ESD-topics remained unchanged, truncated lexemes underwent an overall revision consisting of the inclusion of additional synonyms. In a first step, using the updated lexemes, software-assisted (MAXQDA) text retrieval served to harvest segments including ESD-topics. The second analytical step processed each segment in part. Thereby, each segment was assigned to one of the following three subcategories: (1) relevant: segments addressing the ESD-topics in terms of

ESD (based on the conceptualizations defined in the previous section); (2) not relevant: segments matching the required intension and extension that discussed the ESD-topic strictly in terms of subject-specific core knowledge (e.g., transformation of mechanical energy into electric energy); (3) not applicable: segments not matching the required intension and extension (e.g., learning climate was excluded from climate change). As in the previous study (Bagoly-Simó 2013a, 2013b, 2014a), intercoder reliability rested on jointly coded segments followed by their validation leading to amendments in the coding rules.

The sample consisted of two versions of the Bavarian curriculum for *Realschule* (grades 5–10, students aged 11–16 years), one of the several secondary school types of the Bavarian formal education system. In contrast to other secondary schools, *Realschule* has a stronger vocational profile and experienced the strongest increase of student population compared to the other secondary school types (cf. Bagoly-Simó 2013a, 2013b, 2014a). The two analyzed versions were the 2001 curriculum (BSMUK 2001) already explored in Bagoly-Simó (2013a, 2013b, 2014a) and the 2017 revised curriculum (ISB 2017).

Opting for *Realschule* represents a certain limitation given that the 16 German federal states branded their vocational lower secondary education using various names. Despite of this branding diversity, *Realschule* stands for vocational lower secondary education, reason why our findings may serve as a certain reference for similar schools of the other 15 German federal states.

4. The 2001 Bavarian Curriculum

The 2001 Bavarian lower secondary curriculum for *Realschule* consisted of 27 subjects. However, only 19 of these subjects implemented ESD-topics. With a count of 30, the curricular documents featured almost two thirds of the 46 analyzed ESD-topics.

Software-assisted automatic quantitative text analysis retrieved 3,773 segments of which 998 matched the required intension and extension. Roughly two thirds of these segments addressed subject-specific knowledge, while the remaining one third (349) explored the topics in terms of ESD. This section solely considers the latter segments.

The distribution of both segments and ESD-topics showed an irregular pattern. The maximum number of topics encountered in one subject accounted for 48 per cent of the 46 ESD-topics. In contrast, the maximum number of subjects an ESD-topic covered, was 14, which stands for half of the 27 subjects. Overall, depth and breadth of implementation show a superficial, narrow, and often specialized implementation pattern.

4.1 Implementation Depth

Bagoly-Simó (2013a, 2013b, 2014a) defined two indicators to measure the depth of ESD implementation into curricular documents of formal education, namely the number of segments per subject and the number of topics per subject.

The *number of segments per subject* (Fig. 2) expresses the weight of individual subjects as related to the body of segments fostering ESD. Regarding this first indicator, the 2001 Bavarian curriculum displayed a superficial and hyperspecialized implementation of ESD-topics. The average segment count per subject was 18.37. While three quarters of the canon of subjects entailed segments addressing ESD-topics, three subjects (Geography, Handicraft, and Physics) cumulated half of the 349 segments. Moreover, Geography alone accounted for one quarter of the segments. A second marker of a hyperspecialized implementation is the distribution of a further quarter of segments across three subjects (Biology, Ethics, and Chemistry). Thus, less than one third of the subjects concentrated three quarters of the 349 segments counted in the curriculum. In consequence, ESD implementation into the 2001 Bavarian curriculum rested on Geography and Science with subjects pertaining to the Social Studies and Technological curricular areas playing a complementary role.

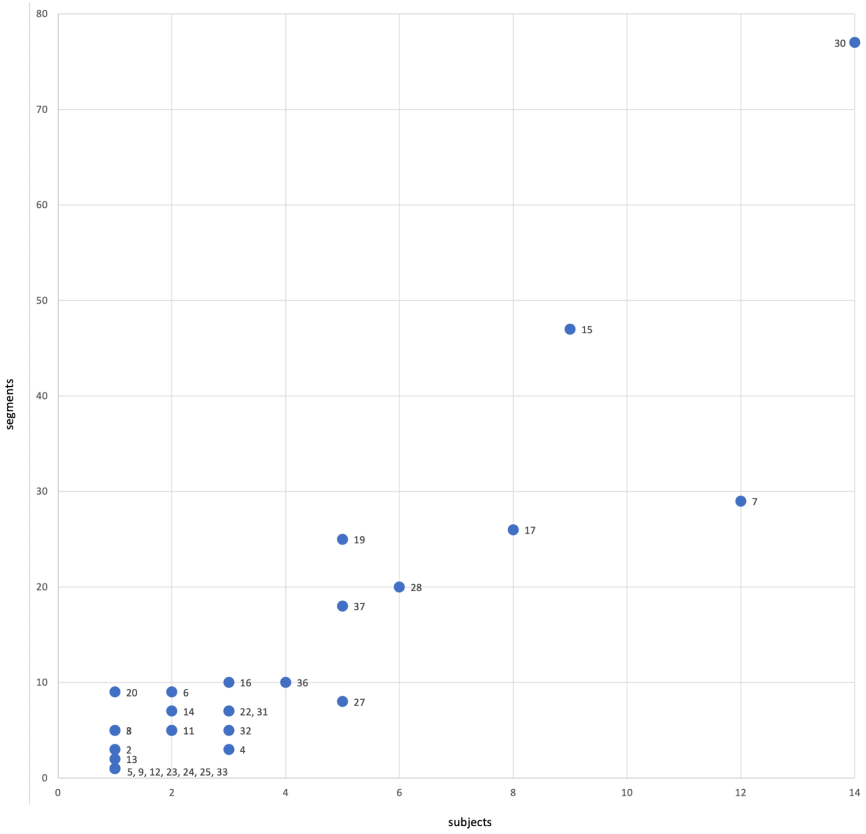
The *number of topics per subject* (Fig. 2) represents the second indicator measuring the depth of ESD implementation and shows the relative weight of individual subjects in securing a deep ESD implementation. Applied

to the 2001 Bavarian curriculum, the second indicator showed a shallow and ultraspecialized implementation with emphasis on one subject. On average, subjects contained 3.81 ESD-topics. While 30 per cent of the subjects were void of any references to ESD-topics, another 37 per cent remained below average in their topic count. With a count of 22, Geography was the only subject that covered almost half of the 46 analyzed ESD-topics. The next cluster of subjects contained eight (Biology and Ethics) and seven (Chemistry and Welfare) ESD-topics.

4.2 Implementation Breadth

The second set of indicators measures the breadth of ESD implementation into curricular documents of formal education (Bagoly-Simó 2013a, 2013b, 2014a) by counting the number of segments per topic and the number of subjects per topic.

As a first indicator, the *number of segments per topic* (Fig. 3) showcased a narrow and hyperspecialized ESD implementation. The 2001 Bavarian curriculum covered two thirds of the 46 analyzed ESD-topics that exhibit an unbalanced distribution. On average, 11.63 segments referenced each topic. Protection, with a share of one quarter of all segments (77 S), eclipsed all other ESD-topics and led to a hyperspecialized implementation. Together with the topic energy (47 S), it concentrated one-third of the 349 segments. Another marker of a hyperspecialized implementation was the finding that nine ESD-topics accounted for three quarters of all segments. Apart from protection, the remaining eight ESD-topics (energy, consumption, globalization, health, peace, and water) covered not only aspects of intergenerational but also of global equity and justice.



1: agriculture
2: atmopshere
3: biological diversity
4: biotechnology
5: catastrophe precaution
6: climate change
7: consumption
8: cultural diversity
9: cultural heritage
10: deforestation
11: demographic development
12: desertification
13: developing countries
14: ecosystem
15: energy
16: ethics
17: globalization
18: HIV & AIDS
19: human health
20: human settlement development
21: hygiene
22: international cooperation
23: land resources
24: lifestyle
25: mountain development
26: national parks
27: nutrition & hunger
28: peace
29: poverty
30: protection
31: raw materials
32: resources
33: seas
34: toxic chemicals
35: vulnerability
36: waste
37: water

Fig. 2. School subjects' segment and ESD-topic count in the 2001 Bavarian lower secondary curriculum (Source: authors)

The *number of subjects per topic* (Fig. 3) is the second indicator that measures the breadth of ESD implementation. The results showed a narrow implementation mainly supporting intergenerational justice and equity. ESD-topics covered, on average, 2.23 subjects. Protection (14 subjects) was the only topic that reached half of the 2001 Bavarian lower secondary canon of subjects followed by consumption (12 subjects). Somewhat above average were the topics energy (9), globalization (8), and health (7). However, almost half of the 30 ESD-topics counted in the subject curricula remained limited to only one subject. The results also showed that more broadly implemented ESD-topics mainly supported intergenerational equity and justice.

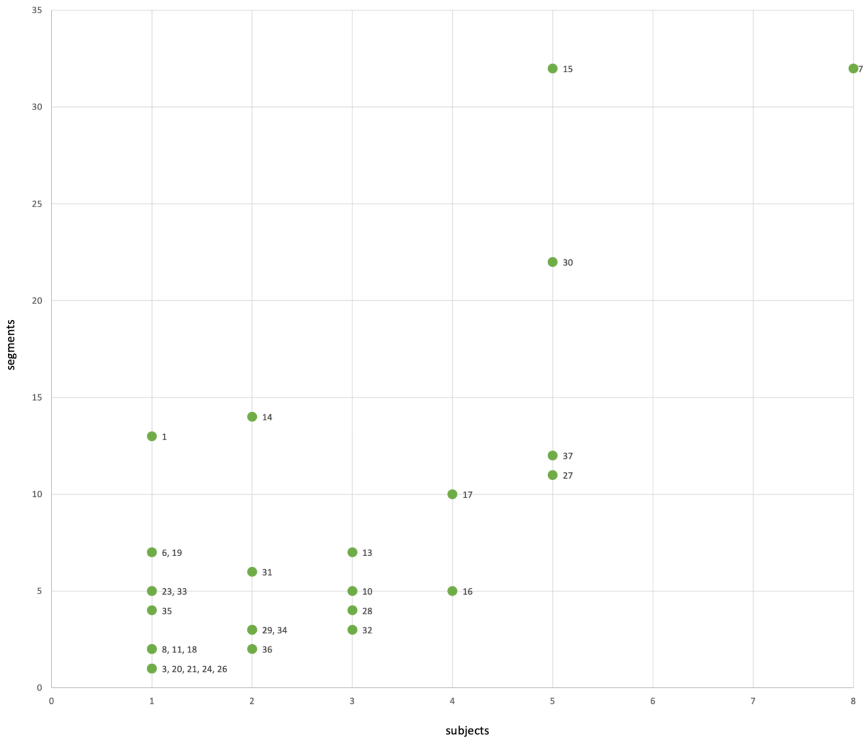


Fig. 3. ESD-topics' segment and subject count in the 2001 Bavarian lower secondary curriculum (Source: authors)

5. The 2017 Bavarian Curriculum

The reformed Bavarian lower secondary curriculum for *Realschule* consisted of 24 subjects, 15 of which entailed ESD-topics and, thus, contributed to ESD implementation. The curricular documents contained two thirds (31) of the 46 ESD-topics.

Computer-assisted quantitative text analysis retrieved 1,319 segments of which 1,140 matched the required intension and extension. Only one fifth (226) of these segments explored the ESD-topics in terms of ESD, while the vast majority focused on subject-specific knowledge. As with the 2001 curriculum, this section also solely considers the 226 segments fostering ESD.

Both the 226 counted segments and the 31 ESD-topics displayed an unequal distribution. The maximum number of topics encountered in one subject accounted for 46 per cent of the 46 ESD-topics. In contrast, the maximum

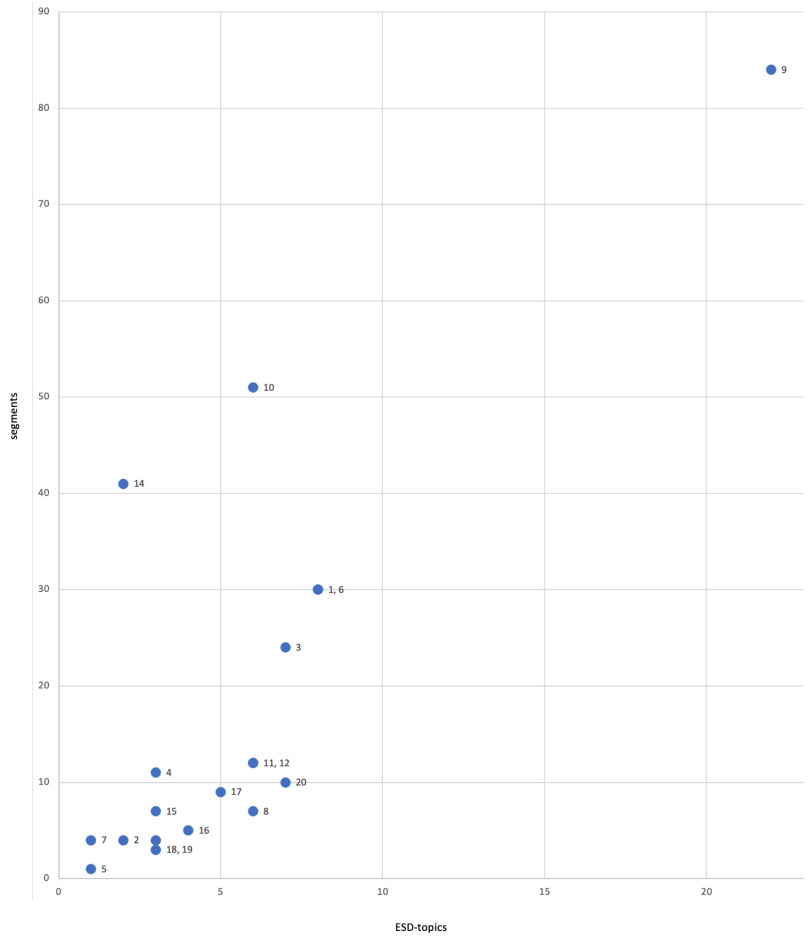
number of subjects an ESD-topic covered, was eight (one third of the 24 subjects). Overall, depth and breadth of implementation show a superficial, narrow, and often specialized implementation pattern.

5.1 Implementation Depth

The two indicators measuring the depth of ESD implementation are the number of segments per subject and the number of topics per subject.

The first indicator, namely the *number of segments per subject* (Fig. 4), showed a superficial and hyperspecialized implementation of ESD into the 2017 Bavarian lower secondary curriculum. Subjects contained 15.06 segments on average. While less than two thirds (62.5%) of the canon of subjects contained segments dedicated to ESD-topics, two subjects, namely Geography (39%) and Biology (16%) accounted for half of the 226 segments counted throughout the curriculum. With an individual share of 40 per cent of all segments, Geography achieved the highest segment count and, consequently, reflected a hyperspecialization on the subject regarding its contribution to ESD implementation. An additional marker of a hyperspecialized implementation is the concentration of three quarters of the 226 segments on only five subjects (Geography, Biology, Home Economics, Chemistry, and Handicrafts). These five subjects accounted for one fifth of the 24 subjects constituting the 2017 Bavarian lower secondary curriculum. In consequence, ESD implementation rested on Geography, Science, and technological subjects.

The number of topics per subject (Fig. 4) constitutes the second indicator measuring the depth of ESD implementation into subject curricula. For the 2017 Bavarian lower sec-



1: Biology
2: Business Studies
3: Chemistry
4: Economics & Law
5: English
6: Ethics
7: Fibre Craft
8: French
9: Geography
10: Handicraft
11: History
12: Home Economics
13: Physical Training
14: Physics
15: Religious Education (cath.)
16: Religious Education (luth.)
17: Social Studies
18: Text Processing
19: Text Processing & Stenography
20: Welfare

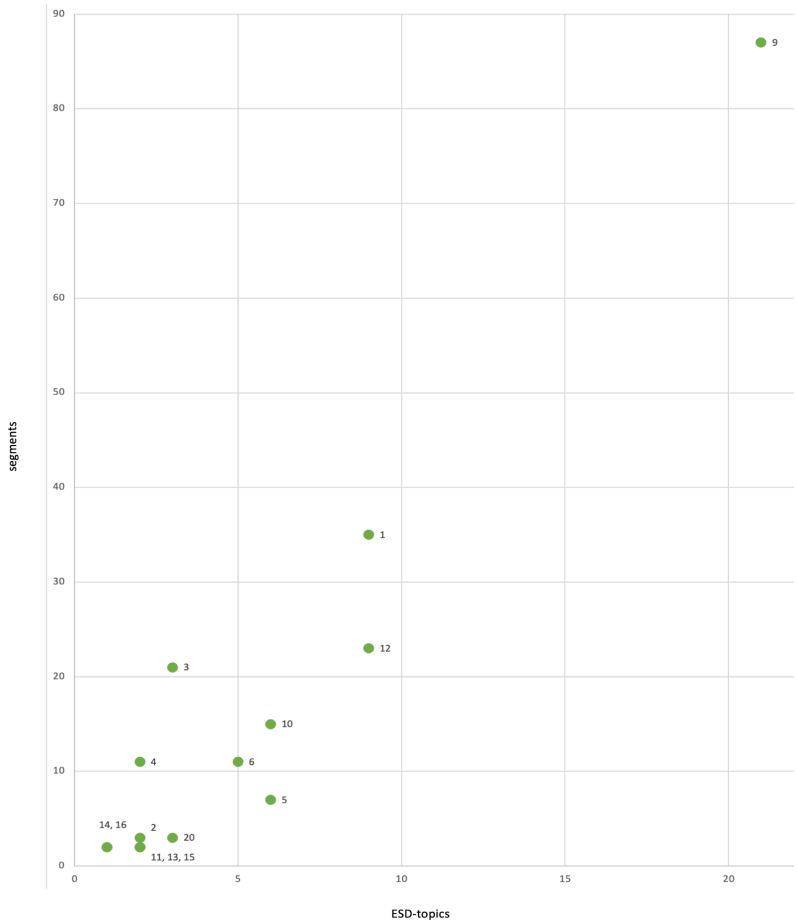
Fig. 4. School subjects' segment and ESD-topic count in the 2017 Bavarian lower secondary curriculum (Source: authors)

ondary curriculum, the indicator showed a shallow implementation that was ultraspecialized on one subject. The average number of topics a subject contained was 3.52. The analysis encountered that ESD-topics were missing from almost 40 per cent of the 24 subjects constituting the 2017 Bavarian lower secondary curriculum, while the topic count of another 38 per cent remained below average. Geography covered, with a count of 21 ESD-topics, almost half of the 46 pre-defined topics. Biology and Home Economics constituted the next cluster of subjects containing a fifth of the total number of ESD-topics each.

5.2 Implementation Breadth

Two indicators that measure the breadth of ESD implementation into curricular documents of formal education are the number of segments per topic and the number of subjects per topic.

The *number of segments per topic* (Fig. 5) in the 2017 Bavarian lower secondary curriculum certified a narrow and specialized ESD implementation. The subject curricula featured 67 per cent of the 46 analyzed ESD-topics that appeared distributed unequally. On average, 7.29 segments referenced each topic. The topics consumption and energy concentrated, with a share of 14.15 per cent each, one quarter of the 226 segments. Protection, ecosystem, and agriculture accounted jointly for another quarter of the segments. Overall, twelve topics concentrated three quarters of the total number of segments, which underlines the narrow and specialized ESD implementation. However, the twelve topics also covered both global and intergenerational equity and justice in a balanced manner.



1: Biology
2: Business Studies
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16: Religious Education (luth.)
17: Social Studies
18: Text Processing
19: Text Processing & Stenography
20: Welfare

Fig. 5. ESD-topics' segment and subject count in the 2017 Bavarian lower secondary curriculum (Source: authors)

Another indicator that measures the implementation breadth is the number of subjects per topic (Fig. 5). The results showed a narrow implementation focused on issues of intergenerational justice and equity. The ESD-topics reached, on average, 1.60 subjects. With eight covered subjects, consumption was the only topic that became part of one third of the 24 subjects constituting the 2017 Bavarian lower secondary canon of subjects. The ESD-topics energy, nutrition and hunger, protection, and water covered five subjects each, thus reaching one fifth of the curriculum. Also, almost half of the 31 topics identified in the subject curricula remained limited to only one subject.

Depth and breadth of ESD implementation color the canon of subject heterogenous. Nevertheless, as previously proven (Bagoly-Simó 2013a, 2013b, 2014a), Geography is one of the subjects that embraced the concept of sustainable development and contributed extensively to ESD implementation. Therefore, the next section puts Geography into spotlight to examine the repercussions of the Bavarian curricular reform on the subject's contribution to ESD implementation.

6. Geography

Both indicators measuring the depth of ESD implementation, namely the number of segments per subject and the number of topics per subject underline Geography's important contribution to ESD implementation.

The 2001 Bavarian Geography curriculum counted 84 segments (Fig. 6), which corresponded to almost one quarter of the total segment count. Similarly, covering 22 of the 46 ESD-topics, the Geography curriculum re-

ESD-topics	Curriculum			
	2001		2017	
	Segments	Rank	Segments	Rank
Agriculture	5	7	15	1
Atmosphere	4	9	2	16
Biological diversity			1	18
Climate change	10	4	8	4
Consumption	4	11	5	12
Cultural diversity	6	5		
Deforestation			2	15
Demographic development	5	6	2	17
Desertification	1	22		
Developing countries	2	15	6	8
Ecosystem	5	8	1	20
Energy	2	14	8	3
Globalization	12	2	7	5
HIV & AIDS			2	13
Human settlement development	11	3	1	21
International cooperation	1	19		
Land resources	1	18	6	6
Lifestyle	1	20		
Mountain development	1	17		
National park			1	19
Nutrition & hunger	4	10	5	11
Poverty			2	14
Protection	15	1	9	2
Raw materials	4	13		
Resources	4	12		
Seas	1	21	6	7
Vulnerability			5	10
Water	2	16	6	9
	100		100	

Fig. 6. Share of segments according to ESD-topics in the 2001 (n = 84) and 2017 (n = 87) Bavarian lower secondary Geography curriculum (Source: authors)

flected a deep ESD implementation (Fig. 6). Nevertheless, the distribution of the segments showed a tendency of hyperspecialization with five topics, namely protection, globalization, human settlement development, climate change, and cultural diversity containing more than half (54%) of the 84 segments. In addition, almost one third of the topics was found in only one segment.

The reformed Geography curriculum of 2017 contained 87 segments corresponding to over one third (38%) of the total segment count. In contrast, the topic count fell to 21 ESD-topics (47% of the 46 analyzed topics) (Fig. 6). Both indicators measured a relatively deep ESD-implementation. The distribution of the segments across the topics showed a tendency of hyperspecialization with the five topics agriculture, protection, energy, climate change, and globalization concentrating 47 per cent of the 87 segments. One fifth of the 21 ESD-topics was identified in solely one segment.

Bavarian Geography's curricular reform also led to high topical variability with only 40 per cent of matching ESD-topics in the two documents (Fig. 6). Seven topics counted in the 2001 curricular document, namely cultural diversity, resources, raw materials, mountain development, international cooperation, lifestyle, and desertification were missing from its 2017 revised version. Similarly, the 2017 curriculum implemented the topics vulnerability, HIV & AIDS, poverty, deforestation, biological diversity, and national parks that were previously missing from the Geography curriculum. The segment count of the topics protection, climate change, globalization, atmosphere, demographic development, ecosystem, and human settlement development experienced a devaluation as opposed to the topics agriculture, energy, land resources, seas, developing countries, water, nutrition & hunger, and consumption experiencing revaluation.

7. Discussion

The two indicators measuring the breadth of ESD implementation indicated a trend of increased specialization (Fig. 7 & Fig. 8). On average, the number of subjects covered by an ESD-topic shrunk from 2.23 in 2001 to 1.60 in 2017. Also, protection, the ESD-topic with the highest subject count in 2001, reached half of the canon whereas consumption, its counterpart in the 2017 curriculum, only made it into one third of the subjects constituting the Bavarian lower secondary curriculum. While the number of subjects per topic showed a clear specialization tendency, the second indicator–segments per topic–displayed a more balanced distribution with the share of the leading ESD-topic shrinking from one quarter of the total segment count to 11 per cent. Also, the number of topics containing three quarters of the total segment count increased from nine in 2001 to twelve in 2017.

In consequence, ESD-topics were present in fewer subjects but represented by a higher segment count. This result is surprising, given that the 2017 curriculum entailed ESD as its mandatory cross-curricular objective and yet it fails to achieve a more systematic deep and broad implementation. They also contradict Grund and Brock's (2020) findings stating that the inclusion of ESD as a cross-curricular objective leads to its stronger implementation. One explanation of this pattern could be the ties between subject-specific knowledge and ESD, as best exemplified by Geography (cf. Bagoly-Simó 2013a, 2013b, 2014a). ESD is best implemented when school subjects introduce deep knowledge on topics to be explored concurrently or subsequently in terms of ESD.

The top three ESD-topics, namely protection, energy, and consumption, remained constant. However, protection, the formerly leading ESD-topic of the 2001 curriculum, fell back on the third rank in the 2017 curriculum. Concurrently, consumption experienced an increase in significance climbing from the third position in 2001 to the leading ESD-topic in 2017. In contrast, four of the top ten ESD-topics differed in the two curricular documents. The topics ecosystem, agriculture, nutrition and hunger, and developing countries replaced in the 2017 the ESD-topics human health, peace, waste, and ethics. Overall, the increased interest in land usage (agriculture), securing nutrition and fighting hunger in connection with ecosystems with particular emphasis on developing countries seem to mirror the

Sustainable Development Goals as grand challenges on the global scale.

Both indicators measuring the depth of ESD implementation indicate a tendency to hyper-specialization (Fig. 9 & Fig. 10). While the average segment count per subject dropped from 18.37 to 15.06, the topic count also decreased from 3.81 to 3.52. Moreover, three quarters of the total segment count concentrated on one fifth of the curriculum as opposed to one third in 2001. Similarly, half of all segments were counted in two subjects. In contrast, the 2001 curriculum condensed the same amount in three subjects. Also, the curricular coverage of ESD-topics declined from three quarters of the subjects in 2001 to 62 per cent in 2017. In both curricula, Geography was the only subject that featured almost half of the 46 ESD-topics.

ESD-Topics	Curriculum	
	2001	2017
Agriculture	1.43	5.75
Atmosphere	0.86	1.33
Biological diversity	1.43	0.44
Biotechnology	0.86	0.00
Catastrophe precautions	0.29	0.00
Climate change	2.58	3.10
Consumption	8.31	14.16
Cultural diversity	1.43	0.88
Cultural heritage	0.29	0.00
Deforestation	0.00	2.21
Demographic development	1.43	0.88
Desertification	0.29	0.00
Developing countries	0.57	3.10
Ecosystem	2.01	6.19
Energy	13.47	14.16
Ethics	2.87	2.21
Globalization	7.45	4.42
HIV & AIDS	0.00	0.88
Human health	7.16	3.10
Human settlement development	2.58	0.44
Hygiene	0.00	0.44
International cooperation	2.01	0.00
Land resources	0.29	2.21
Lifestyle	0.29	0.44
Mountain development	0.29	0.00
National park	0.00	0.44
Nutrition & hunger	2.29	4.87
Peace	5.73	1.77
Poverty	0.00	1.32
Protection	22.06	9.73
Raw materials	2.01	2.65
Resources	1.43	1.33
Seas	0.29	2.21
Toxic chemicals	0.00	1.33
Vulnerability	0.00	1.77
Waste	2.87	0.88
Water	5.16	5.31
	100.00	100.00

Fig. 7. Share of segments according to ESD-topics in the 2001 (n = 349) and 2017 (n = 226) Bavarian lower secondary curriculum (Source: authors)

While Geography maintained its leading role in the aftermath of the curricular reform, the top five subjects contributing to ESD implementation suffered some alterations. The share of Science subjects remained constant; however, Chemistry replaced Physics. In addi-

ESD-Topics	Curriculum	
	2001	2017
Agriculture	11	7
Atmosphere	5	13
Biological diversity	5	7
Biotechnology	16	0
Catastrophe precautions	5	0
Climate change	11	7
Consumption	63	53
Cultural diversity	5	7
Cultural heritage	5	0
Deforestation	0	20
Demographic development	11	7
Desertification	5	0
Developing countries	5	20
Ecosystem	11	13
Energy	47	33
Ethics	16	27
Globalization	42	27
HIV & AIDS	0	7
Human health	26	7
Human settlement development	5	7
Hygiene	0	7
International cooperation	16	0
Land resources	5	7
Lifestyle	5	7
Mountain development	5	0
National park	0	7
Nutrition & hunger	26	33
Peace	32	20
Poverty	0	13
Protection	74	33
Raw materials	16	13
Resources	16	20
Seas	5	7
Toxic chemicals	0	13
Vulnerability	0	7
Waste	21	13
Water	26	33

Fig. 8. Share of subjects according to ESD-topics in the 2001 (n = 19) and 2017 (n = 15) Bavarian lower secondary Geography curriculum (Source: authors)

Subjects	Curriculum	
	2001	2017
Biology	8.60	15.49
Business Studies	1.15	1.33
Chemistry	6.88	9.29
Economics & Law	3.15	4.87
English	0.29	3.10
Ethics	8.60	4.87
Fibre Craft	1.15	0.00
French	2.01	0.00
Geography	24.07	38.50
Handicrafts	14.61	6.64
History	3.44	0.88
Home Economics	3.44	10.18
Physical Training	0.00	0.88
Physics	11.75	0.88
Religious Education (cath.)	2.01	0.88
Religious Education (luth.)	1.43	0.88
Social Studies	2.58	0.00
Text Processing	0.86	0.00
Text Processing & Stenography	1.15	0.00
Welfare	2.87	1.33
	100.00	100.00

Fig. 9. Share of segments according to subject in the 2001 (*n* = 349) and 2017 (*n* = 226) Bavarian lower secondary curriculum (Source: authors)

Subjects	Curriculum	
	2001	2017
Biology	27	29
Business Studies	7	6
Chemistry	23	10
Economics & Law	10	6
English	3	19
Ethics	27	16
Fibre Craft	3	0
French	20	0
Geography	73	68
Handicrafts	20	19
History	20	6
Home Economics	20	29
Physical Training	0	6
Physics	7	3
Religious Education (cath.)	10	6
Religious Education (luth.)	13	3
Social Studies	17	0
Text Processing	10	0
Text Processing & Stenography	10	0
Welfare	23	10

Fig. 10. Share of ESD-topics according to subjects in the 2001 (*n* = 30) and 2017 (*n* = 31) Bavarian lower secondary Geography curriculum (Source: authors)

tion, Home Economics, a vocational subject strongly relying on the concept of sustainable development, replaced Ethics. Overall, Science and vocational subjects exhibiting a certain affinity to both the concept of sustainable development and ESD dominated the 2017 curriculum at the expense of Ethics and other social science subjects.

Despite its leading role, the curricular reform altered considerably the subject Geography. Both indicators measuring the implementation depth (cf. Section 6) showed a shift from a more diverse perspective on sustainable development also including human settlement development and cultural diversity to one dominated by an agenda of survival reflected in a combination of the topics agriculture (standing for availability of fertile land and food), energy, climate change, and protection. Both versions of the curriculum reduced the economic component of sustainable development to globalization.

In consequence, Bavarian lower secondary education seems to have specialized on Geography as its leading subject for ESD implementation. Previous work already stressed in both normative (e.g., McKeown 2007) and empirical terms (cf. Bagoly-Simó 2013a, 2013b, 2014a, 2014b) Geography's conceptual and thematic affinity to sustainable development. Also, Geography as a school subject embraced the cross-disciplinary objective ESD and implemented it as part of its subject-specific knowledge. The results presented in this study confirm Bagoly-Simó's (2014b) findings and indicate that geographers and Geography educators involved in curriculum development, unlike stakeholders representing the other subjects of the Bavarian lower secondary canon, actively tied the concept of sustainable development to Geography's core subject-specific knowledge and aligned the subject's educational aims with those of ESD.

8. Concluding Thoughts

This paper aimed to explore how ESD implementation changed in time by contrasting the results obtained through Bagoly-Simó's (2013a, 2013b, 2014a) four indicators for the 2001 and the reformed 2017 Bavarian curriculum for lower secondary education. The results allow the formulation of four main conclusions.

First, ESD-topics reinforced the individual subjects' heterogenous contribution to ESD implementation. Geography, along with Science and vocational subjects, dedicates special attention to contemporary challenges at the global scale while school subjects with the highest time resources, such as German, Mathematics, Foreign Languages, and Physical Education have a very limited to no contribution to ESD.

Second, ESD-topics reflect the conceptual and thematic affinity of each subject to the concept of sustainable development and to ESD. Subjects already addressing ESD-topics as part of their subject-specific core knowledge are more likely to link them to ESD. Therefore, the ambitious yet unrealistic aim of the German UNESCO Commission to implement ESD into all forms of education and into all subjects of formal education is in need of an urgent revision. It is the conceptual and thematic affinity that accelerates and secures ESD implementation, not the ideology-driven normative imposition of cross-curricular aims on subjects that can have a limited contribution, if at all, to ESD.

Third, ESD-topics in curricula mirror those societal priorities that shaped the academic, public, and educational policy discourse at the time of their enactment. As the results of this comparative study showed, the global discourse on humanity's survival greatly impacted the Bavarian lower secondary curriculum affecting not only the number of ESD-topics but also their influence.

Fourth, ESD-topics exposed a significant sustainability turn of several vocational subjects. Home Economics and Handicrafts are just two of the subjects that address matters of sustainable development at home and at the workplace. Particularly the subjects preparing students for different professions mirror the change happening on the labor market as enterprises are adopting more sustainable workflows.

Summing up, ESD-topics constitute essential components of indicators aimed at measuring ESD implementation into entire curricula and their individual subjects. Unlike normatively implemented concepts, ESD-topics expose the ties between ESD and each sub-

ject's core knowledge–the key to avoid ESD as just another add-on aim.

Naturally, to accurately measure the ESD implementation into formal education, ESD-topics require a constant revision that is sensitive to path-dependencies. As this paper's scope was to compare change over time, the list of ESD-topics remained constant. The only alterations were limited to additional synonyms included in the list of lexemes used for segment harvesting. However, lists of ESD-topics might require major updates to reflect societal discourses on sustainable development's grand challenges. Therefore, future studies should be sensitive to ESD-topics required in a given space at a given time.

Also, focusing on segments solely dedicated to ESD distorts the potential of each subject to contribute to ESD implementation. As Bagoly-Simó (2013b) showed, some subjects are still reluctant to connect ESD by means of ESD-topics to their subject-specific knowledge, while others actively contribute to ESD implementation without having the core knowledge that could carry a deep debate on matters of ESD. Therefore, future studies should explore ESD implementation based on ESD-topics both in terms of subject-specific core knowledge and ESD.

Finally, further studies exploring individual subjects' conceptual and thematic affinity to (E)SD (cf. for Geography, Bagoly-Simó 2014) could uncover implementation barriers and help tying ESD to deep subject-specific knowledge required for informed and just decision-making. Looking beyond the normative framework of curricula, classroom studies and designs relying on stakeholders actively shaping the implementation process would shed a different light on ESD-implementation and also further the debate on paper implementation (Hernández & Hodge 2003).

Literatur

Adomssent, M., Bormann, I., Burandt, S., Fischbach, R., & Michelsen, G. (2012). Indikatoren für Bildung für nachhaltige Entwicklung. In Bundesministerium für Bildung und Forschung (ed.), *Bildung für nachhaltige Entwicklung – Beiträge der Bildungsforschung. Bildungsforschung (vol. 39)* (pp. 71–90). Bonn, Berlin: Bundesministerium für Bildung und Forschung.

Angelstam, P., Roberge, J.-M., Axelsson, R., Elbakidze, M., Bergman, K.-O., Dahlberg, A., & Törnblom, J. (2013). Evidence-Based Knowledge Versus Negotiated Indicators for Assessment of Ecological Sustainability: The Swedish Forest Stewardship Council Standard as a Case Study. *AMBIO, 42*(2), pp. 229–240.

Autorengruppe Bildungsberichterstattung (2020). *Bildung in Deutschland 2020*. Bielefeld: wbv Publikation.

Bagoly-Simó, P. (2013a). Tracing Sustainability: An International Comparison of ESD Implementation into Lower Secondary Education. *Journal of Education for Sustainable Development*, *7*, pp. 91–108.

Bagoly-Simó, P. (2013b). Education for Sustainable Development and School Geography. Theoretical Considerations. *Romanian Review of Geographical Education*, *2*, pp. 4–25.

Bagoly-Simó, P. (2014a). Implementierung von BNE am Ende der UN-Dekade. Eine internationale Vergleichsstudie am Beispiel des Fachunterrichts. *Zeitschrift für Geographiedidaktik | Journal of Geography Education (ZGD), 42*, pp. 219–254.

Bagoly-Simó, P. (2014b). Tracing Sustainability: Concepts of Sustainable Development and Education for Sustainable Development in Lower Secondary Geography Curricula of International Selection. *International Research in Geographical and Environmental Education*, *23*, pp. 126–141.

Brock, A. (2018). Verankerung von Bildung für Nachhaltige Entwicklung im Bildungsbereich Schule. In A. Brock, G. de Haan, N. Etzkorn, & M. Singer-Brodowski (Eds.), *Wegmarken zur Transformation: Nationales Monitoring von Bildung für Nachhaltige Entwicklung in Deutschland* (pp. 67–115). Leverkusen: Verlag Barbara Budrich.

BSMUK (Bayerisches Staatsministerium für Unterricht und Kultus) (2001). *Lehrplan für die sechsstufige Realschule (Curriculum for the six-level Realschule)*. Munich: Bayerisches Staatsministerium für Unterricht und Kultus.

Cruz López, Y. (2011). 5th International Barcelona Conference on Higher Education: Higher Education's Commitment to Sustainability from Understanding to Action. *Journal of Education for Sustainable Development, 5*, pp. 167–169.

DEVCO, D.-G. f. I. C. a. D. (2016). *Integrating the Environment and Climate Change into EU International Cooperation and Development. Towards Sustainable Development*. Luxembourg: Publication Office, European Union.

Di Giulio, A., Ruesch Schweizer, C., Adomssent, M., Blaser, M., Bormann, I., Burandt, S., & Streissler, A. (2011). *Bildung auf dem Weg zur Nachhaltigkeit. Vorschlag eines Indikatoren-Sets zur Beurteilung von Bildung für Nachhaltige Entwicklung*. Bern: Interfakultäre Koordinationstelle für Allgemeine Ökologie, Universität Bern.

Dobson, A. (1996). Environment Sustainabilities: An Analysis and a Typology. *Environmental Politics, 5,* pp. 401–428.

European Union (2007). *Beyond GDP*. Retrieved on 24.09.2021 from here.

Fixsen, D., Naoom, S., Blase, K., Friedman, R., & Wallace, F. (2005). *Implementation Research: A Synthesis of the Literature*. Tampa: University of South Florida.

Grund, J., & Brock, A. (2020). Education for Sustainable Development in Germany: Not Just Desired but Also Effective for Transformative Action. *Sustainability*, *12*, 2838.

Haan, G. de (2008). Gestaltungskompetenz als Kompetenzkonzept für Bildung für nachhaltige Entwicklung. In I. Bormann & G. de Haan (eds.), *Kompetenzen der Bildung für nachhaltige Entwicklung. Operationalisierung, Messung, Rahmenbedingungen, Befunde* (pp. 23–43). Wiesbaden: VS-Verlag.

Hak, T., Moldan, B., & Dahl, A. L. (eds.) (2007). *Sustainability Indicators: A Scientific Assessment.* Scientific Committee on the Problems of Environment based in Paris, vol. 67. Washington DC: Island Press.

Hernandez, M., & Hodges, S. (2003). Building upon the Theory of Change for Systems of Care. *Journal of Emotional and Behavioral Disorders*, *11*, pp. 19–26.

Homborg, S. (2017). ‚Wo Licht ist, ist auch Schatten' – Kritische Perspektiven auf Bildung für nachhaltige Entwicklung und die BNE-Forschung im deutschsprachigen Raum. In M. Brodowski (Hg.), *BNE. Bildung für nachhaltige Entewicklung: Interdisziplinäre Perspektiven. Sozialwissenschaftliche Forschungswerkstatt (Band 4)* (S. 15–32). Berlin: Logos.

ISB (Staatsinstitut für Schulqualität und Bildungsforschung München) (2017). *Realschule R6. Genehmigter Lehrplan (Realschule. Approved Curriculum)*. Munich: ISB.

Jickling, B., & Wals, A. E. J. (2008). Globalization and Environmental Education: Looking beyond Sustainable Development. *Journal of Curriculum Studies, 40*, pp. 1–21.

Jucker, R. (2011). ESD between Systemic Change and Bureaucratic Obfuscation. Some Reflections on Environmental Education and Education for Sustainable Development in Switzerland. *Journal of Education for Sustainable Development, 5*, pp. 39–60.

McDermott, K. (2006). Incentives, Capacity, and Implementation: Evidence from Massachusetts Education Reform. *Journal of Public Administration Research and Theory*, *16*, pp. 45–65.

McKeown, R. (2007). Setting the Stage for a Strategic Research Agenda for the UNDESD: A Joint UNU-UNESCO Workshop. *Journal of Education for Sustainable Development, 1*, pp. 91–96.

McKeown, R., & Hopkins, C. (2007). Moving beyond the EE and ESD Disciplinary Debate in Formal Education. *Journal of Education for Sustainable Development, 1*, pp. 17–26.

Meadows, D. H (1998). *Indicators and Information Systems for Sustainable Development: Report to the Balaton Group*. Hartland Four Corners: The Sustainability Institute.

Michelsen, G., Adomssent, M., Bormann, I., Burandt, S., & Fischbach, R. (2011). *Indikatoren der Bildung für nachhaltige Entwicklung – Ein Werkstattbericht*. Bad Homburg: VAS-Verlag.

Mulà, I., & Tilbury, D. (2008). A United Nations Decade of Education for Sustainable Development (2005–14). What Difference Will It Make? *Journal of Education for Sustainable Development, 3*, pp. 87–97.

NAP (2017). *Nationaler Aktionsplan Bildung für Nachhaltige Entwicklung*. Retrieved on 24.09.2021 from here.

OECD (2003). *OECD Environmental Indicators: Development, Measurement and Use. Reference Paper*. Retrieved on 24.09.2021 from here.

OECD (2009). *Statistics, Knowledge and Policy. 3rd OECD World Forum, Busan, Korea, 27–30 October, 2009*. Retrieved on 24.09.2021 from here.

Paden, M., & Chhokar, K. B. (2007). Exploring Research Priorities for the DESD. *Journal of Education for Sustainable Development, 1*, pp. 73–75.

Podger, D., Piggot, G., Zahradnik, M., Janousková, S., Velasco, I., Hak, T., Dahl, A., Jimenez, A., & Harder, M.K. (2010). The Earth Charter and the ESDinds Initiative: Developing Indicators and Assessment Tools for Civil Society Organisations to Examine the Values Dimensions of Sustainability Projects. *Journal of Education for Sustainable Development, 4*, pp. 297–305.

Raines, J. (2008). *Evidence-Based Practice in School Mental Health. A Primer for School Social Workers, Psychologists, and Counselors*. Oxford: Oxford University Press.

Reid, A., Nikel, J., & Scott, W. A. H. (2006). *Indicators for Education for Sustainable Development: A Report on Perspectives, Challenges and Progress*. London: Anglo-German Foundation for the Study of Industrial Society.

Rieckmann, M. (2010). *Die globale Perspektive der Bildung für eine nachhaltige Entwicklung. Eine europäisch-lateinamerikanische Studie zu Schlüsselkompetenzen für Denken und Handeln in der Weltgesellschaft*. Berlin: Berliner Wissenschafts-Verlag.

Rode, H. (2006). *Different Indicators for Different Contexts? Developing Indicators for ESD in Germany. Presented at Indicators for Education for Sustainable Development: Engaging the Debate on March 17th, 2006 at the Bath Royal Literary and Scientific Institute in Bath*. Retrieved on 24.09.2021 on here.

Rogers, E. (2003). *Diffusion of Innovations*. New York: Free Press.

Rogers, R., Wellins, R., & Conner, D. (2004). *The Power of Realization. Building Competitive Advantage by Maximizing Human Resource Initiatives*. Retrieved on 24.09.2021 here.

Roorda, N. (2004). Developing Sustainability in Higher Education Using AISHE. In P. Corcoran & A. E. J. Wals (eds.), *Higher Education and the Challenge of Sustainability* (pp. 305–318). Dordrecht: Kluwer Academic.

Schöps, A. (2017). Die paper implementation des Kompetenzmodells der Bildungsstandards Geographie (DGfG) – Eine Analyse der Weiterentwicklung des bayerischen Gymnasiallehrplans Geographie zum kompetenzorientierten LehrplanPLUS. *Zeitschrift für Geographiedidaktik | Journal of Geography Education*, *45*, pp. 3–36.

Selby, D., & Kagawa, F. (2010). Runaway Climate Change as Challenge to the 'Closing Circle' of Education for Sustainable Development. *Journal of Education for Sustainable Development, 4*, pp. 37–50.

Siegmund, A., & Jahn, M. (2014). *Lernen über den Tag hinaus – Bildung für eine zukunftsfähige Welt*. Retrieved on 24.09.2021 here.

Sollart, K. (2005). *Framework on Indicators for Education for Sustainable Development: Some Conceptual Thoughts*. Netherlands: Netherlands Environmental Assessment Agency.

Stibbe, A. (2009). *The Handbook of Sustainability Literacy: Skills for a Changing World*. Dartington: Green Books.

Stiglitz, J., Sen, A., & Fitoussi, J. (2009). *Report by the Commission on the Measurement of Economic Performance and Social Progress*. Retrieved on 24.09.2021 on here.

Tilbury, D. (2007). Monitoring and Evaluation during the UN Decade of Education for Sustainable Development. *Journal of Education for Sustainable Development, 1*, pp. 239–254.

Tilbury, D., & Janousek, S. (2007). *Monitoring and Assessing Progress in Education for Sustainability Programs Nationally*. Brisbane: International Geographical Union Congress.

Tilbury, D., Janousek, S, Elias, D., & Bacha, J. (2007). *Asia Pacific Guidelines for the Development of Education for Sustainable Development Indicators.* Bangkok: UNESCO Asia and Pacific Regional Bureau.

Tilbury, D., Janousek, S., Elias, D., & Bach, J. (2007). *Asia-Pacific Guidelines for the Development of National ESD Indicators*. Bangkok: UNESCO Bangkok.

Tremmel, J. (2003). *Nachhaltigkeit als politische und analytische Kategorie. Der deutsche Diskurs um nachhaltige Entwicklung im Spiegel der Interessen der Akteure*. Munich: Oekom.

UNECE (2005a). *UNECE Expert Group on Indicators for Education for Sustainable Development Report. First Meeting 26–28 September 2005.* Ede, The Netherlands: UNECE.

UNECE (2005b). *Background Paper on Development of Indicators to Measure Implementation of the UNECE Strategy for ESD*. Ede, The Netherlands: UNECE.

UNECE (2008). *Extract of Issues Relevant to Competences in ESD*. Retrieved on 24.09.2021 on here.

UNESCO (2007). *The UN Decade of Education for Sustainable Development (DESD 2005-2014). The First Two Years*. Retrieved on 24.09.2021 on here.

UNESCO (2009). *Review of Contexts and Structures for Education for Sustainable Development 2009*. Paris: UNESCO Section for DESD Coordination.

Vandenberghe, R. (1987). The Renewed Primary School in Belgium: Institutionalization of a Local Innovation Policy. In M. Miles, M. Eckholm & R. Vandenberghe (Hg.), *Lasting School Improvement. Explo-ring the Process of Institutionalization*. *ISIP-booK (Band 5)* (S. 47–67). Leuven: Acco.

Wals, A. E. J. (2009). A Mid-DESD Review: Key Findings and Ways Forward. *Journal of Education for Sustainable Development, 3*(2), pp. 195–204.

Waltner, E.-M., Glaubitz, D., & Riess, W. (2017). *Entwicklung und Evaluation eines nationalen BNE-Indikators für Lehrerfortbildungen*. Freiburg i.B.: Institut für Biologie und ihre Didaktik an der Pädagogischen Hochschule Freiburg.

Waltner, E.-M., Riess, W., & Brock, A. (2018). Development of an ESD Indicator for Teacher Training and the National Monitoring for ESD Implementation in Germany. *Sustainability, 10*, 2508.

Wismar, M., McKee, M., Ernst, K., Srivastava, D., & Busse, R. (2008). Introduction. In M. Wismar, M. McKee, K. Ernst, D. Srivastava, & R. Busse (eds.), *Health Targets in Europe. Learning from experience* (pp. 174). Copenhagen: World Health Organization on behalf of the European Observatory on Health Systems and Policies.