

Holst, Jorrit; Singer-Brodowski, Mandy; Brock, Antje; de Haan, Gerhard

Article — Published Version

Monitoring SDG 4.7: Assessing Education for Sustainable Development in policies, curricula, training of educators and student assessment (input-indicator)

Sustainable Development

Provided in Cooperation with:

John Wiley & Sons

Suggested Citation: Holst, Jorrit; Singer-Brodowski, Mandy; Brock, Antje; de Haan, Gerhard (2024) : Monitoring SDG 4.7: Assessing Education for Sustainable Development in policies, curricula, training of educators and student assessment (input-indicator), Sustainable Development, ISSN 330, John Wiley & Sons, Inc., Chichester, UK, Vol. 32, Iss. 4, pp. 3908-3923, <https://doi.org/10.1002/sd.2865>

This Version is available at:

<https://hdl.handle.net/10419/306215>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<http://creativecommons.org/licenses/by/4.0/>

Monitoring SDG 4.7: Assessing Education for Sustainable Development in policies, curricula, training of educators and student assessment (input-indicator)

Jorrit Holst  | Mandy Singer-Brodowski  | Antje Brock | Gerhard de Haan

Institut Futur, Department of Education and Psychology, Freie Universität Berlin, Berlin, Germany

Correspondence

Jorrit Holst, Institut Futur, Department of Education and Psychology, Freie Universität Berlin, Fabekstr. 37, Berlin, 14195, German. Email: j.holst@fu-berlin.de

Funding information

Bundesministerium für Bildung und Forschung, Grant/Award Numbers: 01JO2004, 01JO2305

Abstract

Education is viewed as a critical keystone in achieving the Sustainable Development Goals (SDGs). Specifically, Education for Sustainable Development (ESD) is meant to enable everyone to contribute to sustainable development (SDG 4.7). This target is monitored using the global indicator 4.7.1 – mainstreaming of ESD in policies, curricula, training of educators and student assessment. Here, we offer a conceptual and methodological framework for assessments of SDG 4.7.1 (input-level) that addresses both quality and depth of implementation and speed of change. The approach combines document analysis with external expert evaluation and is applied to 10-year data (>11,000 documents) from all formal areas of education in Germany (early childhood education, school education, vocational education and training, higher education). Currently, ESD is mostly implemented in Germany as an “add-on” to the educational system, with all sub-indicators ranging from “isolated mentioning” of ESD and related concepts to “partial integration”. Across most areas of education, the sub-indicator training of educators was evaluated as most deficient. With regard to the speed of change, it was found that the implementation of ESD is dynamic, with all sub-indicators having been evaluated as increasing. The proposed framework can increase the validity, reliability, and comparability of both country reporting and scientific assessments of SDG 4.7.1. We argue for independent and integrative monitoring across input, process, output and outcome to complement self-reporting and to support evidence-informed policymaking on sustainability in education.

KEYWORDS

Sustainable Development Goals (SDGs), SDG 4.7, Education for Sustainable Development (ESD), monitoring & evaluation, document analysis, input-indicator, early childhood education & school education, vocational education & higher education

1 | TOWARD SDG 4.7 – RESPONDING TO AN EXISTENTIAL CHALLENGE

Sustainable Development (SD) encompasses an ambitious global agenda for the development of resilient, socially just human life within

the limits of planet Earth. With 17 globally agreed upon goals, 169 targets and well over 200 indicators, the Sustainable Development Goals (SDGs) are currently the core normative framework for global sustainability efforts (e.g., Biermann et al., 2017; Biermann et al., 2022). Although the SDGs are not without controversy due to their

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2024 The Authors. *Sustainable Development* published by ERP Environment and John Wiley & Sons Ltd.

inherently conflicting goals (Hickel, 2019; Holden et al., 2017; Spangenberg, 2017), the general necessity and urgency to move toward global sustainability is virtually undisputed in academia and international politics (e.g., Richardson et al., 2023; Rockström et al., 2023; United Nations General Assembly, 2023). As important as the SDGs are, the findings of the mid-term report on their implementation are very sobering (Sachs et al., 2023): Currently, none of the 17 goals are on track, and in some cases progress is reported to be going backwards. Nonetheless, the authors remind us that all of the goals are still achievable (ibid.). For this transition, the mid-term report highlights universal quality education as a critical SD pathway, among others. This is supported by studies on assessments of the SDGs and their interactions, in which quality education (SDG 4) and particularly SDG 4.7 are described as having a strong positive relationship with various other SDGs (Dalampira & Nastis, 2020; Fonseca et al., 2020; Pham-Truffert et al., 2020; Vladimirova & Le Blanc, 2016; Xiao et al., 2023). In this vein, linking education with sustainability has been discussed as fundamental for change toward sustainability both in the fields of education (Agbedahin, 2019; Sterling, 2003, 2016; Wals & Benavot, 2017) and sustainability research (Abson et al., 2017; Otto et al., 2020; Sachs et al., 2019; Van Poeck et al., 2020).

Correspondingly, target 4.7 of the SDGs calls for education systems worldwide to “ensure [by 2030] that all learners acquire the knowledge and skills needed to promote sustainable development” (United Nations General Assembly, 2015, p. 21). Against this backdrop, Education for Sustainable Development (ESD) is approached by UNESCO and its member states as “an enabler for all 17 SDGs” and a “foundation for the required transformation” (UNESCO, 2021). Consequently, the final declaration at the UNESCO World Conference on ESD in 2021 set a commitment for member states to “[e]nsure that ESD is a foundational element of our education systems at all levels” (UNESCO, 2021, p. 2).

To be able to meet this commitment as well as the objective set in SDG 4.7, it is of critical importance to systematically monitor and evaluate the degree to which ESD and sustainability are being integrated within education systems (Brent Edwards et al., 2020; Kioupi & Voulvoulis, 2019; Stepanek Lockhart, 2018). Such data provide the basis for observing trends, identifying progress and gaps as well as deriving necessary policy measures to strengthen the implementation of ESD. As with all SDGs, the development of concrete and facilitative indicators for the integration of sustainability in education is crucial for its governance and practical implementation (Biermann et al., 2017; Hák et al., 2016; Kim, 2023). Currently, the global indicator for target 4.7 of the SDGs is described as the “extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment” (UNESCO, 2017, 2019a, 2019b). However, this indicator has not yet been sufficiently operationalized for independent and scientific assessments (Brent Edwards et al., 2020; Giangrande et al., 2019). Monitoring is currently based on countries' self-reporting using a dichotomous (yes/no) assessment scheme as well as qualitative highlighting of best-practice cases (UNESCO, 2019a, 2019b). This

reliance on countries' self-reporting results in a bias toward positive reporting (e.g., Nazir et al., 2011), which most likely does not reflect the real status of target 4.7. Taking the example of Germany, the current score on the global indicator for SDG 4.7.1 is reported at 1.0 for national education policies (range: 0–1), 0.904 for curricula, 0.95 for teacher education and 0.917 for student assessment (Destatis, 2023). However, the results derived from independent data from the national monitoring of ESD in Germany (e.g., Grund & Brock, 2020; Holst et al., 2020) are significantly different. While there is considerable support for the integration of ESD into the German education system, including through a large participatory multi-stakeholder process (Nationale Plattform BNE c/o BMBF, 2017; Singer-Brodowski et al., 2020), the discrepancies between self-reporting scores and evaluations by independent monitoring provide good reasons for complementing countries' self-reporting on SDG 4.7 with independent evaluations to allow for evidence-informed policy-making (Lingard, 2013).

Also, with regard to operationalization, the conceptual openness of the current global indicator 4.7.1. is viewed by some authors as problematic because, among other reasons, “it is not clear how comparisons of this indicator across countries should be interpreted” (Brent Edwards et al., 2020, p. 35) and because the term “*mainstreaming*” is not sufficiently concrete with regard to depth of integration (Gallwey, 2016). However, a more nuanced approach to measuring SDG 4.7.1 at the input-level of documents has not yet been proposed. Aware of the necessity of monitoring ESD across the different indicator levels (inputs, e.g., in documents; processes, e.g., assessments of Whole Institution Approaches; outputs and outcomes, e.g., assessments of competencies) and the need to develop both international and more context-specific indicators, we focus here on measurement strategies for the assessment of ESD at the input-level of documents. While we are proposing a way to further operationalize SDG 4.7.1 and apply in one illustrative context (Germany), the approach can also be used as a general input-indicator for ESD in other contexts.

Various authors have already conducted document analyses on ESD (e.g., Beveridge et al., 2019; Fredriksson et al., 2020; De Haan, 2021; Holst et al., 2020; Krah et al., 2021). However, evaluating the results of these studies has often proved difficult and, because of the lack of clear criteria for “sufficient” or “satisfactory” ESD implementation, it has not been possible to compare evaluations across different contexts and over time. This also accounts for past document analyses as part of the monitoring of ESD in Germany, where the focus has primarily been on whether the goals set by stakeholders themselves were met and how the observed status compared to other contexts described in the international literature (Holst et al., 2020). We thus see a considerable need for a conceptual and methodological framework for evaluating the current status quo and progress toward implementing SDG 4.7. Such a framework must allow for more standardized assessments that provide greater reliability and validity, and thus better comparability across contexts and over time.

In this article, we (1) propose an input-level framework for indicating and systematically assessing ESD, and specifically SDG 4.7,

based on lexical document analysis and external expert evaluation. We (2) report on the results of an assessment of the operationalized indicator 4.7.1 based on a longitudinal analysis of >11,000 documents from early-childhood education, school education, vocational education and training, and higher education in Germany. By combining systematic document analysis with an external expert evaluation, we propose an operationalization that can be used both for independent scientific assessments and as part of countries reporting on SDG 4.7.

2 | MONITORING SDG 4.7.1 AT THE INPUT-LEVEL: BASELINE DOCUMENT ANALYSES AND CONCEPTUAL FRAMEWORK FOR OPERATIONALIZATION

At the international level, the UNECE expert group on indicators for ESD contributed to the design of ESD indicators during the United Nations Decade on ESD (UNECE, 2005). This provided a basis for countries to report on their progress (UNECE, 2009, 2022) and was intended to cover a broad range of educational areas and levels (e.g., input, output/outcome). While international reporting to date has mostly been based on countries' self-assessments, independent national monitoring of ESD has been carried out at Freie Universität Berlin in Germany since 2015. This monitoring includes conducting repeated document analyses to track the status and progress of ESD implementation at the input level of educational governance. Systematic assessments of documents are considered a fundamental part of educational monitoring (Ioannidou, 2010) as documents (e.g., policies, curricula) provide important leverage for integrating emerging concepts and objectives within the structures of education systems. In Germany, data have now been collected and analyzed over a 10-year period (from 2012 to 2021) in all areas of formal education (early childhood education, school education, vocational education and training, higher education). This longitudinal document analysis serves as an exemplary data base for the operationalization of indicator 4.7.1 in this article.

In the following sections, we first present a conceptual framework for assessing different degrees of implementation of sustainability and ESD in education system documents, in line with SDG 4.7. We then outline our methodological approach to document analysis and, building on the proposed conceptual framework for indicatorising SDG 4.7.1 at the input-level, and describe the process of expert evaluation. In the results, we first synthesize the core findings from the document analysis on the status of ESD and sustainability in Germany and then present the results of the external expert evaluation on SDG 4.7.1. In the discussion, we reflect upon the core implications of the findings, strengths and limitations of the approach, and ways to further operationalize and assess SDG 4.7.

Redesign? Integrate? Add-On? What does it mean to “mainstream ESD”?

As the fundamental basis for the development of indicators for SDG 4.7, it is necessary to consider the different degrees to which

ESD and sustainability may or may not be “implemented” or “mainstreamed” within education systems. From an implementation theory perspective, the mainstreaming of the social innovation of ESD (Bormann & Nickel, 2017) can be described as the scaling of an educational reform. Coburn (2003) identifies four dimensions of the scaling of such innovations in education: depth, sustainability (in the sense of durability), spread and shift in ownership. A document analysis, by its very nature, can hardly capture a shift in ownership (the fourth dimension of Coburn's approach). However, the proposed framework traces the scaling of ESD in documents in terms of (1) depth, quality and spread (Coburn's first and third dimensions) and (2) stability and speed of scaling (Coburn's second dimension) by analyzing data at different times. With regard to depth and quality, Sterling (2003, 282ff.) describes four different modes of implementation: “*denial*” (rejection, leading to no change), “*bolt-on*” (“accommodation”, resulting in surface level reforms where sustainability is added to an existing system without changing the underlying paradigms), “*build-in*” (“serious greening”, resulting in significant system changes) and “*redesign*” (whole system change, a “deep reordering of assumptions equivalent to epistemic change”). Since the early 2000s, various authors have referred to this heuristic for evaluating the depth and quality of sustainability implementation (e.g., Kolmos et al., 2016 on engineering education; Wals & Benavot, 2017 generally on education; Weiss & Barth, 2021 on curriculum change in higher education). For the conceptual framework proposed here, we adapt, refine, and further operationalize the heuristic for evaluating SDG 4.7.1. Regarding the second aspect of mainstreaming ESD, *speed of change*, it is important to consider the usual cycles in which different types of documents are revised. As both aspects are important for the evaluation of the status and progress of ESD implementation, the proposed framework for assessments of SDG 4.7.1 contains two modules for the two separate yet interrelated domains: (1) quality and depth and (2) speed of change. The first (depth) is considered as the foundational module, which can be utilized in one-off or continuous (longitudinal) assessments. The latter (speed of change) requires time series, either – where possible – through the inclusion of past data (e.g., old and new versions of curricula, laws, exams) or, through comparative surveys (ideally, as part of long-term monitoring). Both parts of the framework are introduced in the following.

2.1 | Quality and depth of implementation

With regard to depth of implementation, we adapt and operationalize Sterling (2003) heuristic for the evaluation of document analysis within six demarcated assessment categories: (1) No Mentioning, (2) Isolated Mentioning, (3) Add-On, (4) Partial Integration, (5) Substantial Integration and (6) Redesign (for an overview, see Figure 1). In line with Sterling's approach, we suggest focusing primarily on the quality of observed implementation patterns (e.g., Redesign, Integration, Add-On, Isolated Mentioning) rather than the sheer quantity of textual references to concepts such as ESD or sustainability. At the same time,

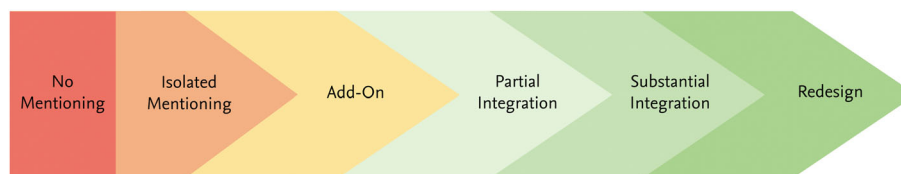


FIGURE 1 Conceptual framework for the depth of implementation of sustainability and Education for Sustainable Development (ESD) in education system documents; refined operationalization based on the underlying heuristic by Sterling (2003).

quantification is to some extent inherent in the categories presented below, considering that “Redesign” and “Substantial Integration”, by definition, require more textual references, while the categories of “No Mentioning” and “Isolated Mentioning” always imply low or non-existent quantities.

Redesign is described by Sterling (2003, p. 284) as transformation in the sense of “a deep, conscious reordering of assumptions equivalent to epistemic change, leading to change of paradigm”. Education is thereby re-thought “through a continuous learning process – to embody and reflect a whole system approach” to sustainability (ibid.:285). This paradigm shift (sustainability as a central objective of quality education) is manifested at all levels of education systems (e.g., policy, organizations and learning networks, specific learning environments and situations). In line with theories on leverage points for system changes, redesign addresses the “mindset or paradigm out of which the goals, rules, feedback structure arise” as well as the “goals of the system” itself (Abson et al., 2017; Meadows, 1997).

As the deepest form of implementation, which does not by definition require a fundamental shift in the underlying educational paradigms, **Substantial Integration** of ESD and sustainability in education system documents is operationalized to include the goal of ensuring “that all learners acquire the knowledge and skills needed to promote sustainable development” (UNESCO, 2020; United Nations General Assembly, 2015, p. 21) as a priority and guiding objective of all learning processes in a given sector of education (UNESCO, 2021). With reference to the sub-areas of the indicator for SDG 4.7, we propose operationalizing this as the following type of integration in the different areas of education:

1. **Policy:** Ambitious and binding education policy decisions and recommendations of the relevant actors in the respective education sector for the implementation of ESD and sustainability at all levels of the education sector. Key references for this are the roadmap of the UNESCO “ESD for 2030” program and the Berlin Declaration on the implementation of ESD (UNESCO, 2020, 2021).
2. **Curricula:** Cross-cutting integration of discipline-, subject- or occupation-specific goals (e.g., relevant competences), content (e.g., aspects of the SDGs, the socio-ecological transformation), didactic principles (e.g., action- and life world orientation, participation), and, if appropriate for the respective type of document, forms of organizational implementation (e.g., inclusion of the socio-physical learning environment as well as regional partners in

the sense of a whole institution approach; see Buckler & Creech, 2014; Holst, 2023).

3. **Training of educators:** Cross-cutting integration of ESD- and sustainability-specific competence goals in the relevant documents for the training and further education of educators (e.g., teachers, trainers, early childhood educators), that is, across all subjects, disciplines and age groups.
4. **Student performance assessments:** Design of examination questions in all subjects, disciplines, and professions in a form that takes into account other objectives of performance assessment and provides an incentive to promote and measure sustainability-related competences, including the critical and systemic examination of current non-sustainable development and the development of future-oriented possibilities for action.

By definition, such **Substantial Integration** implies both high *quality* and high *quantity* textual references. In contrast, **Partial Integration** requires a similarly high level of quality, but a lower level of quantity. This means that several, but not most, documents, groups or contexts apply an ambitious and binding conceptual understanding of ESD. Taking an example from Germany, partial integration might mean that there are high quality passages in texts on sustainability and ESD in the laws or curricula of several, but not most federal states.

The quality of implementation of **Add-On** differs from that of partial and substantial integration in that it refers to a pattern where the integration of textual references to SD, ESD and related concepts is predominantly of low quality and where such references are often simply added to objectives and explanations that are otherwise hardly changed at all. Sterling (2003, p. 282) describes this as “a ‘bolt-on’ of sustainability ideas to [an] existing system, which itself remains largely unchanged”. In the case of curricula, for example, this could mean adding the label “ESD” to courses without making substantial changes to their content, adding new electives on topics related to SD without making changes to the main body of compulsory courses, or modifying parts of courses or subjects so that they briefly touch on sustainability.

We suggest that isolated textual references to ESD/sustainability learning-related concepts (low quantity) that are not further contextualized and/or picked up in the rest of the document (low quality) should be considered as **Isolated Mentioning**.

The lowest proposed category (**No Mentioning**) implies that no anchoring can be identified at all.

2.2 | Speed of change

When assessing documents, speed of change always relates to the usual publication dates and revision cycles (e.g., school curricula are revised less frequently than, for example, examination questions). Moreover, speed of change can only refer to documents in which references to ESD/sustainability can be expected (e.g., no reference to sustainability or ESD could be expected in resolutions by ministries in response to the Covid-19 pandemic). Based on these considerations, we suggest operationalizing speed of change in five categories (Strong Increase, Medium Increase, Small Increase, No Change, Decrease; detailed operationalization: see methods). These can be evaluated either by external experts who have comprehensive knowledge of the fields of education (as in this study), or as part of countries' self-reporting (see discussion). Lastly, an assessment of speed of change requires data for comparisons across time, which may not always be available.

In the following section, we provide an introduction to the document analysis that serves as the data basis for external expert evaluation, and operationalize the conceptual framework within a code system for evaluations.

3 | METHODS FOR MEASURING SDG 4.7.1: DOCUMENT ANALYSIS AND EXPERT EVALUATION

3.1 | Systematic document analysis (quantitative, qualitative)

Since 2017, the national monitoring on ESD in Germany has conducted repeated large-scale document analyses, which serve as the data basis for reviewing the status and progress on SDG 4.7.1 at the input level. This current analysis includes a total of 11,061 documents (2017: 2795 (Brock et al., 2018; Singer-Brodowski, et al., 2019), 2019: 45078 (1713 new) (Holst et al., 2020), 2021/22: 11,061 (6553 new)) from all subdomains of the global indicator for 4.7: education policy, curricula, training of educators and student assessment. Table 1 provides an overview of the different types of documents included from each of the four areas of formal education (Early Childhood Education, School Education, Vocational Education and Training, Higher Education) for the four sub-indicators (Education Policy, Curricula, Training of Educators, Student Assessment).

The choice of document groups is based on (i) international indicators that were operationalized into groups of documents for assessment (Brock et al., 2018; Singer-Brodowski et al., 2019; UNECE, 2005), (ii) groups of documents specifically addressed in the National Action Plan on ESD (National Platform ESD c/o BMBF, 2017) and (iii) a systematic alignment of the document base with the subdomains of SDG 4.7.1 (education policy, curricula, training of educators, student assessment). A transdisciplinary knowledge exchange with members of the German ESD expert fora took place throughout all process steps. This iterative approach, which began in 2016,

gradually led to the inclusion of further groups of documents (e.g., exams in school education and didactic training of educators in higher education were assessed for the first time for this study).

Applying the same data collection procedure used for the 2017, 2018, and 2019 benchmark data, the new and updated data for all document groups included in this study were collected between November 2021 and January 2022. A total of 6553 additional documents were downloaded, inventoried and loaded into the data analysis software MAXQDA for this study, bringing the total dataset to 11,061 documents. All data were automatically searched for conceptual keywords relating to (i) ESD, (ii) Sustainability/Sustainable Development, (iii) Perspectives on and from ESD and (iv) Related educational concepts. An overview of all keywords used in the lexical analysis is provided in Figure 2.

Keywords on a conceptual level were chosen to address the thematic as well as the didactic level of ESD. All codings of identified text segments were checked manually, for example, to avoid miscoding, such as the use of "nachhaltig" (German for sustainable) only in the sense of "langfristig" (durable/long-term) instead of in the sense of the normative concept of sustainability/SD. As a coding rule, all segments where the coding did not seem entirely clear were strictly coded as "uncertain" and discussed in a peer debriefing (Spall, 1998) with three researchers to reach consensus or, where this was not possible, to vote on the coding. The coded text segments within each group of documents were analyzed both quantitatively and qualitatively.

3.2 | External Expert Evaluation

After reports had been finalized in German for each area of education, six external experts on ESD and educational measurement in the German education system were asked to evaluate the descriptive results according to the predefined system of categories. The experts were chosen based on their context of expertise, representing all areas of education, and their professional experience with indicator development as professors in the fields of general education and ESD. Table 2 provides an overview of the experts involved in the external evaluation with their institutional affiliation and context of expertise. The number and selection of experts took into account both the need for reliability and validity of evaluations, and the feasibility of applying the methodological framework in different contexts. Given the extensive and long-standing field knowledge and experience of the experts, in one specific area of education and more generally across all areas of education, it can be assumed that they were able to make robust assessments of the quality and speed categories based on the predefined template (below).

A template was developed (supplementary material) to standardize the external expert evaluation, including background information on the document analysis and the scales for evaluation (quality/depth, speed of change). As the descriptive basis for their judgments, the experts received a descriptive raw version of four reports on the most recent document analysis (in German: Brock & Holst, 2022; Holst, 2022; Holst & Singer-Brodowski, 2022; Singer-Brodowski &

TABLE 1 Document groups included in the systematic lexical document analysis sorted by areas of education and sub-indicators of SDG 4.7.1 (education policy, curricula, training of educators, student assessment).

	Education policy	Curricula	Training of educators	Student assessment
Early Childhood Education (ECE)	<ul style="list-style-type: none"> Laws of all states and federal laws 	<ul style="list-style-type: none"> Educational plans from all states 	<ul style="list-style-type: none"> School curricula of courses in ECE from all federal states 	
	<ul style="list-style-type: none"> Education reports 		<ul style="list-style-type: none"> Course handbooks and study/examination regulations for all study programs at higher education institutions (HEI) for educators in ECE 	
School Education (SE)	<ul style="list-style-type: none"> Documents from the conferences of Ministers for Youth and Family Affairs (JFMK) / Education (KMK) and the Child and Youth Welfare Association (AGJ) 			
	<ul style="list-style-type: none"> Laws of all states 	<ul style="list-style-type: none"> School curricula of all 16 states for 9 selected subjects 	<ul style="list-style-type: none"> Course handbooks and study/examination regulations for teacher training at the 20 higher education institutions with most graduates in Germany 	<ul style="list-style-type: none"> Exams for degrees in secondary education (Abitur, Realschule, Hauptschule) from 2005 until 2021
Vocational Education and Training (VET)	<ul style="list-style-type: none"> Documents from the Standing Conference of the Ministers of Education and Cultural Affairs (KMK) with focus on SE 			
	<ul style="list-style-type: none"> Federal and state laws 	<ul style="list-style-type: none"> All new or modified training regulations since 2015 	<ul style="list-style-type: none"> Course handbooks and study/ examination regulations for teacher training in five selected states 	<ul style="list-style-type: none"> Regulations on exams in training regulations since 2015
	<ul style="list-style-type: none"> Federal Institute for VET (BIBB), KMK-Committee on VET 	<ul style="list-style-type: none"> All new or modified frame-curricula for VET-schools since 2015 	<ul style="list-style-type: none"> Ordinance on Trainer Aptitude (AEVO) and regulations for further training of educators 	
Higher Education (HE)	<ul style="list-style-type: none"> Education reports and data reports (BIBB) 	<ul style="list-style-type: none"> Guides for Educational Practice (BIBB) since 2015 		
	<ul style="list-style-type: none"> Federal and state laws 	<ul style="list-style-type: none"> Course handbooks and course regulations of 3 subjects (biology, mechanical engineering, business administration) from 20 HEIs 	<ul style="list-style-type: none"> Didactic training of educators at 20 HEIs and respective networks for didactic training in HE 	
	<ul style="list-style-type: none"> Federal, regional rectors' conferences (HRK/LRK) 			
	<ul style="list-style-type: none"> Target agreements of all states with HEI 			
	<ul style="list-style-type: none"> Education reports 			
	<ul style="list-style-type: none"> Student associations 			
	<ul style="list-style-type: none"> HEI self-governance (e.g., mission statements, reports, strategies, statutes) from 20 HEIs 			

1. Education for Sustainable Development <ul style="list-style-type: none"> • Education for Sustainable Development • Education as Sustainable Development • ESD / EFS* (German & English) 	2. Sustainability / Sustainable Development <ul style="list-style-type: none"> • Sustainability • Sustainable Development • sustain (German & English)
3. Perspectives on and from ESD <ul style="list-style-type: none"> • Global Action Programme, GAP • ESD for 2030*, ESD2030* • National Action Plan* • Whole Institution Approach • Whole School Approach • SDG, Agenda 2030 • Global goal • Intergenerational / Future generation • Planetary Boundar / Guardrail • Global development 	4. Related educational concepts <ul style="list-style-type: none"> • Gestaltungskompetenz (Shaping competency) • Transformative learning / education • Global citizenship education • Climate education • Global learning • Learning in global contexts • Development policy education • Environmental education / pedagogy • Nature education / pedagogy • Ecological education

FIGURE 2 Conceptual keywords used for lexical search (translated from German, different forms for singular/plural as well as different suffixes were included); based on Holst et al. (2020). Keywords which were included in this study for the first time are marked with.

TABLE 2 Experts involved in the external expert evaluation with institutional affiliation and context of expertise.

Expert	Institutional affiliation	Context of expertise
Prof. Dr. Inka Bormann	Freie Universität Berlin	Professor of General Education
Prof. Dr. Johannes Hartig	Leibniz Institute for Research and Information in Education	Professor of Educational Measurement
Prof. Dr. Werner Kuhlmeier	University of Hamburg	Professor of Vocational Education
Prof. Dr. Armin Lude	Ludwigsburg University of Education	Professor of Biology and Biology Education
Prof. Dr. Heike Molitor	Eberswalde University for Sustainable Development	Professor of Environmental Education and Education for Sustainable Development
Prof. Dr. Marco Rieckmann	University of Vechta	Professor of Higher Education Development

Holst, 2022). Abstracts, evaluations and recommendations were removed to better ensure an unbiased and independent evaluation by the experts. The descriptive reports were divided into five PDFs (introduction and methods, one PDF for each sub-indicator of SDG 4.7.1) and provided to the experts with the template. The following Tables 3 and 4 are part of the template and were provided to the experts as the predefined category system for assessment. First, Table 3 introduces the category system used to evaluate the quality and depth of ESD implementation. Table 4 subsequently introduces the category system used to evaluate speed of change.

Importantly, the rating of both categories (depth/quality, speed) refers to the predominant pattern of anchoring, which means that individual references are less important in the evaluation than the larger patterns. During the evaluation, all document groups were evaluated

individually and an aggregated assessment was made for each sub-indicator. After the six expert evaluations had been collected, the mean and modus were calculated for each document group and sub-indicator.

4 | RESULTS

Section 4.1 provides a descriptive overview of the main results of the document analysis for each area of education. These serve as the data for the evaluation of SDG 4.7.1. The results of the expert evaluation are reported in section 4.2.

4.1 | Implementation of ESD and related concepts in Germany: Descriptive overview

Before presenting the results for each area of education, it is important to note that, under the German constitution, education in Germany is the responsibility of the 16 federal states. This means that the federal government only has direct influence on some parts of the education system (e.g., parts of vocational education) and that most data are reported for the 16 states.

4.1.1 | Early childhood education (ECE)

Early childhood education in Germany is primarily organized by independent institutions. Municipalities and states support daycare places, and in recent years the federal government has provided funding for overall quality development. At the level of **education policy** (state laws), there is a slight trend toward the inclusion of ESD compared to the previous study, with 4 state laws (2019: 1) referring to sustainability or ESD. The supporting associations, which are united in the Child and Youth Welfare Association (AGJ), have also taken a position on ESD.¹ Position papers of the Standing Conference of the Ministers of Education and Cultural Affairs (KMK) on the training of early childhood education specialists and support staff have provided a basis for

TABLE 3 Category system for quality and depth of ESD implementation with descriptions and further elaborations for the categories “Redesign”, “Substantial Integration”, “Partial Integration”, “Add-On”, “Isolated Mentioning” and “No Mentioning”.

Category	Description	Further elaboration
Redesign	<u>Comprehensive redesign or reorganization of the fundamental orientation of documents/document groups toward sustainability/ESD (paradigm/lived culture of sustainability).</u>	Understanding of ESD as a central, continuous and binding part of the educational mission in the sense of a whole institution and ultimately a whole-system approach, which in turn corresponds to a fundamentally changed educational paradigm/a lived culture of sustainability (cf. also Sterling, 2003). The orientation toward sustainability restructures the goals and paths of the educational sector / institution in question.
Substantial Integration	<u>Deep and cross-sectional integration of sustainability/ESD in the various documents/document groups; high quantity and quality (substantial integration) of references on ESD and sustainability.</u>	An ambitious and binding conceptual understanding of ESD is consistently applied to the content of the respective documents (e.g., curriculum or resolution).
Partial Integration	<u>Predominantly high content quality of the references to ESD/sustainability in the sense of substantial integration in several documents/document groups</u> (e.g., in several, but not all federal states) with differences between or within the documents/document groups.	An ambitious and binding conceptual understanding of ESD is applied in several documents of a document group or in several federal states, subjects, or at several locations with high content quality in the sense of substantial integration (see above).
Add-on	References to ESD/sustainability are predominantly of <u>medium to low content quality</u> , often as a supplement to otherwise frequently unchanged requirements/objectives/explanations.	For example, naming the concept of ESD in curricula, but without describing goals, content, methods/media, and organizational implementation as substantially oriented toward ESD/sustainability.
Isolated mentioning	<u>Isolated references</u> in individual documents (groups of documents) that are not further contextualized and/or taken up in the rest of the document.	Isolated references to for example, sustainability, ESD or related concepts.
No mentioning	<u>No mentioning</u> of sustainability, ESD or related concepts.	

TABLE 4 Category system for speed of change of ESD-implementation with descriptions for the categories “Strong Increase”, “Medium Increase”, “Small Increase”, “No Increase” and “Decrease”.

Category	Description
Strong increase	A <u>very strong/rapid increase</u> in references to ESD/sustainability in the respective documents (groups) compared to usual publication/revision times.
Medium increase	A <u>significant increase</u> in references to ESD/sustainability in the respective documents (groups) compared to usual publication/revision times.
Small increase	A <u>slow increase</u> in references to ESD/sustainability in the respective documents (groups) compared to usual publication/revision times, recognizable by sporadically increasing references.
No change	<u>No change</u> is discernible over time.
Decrease	A <u>reduction of references</u> to sustainability/ESD can be observed in the periods under consideration.

strengthening ESD in training (see below). ESD has not been included in education reporting. Regarding the **curricula**, there are no binding documents for young children up to the age of 6. However, by the end of 2021, 9 of the 16 educational plans of the federal states explicitly referred to ESD (2017: 6; 2019: 8). A clear trend can therefore be

observed, which applies in particular to the recently revised educational plans. Early childhood **educators** follow one of two training paths: traditional dual educator training (see section on Vocational Education and Training (VET) below) or an early education/childhood study program at higher education institutions. An increase of references to ESD or related concepts was found in documents related to study programs (3% of documents with references in 2017 to 5% in 2021). Specifically, this means that references to ESD could be found on about one in 31 analyzed pages (2017: 1/139 pages), and references to sustainability on about one in 45 pages (2017: 1/256 pages). There is also an increase in the proportion of ESD in relation to other sustainability-related educational concepts. An even clearer trend is evident in VET for early childhood educators: starting from comparatively few references in the baseline analysis (2017: 1 reference every 280 pages, $n = 292$), ESD is more frequently integrated in more recent documents (2019: 1 reference every 43 pages, $n = 44$; 2021: 1 reference every 24 pages, $n = 72$). No ECE documents exist that could be analyzed in the area of **student assessments**.

4.1.2 | School education (SE)

In Germany, SE laws, curricula and examination questions differ from state to state. The Standing Conference of the Ministers of Education and Cultural Affairs (KMK) therefore wields considerable influence as the joint consulting body of the federal states. A review of the

different **education policies** adopted in each state shows that no change has occurred in the education laws of the 16 federal states since 2019. Four laws explicitly refer to ESD and another four mention sustainability. The recommendations and resolutions issued by the KMK since 2019 only refer to ESD in one thematically relevant document on consumer education. ESD is not referred to in documents that focus on the overarching design of the school system. The analysis of **curricula** continues to show that references to ESD and SD differ greatly across federal states and subjects. Looking first at all curricula valid at the time of data collection ($n = 422$), four federal states included at least some explicit references to ESD in more than 50% of all curricula assessed. However, the curricula documents from eight states included ESD in less than 20% of the documents analyzed. There is a strong tendency to include references in subjects that are thematically close to SD, which limits the cross-cutting implementation of ESD. In a few federal states, ESD has been implemented across different subjects (e.g., Baden-Württemberg, North Rhine-Westphalia, Saxony). ESD is rarely – 6% of all documents – integrated in training course handbooks and course/examination regulations for the **training of educators**, whereas ESD-relevant terms, including related concepts, appear in 14% of the documents. Documents that contain references to (E)SD focus primarily on specific universities and, again, on specific subjects (e.g., biology, geography). In 5 out of 20 of the largest teacher training institutions in Germany, ESD did not appear in any document. Within the category of **student assessment**, thematic references to the ecological dimension of SD were analyzed based on dimensions of the planetary boundary concept (Steffen et al., 2015). The number of text segments has increased over the past years, especially those related to climate change and, less frequently, biodiversity. Strong differences were also found between subjects. For instance, 78% of geography exams referred to SD, and 46% to climate change. In business administration, 41% referred to SD and around one third (28%) to climate. There were far fewer references to SD in other subjects, such as most natural sciences, German, history, or arts, with a maximum of 3% of all exams in each subject referring to SD-related issues.

4.1.3 | Vocational education and training (VET)

In Germany, VET is organized in a dual system, in which vocational schools cooperate with companies to combine both theoretical and practical perspectives. While a programmatic discourse on sustainability in VET was observed in the last assessment in 2019, the concrete integration of ESD was described as slower and less dynamic (Holst et al., 2020). In contrast, the present analysis shows significant trends toward embedding sustainability in the German VET system between 2019 and 2021. Regarding VET-related **education policies**, the concept of sustainability (not ESD) has been included in the standard training elements (“Standardberufsbildpositionen”) by the Federal Institute for VET (BIBB), and the contribution to SD has been included by the KMK in the corresponding agreement as a task of vocational schools. No major changes were observed with regard to laws and

educational reporting. In particular, the inclusion of sustainability in the standard training elements and the KMK's curriculum development guidebook has led to a sharp increase in the number of text segments in **curricula** (training regulations, school curricula) that refer to sustainability. As of 2021, all new or updated documents include references to sustainability (not to ESD, which could only be expected in school curricula). So far, this only affects a comparatively small number of vocations (e.g., 5 training regulations in 2021), in which the number of references to sustainability has increased (e.g., in training regulations, from an average of 4.5 to 10.8 mentions per document). In terms of depth, references are frequently overarching VET requirements or closely follow the wording of the standard training element. The concrete meaning of sustainability for a specific vocational context is only defined in individual cases. Regarding the **training of educators** (teacher training in universities), the longitudinal data show an increase in the relevant text segments based on an overall low anchorage in 2017 and 2019 (Holst et al., 2020). However, these references focus primarily on single HEIs and individual courses (1% of all text segments at four out of 16 HEIs). Further, the respective sections on **student assessment** in all training regulations published between 2015 and 2021 were analyzed: Out of a total of 66 vocations, 6 training regulations (9%) referred to sustainability. Although the standard training elements should legally be part of all assessments, this is not yet reflected in the data since 2020.

4.1.4 | Higher education (HE)

In HE, the category of **education policy** includes state-policies (including agreements between federal states and HEIs) and the documents produced by self-governing HEIs. Continuing a trend described in Holst et al. (2020), the data shows that sustainability – and to some extent ESD – is increasingly included in target agreements between state ministries and HEIs. In 2021, 12 of the 16 federal states mentioned sustainability at least once in >50% of their agreements with HEIs (7/16 for ESD). At the same time, frequency and qualitative depth vary strongly between states and among HEIs. In contrast to earlier observations, significant dynamic can be observed in state laws, with 10 of the 16 states mentioning sustainability as a core mission of HEIs (2017: 5, 2019: 6). In addition, from 2022 onwards, two states explicitly designate ESD as a compulsory objective (Hesse, Bavaria). In contrast to state policies, there are far fewer references to ESD and sustainability in documents in the self-governance documents of HEIs (e.g., mission statements, strategies, statutes) and in the positions formulated by the federal and regional rectors' conferences. A slowly increasing number of individual references to sustainability were found in **curricula** (module guides; e.g., in biology, business administration, mechanical engineering) at almost all of the 20 HEIs surveyed, albeit with a low frequency (2021: approx. one reference every 14.8 pages, 2017: 19.3, 2019: 25.7). The majority of references are concentrated in individual HEIs and within individual study programs and modules (82% of all references at 5 out of 20 HEIs). Overall, the data do not show a comprehensive horizontal integration of

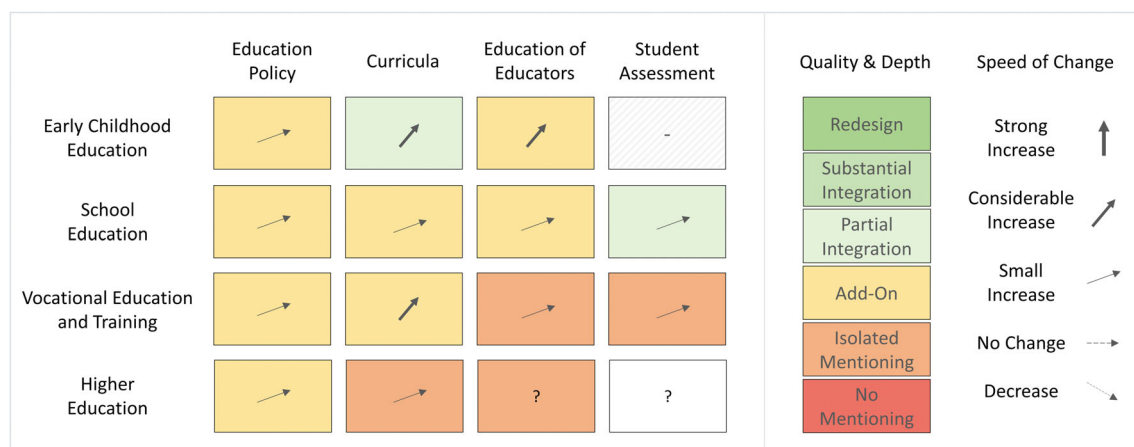


FIGURE 3 The status of and progress with the implementation of Education for Sustainable Development (ESD) in the German education system. Colors and arrows refer to the rounded mean external expert evaluations (see Table 5) of quality and depth of implementation as well as speed of change. No data exists for student assessment in Early Childhood Education (ECE) and no data was assessed for student assessment in Higher Education (HE). Speed of change could not be evaluated for training of educators and student assessment in HE due to a lack of appropriate data (indicated with a question mark).

sustainability or ESD in the analyzed curricula. Bearing in mind their importance in enhancing the quality of training in the **training of educators**, assessments were carried out on programs for further training in higher education didactics. Of the 126 documents from the 20 assessed HEIs and related networks (2020, 2021), 6 documents (5 modules) referred to ESD and sustainability in individual modules at 7 of the 20 HEIs. The data did not show structural that is, systematic, cross-sectional and comprehensive embedding of ESD, sustainability and related concepts. As exams in HE are mostly created individually by each lecturer and are therefore highly heterogeneous, no data on **student assessment** in HE could be assessed.

4.2 | External expert evaluation on SDG 4.7.1

As part of the external evaluation, six experts in ESD and educational monitoring evaluated the descriptive results in terms of both depth and quality of implementation as well as speed of change. Figure 3 and Table 5 show their evaluation of the status and progress of ESD implementation in Germany across all formal areas of education and sub-indicators for SDG 4.7. Figure 3 provides a graphical overview of both quality and depth (background colors) and speed of change (arrows). The same result is presented in descriptive form (means and distributions for the ratings of each sub-indicator) in Table 4 below. Across all sub-indicators and areas of education, the mean expert-evaluations are concentrated on and spread around the “Add-on”-pattern of implementation (indicated in yellow in Figure 3). This pattern describes a medium to low overall quality of integration, where implementation usually involves adding ESD to a mostly unchanged main body of content. The evaluations by the experts range from isolated mentions of sustainability, ESD and related concepts (curricula in HE, training of educators in VET and HE, student assessment in VET, orange in Figure 3) to partial integration, which

describes a high quality of implementation in several but not the majority of documents or document groups (curricula in ECE, student assessment in SE; light green in Figure 3). Of the sub-indicators, the training of educators is currently the lowest ranked sub-indicator in Germany with two areas of education rated as “Isolated Mentioning” (VET, HE), and two as “Add-On” (ECE, SE). No sub-indicator scored within the lowest and highest categories of “No Mentioning” and “Substantial Integration” or “Redesign” respectively. Even one aggregation level below sub-indicators, within the specific document groups, none of the 34 document groups were rated by the experts as fitting into the categories of “Substantial Integration” or “Redesign”. Two were rated as not mentioning sustainability, ESD or related concepts at all (National Education Reports, Ordinance on Trainer Aptitude in VET (AEVO)).

In terms of the speed of change, the experts evaluated the increases in implementation since the last assessment to be small for most of the sub-indicators (30° upward pointing arrows in Figure 3). For the sub-indicators on ECE and VET curricula and on ECE educator training, all three of which started from a comparatively low level of implementation in the previous evaluation (Holst et al., 2020), the increases were rated as medium/significant (60° upward pointing arrows in Figure 3). None of the sub-indicators were considered by the experts to have increased significantly, and none was judged to have decreased or not changed at all. Looking at the individual document groups, considerable increases were seen in nine of the 34 document groups. These include laws and target agreements in HE, different types of curricula (ECE, VET), documents of the Standing Committee of the Federal Institute for Vocational Education and Training (BIBB-Hauptausschuss) in VET and positions formulated by the Child and Youth Welfare Association (AGJ) in ECE.

With regard to the variance of the responses (Table 5) it is worth noting that, with the exception of one sub-indicator (curricula in VET), the responses scatter around a maximum of three assessment

TABLE 5 Expert evaluations of quality/depth and speed of ESD implementation in documents of the German education system (mean, distribution in brackets) for all four subdomains of target 4.7.1 of the Sustainable Development Goals (mainstreaming of ESD in education policy, curricula, training of educators and student assessment). Results are shown for early childhood education (ECE), school education (SE), vocational education and training (VET) and higher education (HE). Scale for quality: 0 = No Mentioning, 1 = Isolated Mentioning, 2 = Add-On, 3 = Partial Integration, 4 = Substantial Integration, 5 = Redesign. Scale for speed: -1 = Decrease, 0 = No Change, 1 = Small Increase, 2 = Considerable Increase, 3 = Strong Increase. nR = No Response.

		Education policy	Curricula	Training of educators	Student assessment
Early childhood education	Quality	1,7 (1***, 2**, 3*)	2,8 (2*, 3*****)	1,8 (1**, 2***, 3*)	-
	Speed	1,0 (1*****)	1,5 (1***, 2****)	1,8 (1*, 2*****)	-
School education	Quality	1,7 (1***, 2**, 3*)	2,3 (1*, 2**, 3****)	1,7 (1**, 2****)	2,5 (2***, 3****)
	Speed	0,5 (0**, 1****)	1,0 (1*****)	0,8 (0*, 1****, nR*)	1,2 (1****, 2*, nR*)
Vocational education and training	Quality	1,8 (1**, 2***, 3*)	2,3 (1*, 2***, 3*, 4*)	1,0 (1*****)	1,2 (1****, 2*)
	Speed	1,2 (1****, 2*)	1,8 (1**, 2***, 3*)	1,0 (1*****)	0,8 (0*, 1****)
Higher education	Quality	2,2 (1*, 2***, 3**)	1,2 (1****, 2*)	1,0 (1*****)	-
	Speed	1,0 (1*****)	1,0 (0*, 1***, 2*, nR*)	-	-

categories and in most cases the mode matches the mean. Focusing on the differences in the evaluations of all 34 individual document groups (one aggregation level below the sub-indicators), the highest mean score of the expert evaluation on depth of implementation is 3.3 (“Partial Integration”) for the most recent documents from the BIBB-Hauptausschuss (part of education policies in VET), which issued an update to the standard training elements (“Standardberufsbildpositionen”) in 2020 to include sustainability as a focus for all training programs in VET. This score is considerably higher than the scores for the document groups in the sub-indicator for education policies in VET (e.g., laws, documents by the KMK which focus primarily on the school side of the dual VET system in Germany). A further finding specific to the area of HE is that policy documents are evaluated differently depending on whether they are the responsibility of state actors (laws, target agreements) or students (publications by state student councils) on the one hand, or the direct responsibility of autonomous HE institutions on the other. While state and student-driven documents were generally evaluated as “Partial Integration” and as increasing considerably (e.g., target agreements ($M_{\text{Quality}} = 2.8$) or documents by State Student Councils ($M_{\text{Quality}} = 3.0$)), most documents produced by HE institutions and their representative bodies were categorized as “Isolated Mentioning” and sometimes “Add-On” with little or no increase. In ECE, the documents of the Child and Youth Welfare Association (AGJ) were evaluated as of higher quality ($M = 2.3$) with a considerably faster speed of change ($M = 1.8$) than policy documents from the federal states or the minister conferences.

5 | DISCUSSION: DEVELOPMENT OF INPUT-INDICATOR FOR ESD IN LINE WITH SDG 4.7 AND ILLUSTRATIVE ASSESSMENT IN GERMANY

The development of concrete, measurable and facilitative indicators is crucial to support evidence-based governance of the integration of sustainability into all levels of education (on SDG indicators generally,

Hák et al., 2016; Biermann et al., 2017; Kim, 2023). However, most international SDG assessments do not focus on the implementation of ESD and sustainability in education (SDG 4.7). Instead, SDG assessments to date have tended to refer to general developments in education. As an example, the SDG-mid-term report includes data on participation rates in pre-primary learning, primary-, secondary school enrollment and literacy rates (Sachs et al., 2023). Other assessments measure SDG 4 according to school enrollment rates, literacy rates, or gender parity index of school enrolment among others (e.g., Campagnolo et al., 2018; Huan et al., 2021). The input-indicator framework presented in this article differs from these analyses in that it focuses explicitly on the depth and speed of ESD integration, which is critical to the quality with which sustainable development is implemented and practiced in education. While the importance of ESD for high quality education has often been proclaimed and indicators for ESD have been discussed for over 15 years (e.g., Tilbury, 2007), monitoring of SDG 4.7 specifically has to date mostly relied upon country self-reporting using a binary (yes/no) scheme (UNESCO, 2019a, 2019b). With the proposed framework we respond to this by offering a procedure to increase the validity, reliability and reproducibility of input-assessments of SDG 4.7.1.

The framework can be used to evaluate the status and development of ESD implementation in documents at the level of countries and federal states, as well as in the context of international frameworks and education partnerships (e.g., UN, UNESCO, OECD, and others). The operationalization is two-dimensional. It includes the quality and depth of ESD implementation as well as speed of change and combines lexical document analysis with structured external expert evaluation. The reliability of assessments is increased by proposing clearly structured categories for the evaluation of quality (6 categories) and speed of change (5 categories) of implementation of ESD and related concepts in documents. This allows for a more concise and comparable understanding of the different levels of monitoring and mainstreaming of ESD (see Brent Edwards et al., 2020; Gallwey, 2016). As the literature-based conceptual framework beneath the category system provides a condensed understanding of

the different degrees of quality of integration and depth, the framework itself also contributes to increased assessment validity. By providing clear methodological steps, the framework allows for reproducibility and comparability across diverse research contexts and time periods. By broadening the knowledge base for future evaluations, the framework might also bridge approaches between international large-scale assessments and less quantitative evaluations of cross-cutting educational topics such as ESD (e.g., Sinnes & Eriksen, 2016). In addition, by minimizing the risk of author or self-reporting bias, external expert evaluation increases the objectivity of evaluations.

The framework could be used in future assessments in two ways:

1. First, the use of independent scientific analyses with external expert evaluation is proposed as a complement to country self-reporting. Depending on the resources and data available, assessments can either focus solely on current quality and depth, or – if longitudinal data are available – also include speed of change. The commissioning of independent assessments would allow for countries to assess the current situation as well as shortcomings and trends and would provide an empirical basis for informed policy making.
2. Second, the conceptual framework can be used as part of self-assessments: The quality of self-assessments could be enhanced by complementing reporting on thematic indicators (e.g., on the integration of human rights, gender equality, peace and non-violence) with a structured and critical self-evaluation of the patterns of quality and depth of ESD implementation (0: No Mentioning, 1: Isolated Mentioning, 2: Add-On, 3: Partial Integration, 4: Substantial Integration, 5: Redesign) as well as speed of change in the domains of SDG 4.7.1 (–1: Decrease, 0: No Change, 1: Small Increase, 2: Medium Increase, 3: Strong Increase).

The quality of the data evaluated is critical to the validity of the results for both pathways (scientific assessments, self-assessments). The documents assessed must be representative of the total set of documents (e.g., no showcasing of best practices; focus not only on latest, but on all currently valid documents). It is moreover important for external evaluation purposes to involve external experts from the specific region who have considerable contextualized field knowledge of the different educational areas and, ideally, of educational monitoring in general.

5.1 | Assessment in Germany: From add-on to substantial integration?

The conceptual and methodological framework for assessing SDG 4.7.1 was applied in this study to the German context. The experts on ESD and educational measurement evaluated most 4.7.1 sub-indicators in the “Add-On” category. This describes the implementation of ESD and sustainability content as predominantly of medium to low quality, often as an addition to otherwise unchanged educational

objectives or explanations (also Sterling, 2003). Evaluations ranged around the “Add-On” category from isolated mentioning of ESD-related concepts in the training of educators (VET, HE), curricula (HE) and student assessment (VET) to partial integration in curricula of ECE and student assessment in SE. Across the four sub-domains, educator training is still the lowest ranked sub-indicator, which is in line with previous studies (Grund & Brock, 2020; Holst et al., 2020) and international studies on ESD (De Haan 2021; Fischer et al., 2022; Gough, 2016). In the area of education policy, we found that in many cases there are policies on ESD, but they are often non-binding and often address ESD as an “add-on” instead of a central point of reference. Particularly within curricula, but also across all other domains, we found strong foci of textual references within specific states, subjects, organizations (e.g., HEIs) and modules. Overall, based on the conceptual framework presented in this study, it is not yet apparent that ESD has been comprehensively integrated (in a cross-cutting way) into documents of the German education system. While the “No Mentioning” category was not used at all, which means that ESD has its place in all areas of education and all sub-domains of SDG 4.7.1 in Germany, the same is currently true for the “Substantial Integration” and “Redesign” categories. In terms of speed of change, the German data clearly show a dynamic of implementation (all sub-indicators were evaluated as increasing). However, the experts rated the increases as mostly small or, in some sub-indicators and areas of education, as considerable. It is important to note here that the evaluation of the speed of change is related both to the revision cycles of documents (e.g., curricula are only revised every 10 to 20 years) and the speed of change required to achieve the objective set in SDG 4.7 – enabling all to contribute to sustainability by 2030. While the current implementation might be considered dynamic compared to (a) past timescales of substantial changes in education systems and (b) the low implementation status reported in the first analysis in 2017 (Brock et al., 2018; Singer-Brodowski et al., 2019), this dynamic is still too slow given the ambition of SDG 4.7.

5.1.1 | Methodological strengths and limitations

In addition to the contributions of the presented framework to enhancing the reliability, validity and objectivity of ESD assessments at the input level, further methodological strengths and limitations require discussion. First, the data set containing over 11,000 documents from over 30 document groups is very heterogeneous. This implies that both the initial analysis and the external evaluation required considerable system-specific knowledge on the part of the researchers and external experts involved. The analysis presented here therefore needed time and resources, which may not be available in every context. However, one strength of the approach lies in its scalability, that is, the same procedure can be applied to a much smaller dataset, as long as the selection of documents accurately represents the total set of documents (e.g., a document analysis for one federal state in one area of education, see Krah et al., 2021) or other educational concepts (e.g., Global Citizenship Education). For regional

adaptation, we suggest involving key stakeholders from civil society, educational practice, administration and academia in the selection of document groups to be assessed. Regarding the keywords used for lexical analysis, we deliberately focused on conceptual keywords (e.g., ESD, sustainability/SD, related educational concepts and perspectives). Naturally, thematic references to sustainability and ESD (e.g., to sustainability-related topics) can be found more frequently across the set of documents than conceptual keywords. However, assessing a wide range of conceptual keywords gives a broader impression not only of the topics but also of the objectives, methods and approaches associated with the educational concept of ESD (e.g., Brundijs et al., 2021; De Haan, 2010; Rieckmann et al., 2017). Also, SDG 4.7.1 specifically focuses on the “mainstreaming” of ESD. Here we argue again that this is best operationalized by focusing on the relevant key concepts. Lastly, while a wide range of data was included in the present study, not all sub-indicators could be covered equally: No data are available for student assessment in ECE (there are no assessments in ECE) and no data were collected in HE, where data might theoretically exist, but in practice are very difficult to acquire as exams in HE are very diverse and mostly created by the individual lecturers themselves.

6 | CONCLUSIONS & OUTLOOK

In light of the ambition articulated in SDG 4.7 – to enable all to contribute to SD until 2030 – the Declaration from the recent UNESCO World Conference on ESD calls on all countries to “[e]nsure that ESD is a foundational element of our education systems at all levels” (UNESCO, 2021, p. 2). If the practice of sustainability in education is to live up to the call for ESD to become a “key enabler of all the other SDGs” (United Nations General Assembly, 2017), it is necessary that its structural integration into education systems matches this ambition. Clearly, individuals cannot be expected to act consistently in a sustainable manner if the norms around them – as formalized in documents – treat sustainability as an isolated issue or “add-on”. Although integration in structures involves more than anchoring in documents (e.g., mental structures), these formalizations set a frame for human action, provide orientation and are therefore an important lever for changing practice. For this reason, it is crucial that reliable assessments are made of the status and progress on SDG 4.7. The proposed framework adds validity, reliability, and comparability to country reporting and scientific assessments (Brent Edwards et al., 2020; Giangrande et al., 2019). Furthermore, the categories introduced can also be a means for policymakers, administrators, and practitioners to reflect on their actions in relation to sustainability in education.

With regard to further developments, future research may focus particularly on understanding the processes of policy development and policy mobility (McKenzie et al., 2015) which lead to ESD implementation in line with a pattern of integration or even redesign. In this vein of public policy-making, it would be critical to explore how administrative stakeholders in particular can overcome status-quo

biases (e.g., thinking ESD in an “add-on”-mode). We further argue that while stocktaking through input assessments is critical to understanding the status and progress of structural implementation, integrative monitoring approaches may go further and include indicators also across the levels of educational processes, outputs and outcomes (e.g., Holst et al., *in review*; Marron & Naughton, 2019; Unterhalter, 2019). Regarding monitoring, internationally agreed-upon indicators (e.g., on 4.7) may be complemented with context-specific indicators to foster participation and generation of policy-relevant knowledge, e.g., at sub-national levels (also Brockwell et al., 2022; Gallwey, 2016). Finally, while there is a tendency to focus on what is easy to measure using existing data, we join various other scholars in arguing that it is critical to aim for assessments that actually measure what is important for achieving the targets set (e.g., Brockwell et al., 2022; McCool & Stankey, 2004). Ultimately, consistently linking education with sustainability in times of mounting unsustainability crises is closely connected to what education is fundamentally about: to empower learners to understand and address the key epochal problems of any given time (Klafki, 1996; Kvamme, 2021).

ACKNOWLEDGMENTS

We would like to thank the six external experts, Prof. Dr. Inka Bormann, Prof. Dr. Johannes Hartig, Prof. Dr. Werner Kuhlmeier, Prof. Dr. Armin Lude, Prof. Dr. Heike Molitor and Prof. Dr. Marco Rieckmann for their participation in the expert evaluation as well as for helpful feedback on the analysis. We also thank our colleagues Julius Grund, Marie Heitfeld, Niclas Kollhoff, Christoph Schönherr and Sophie Schulte for their feedback on the evaluation template and the manuscript. This research received funding from the German Federal Ministry of Education and Research under Grants No. 01JO2004 and 01JO2305. Open Access funding enabled and organized by Projekt DEAL.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ORCID

Jorrit Holst  <https://orcid.org/0000-0002-2677-806X>

Mandy Singer-Brodowski  <https://orcid.org/0000-0002-9176-318X>

ENDNOTE

¹ https://www.agj.de/fileadmin/files/positionen/2021/AGJ-Discussion_Paper_How_dare_you.pdf.

REFERENCES

- Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C. D., Jäger, N. W., & Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio*, 46(1), 30–39. <https://doi.org/10.1007/s13280-016-0800-y>
- Agbedahin, A. V. (2019). Sustainable development, education for sustainable development and the 2030 agenda for sustainable development: Emergence, efficacy, eminence, and future. *Sustainable Development*, 27(4), 669–680. <https://doi.org/10.1002/sd.1931>

- Beveridge, D., McKenzie, M., Aikens, K., & Strobbe, K. M. (2019). A National Census of sustainability in K-12 education policy: Implications for international monitoring, evaluation, and research. *Canadian Journal of Educational Administration and Policy*, 188, 36–52.
- Biermann, F., Hickmann, T., S  nit, C.-A., Beisheim, M., Bernstein, S., Chasek, P., Grob, L., Kim, R. E., Kotz  , L. J., Nilsson, M., Ord    ez Llanos, A., Okereke, C., Pradhan, P., Raven, R., Sun, Y., Vijge, M. J., van Vuuren, D., & Wicke, B. (2022). Scientific evidence on the political impact of the sustainable development goals. *Nature Sustainability*, 5(9), 795–800. <https://doi.org/10.1038/s41893-022-00909-5>
- Biermann, F., Kanie, N., & Kim, R. E. (2017). Global governance by goal-setting: The novel approach of the UN sustainable development goals. *Current Opinion in Environmental Sustainability*, 26–27, 26–31. <https://doi.org/10.1016/j.cosust.2017.01.010>
- Bormann, I., & Nikel, J. (2017). How education for sustainable development is implemented in Germany: Looking through the lens of educational governance theory. *International Review of Education*, 63(6), 793–809. <https://doi.org/10.1007/s11159-017-9683-9>
- Brent Edwards, D., Sustarsic, M., Chiba, M., McCormick, M., Goo, M., & Perriton, S. (2020). Achieving and monitoring education for sustainable development and global citizenship: A systematic review of the literature. *Sustainability*, 12(4), 1–57. <https://doi.org/10.3390/su12041383>
- Brock, A., De Haan, G., Etzkorn, N., & Singer-Brodowski, M. (Eds.). (2018). *Wegmarken zur Transformation—Nationales Monitoring von Bildung f  r nachhaltige Entwicklung in Deutschland*. Verlag Barbara Budrich.
- Brock, A., & Holst, J. (2022). Schl  ssel zu Nachhaltigkeit und BNE in der Schule: Ausbildung von Lehrenden, Verankerung in der Breite des F  cherkanons und jenseits der Vorworte. Kurzbericht des Nationalen Monitorings zu Bildung f  r nachhaltige Entwicklung (BNE). Freie Universit  t Berlin. <https://doi.org/10.17169/refubium-36094>
- Brockwell, A. J., Mochizuki, Y., & Sprague, T. (2022). Designing indicators and assessment tools for SDG target 4.7: A critique of the current approach and a proposal for an 'Inside-out' strategy. *Compare: A Journal of Comparative and International Education*, 1–19. <https://doi.org/10.1080/03057925.2022.2129957>
- Brundiers, K., Barth, M., Cebri  n, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W. R., Habron, G., Harre, N., Jarchow, M. E., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R. A., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—Toward an agreed-upon reference framework. *Sustainability Science*, 16(1), 13–29. <https://doi.org/10.1007/s11625-020-00838-2>
- Buckler, C., & Creech, H. (2014). *Shaping the future we want: UN decade of education for sustainable development (2005-2014). Final report*. UNESCO.
- Campagnolo, L., Eboli, F., Farnia, L., & Carraro, C. (2018). Supporting the UN SDGs transition: Methodology for sustainability assessment and current worldwide ranking. *Economics*, 12(1), 1–31. <https://doi.org/10.5018/economics-ejournal.ja.2018-10>
- Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher*, 32(6), 3–12. <https://doi.org/10.3102/0013189X032006003>
- Dalampira, E.-S., & Nastis, S. A. (2020). Mapping sustainable development goals: A network analysis framework. *Sustainable Development*, 28(1), 46–55. <https://doi.org/10.1002/sd.1964>
- De Haan, G. (2010). The development of ESD-related competencies in supportive institutional frameworks. *International Review of Education*, 56(2-3), 315–328. <https://doi.org/10.1007/s11159-010-9157-9>
- De Haan, G. (2021). Bildung f  r nachhaltige Entwicklung in Luxemburg: Eine Bestandsaufnahme. In LUCET & SCRIPT (Eds.), *Nationaler Bildungsbericht Luxemburg 2021* (pp. 211–225). Imprimerie Centrale.
- Destatis. (2023). Integration von 'Global Citizenship Education' und, Bildung f  r nachhaltige Entwicklung' im Bildungswesen. Retrieved from <https://sdg-indikatoren.de/4-7-1/>
- Fischer, D., King, J., Rieckmann, M., Barth, M., B  ssing, A., Hemmer, I., & Lindau-Bank, D. (2022). Teacher education for sustainable development: A review of an emerging research field. *Journal of Teacher Education*, 73(5), 509–524. <https://doi.org/10.1177/00224871221105784>
- Fonseca, L. M., Domingues, J. P., & Dima, A. M. (2020). Mapping the sustainable development goals relationships. *Sustainability*, 12(8), 3359. <https://doi.org/10.3390/su12083359>
- Fredriksson, U., Kusanagi, N., Gougoulakis, P., Matsuda, Y., & Kitamura, Y. (2020). A comparative study of curriculums for education for sustainable development (ESD) in Sweden and Japan. *Sustainability*, 12(3), 1123. <https://doi.org/10.3390/su12031123>
- Gallwey, S. (2016). Capturing transformative change in education: The challenge of tracking Progress towards SDG target 4.7. *Policy and Practice: A Development Education Review*, 23, 124–138.
- Giangrande, N., White, R. M., East, M., Jackson, R., Clarke, T., Saloff Coste, M., & Penha-Lopes, G. (2019). A competency framework to assess and activate education for sustainable development: Addressing the UN sustainable development goals 4.7 challenge. *Sustainability*, 11(10), 2832. <https://doi.org/10.3390/su11102832>
- Gough, A. (2016). Teacher education for sustainable development: Past, present and future. In W. Leal Filho & P. Pace (Eds.), *World sustainability series. Teaching education for sustainable development at university level* (pp. 109–122). Springer International Publishing. https://doi.org/10.1007/978-3-319-32928-4_8
- Grund, J., & Brock, A. (2020). Education for sustainable development in Germany: Not just desired but also effective for transformative action. *Sustainability*, 12(2838), 1–20. <https://doi.org/10.3390/su12072838>
- H  k, T., Janou  skov  , S., & Moldan, B. (2016). Sustainable development goals: A need for relevant indicators. *Ecological Indicators*, 60, 565–573. <https://doi.org/10.1016/j.ecolind.2015.08.003>
- Hickel, J. (2019). The contradiction of the sustainable development goals: Growth versus ecology on a finite planet. *Sustainable Development*, 27(5), 873–884. <https://doi.org/10.1002/sd.1947>
- Holden, E., Linnerud, K., & Banister, D. (2017). The imperatives of sustainable development. *Sustainable Development*, 25(3), 213–226. <https://doi.org/10.1002/sd.1647>
- Holst, J. (2022). Nachhaltigkeit & BNE in der Beruflichen Bildung: Dynamik in Ordnungsmitteln, Potentiale bei Berufen, Lernorten und in der Qualifizierung von Auszubildenden. Kurzbericht des Nationalen Monitorings zu Bildung f  r nachhaltige Entwicklung (BNE). Freie Universit  t Berlin. <https://doi.org/10.17169/refubium-35827>
- Holst, J. (2023). Towards coherence on sustainability in education: A systematic review of whole institution approaches. *Sustainability Science*, 18(2), 1015–1030. <https://doi.org/10.1007/s11625-022-01226-8>
- Holst, J., Brock, A., Singer-Brodowski, M., & de Haan, G. (2020). Monitoring progress of change: Implementation of Education for Sustainable Development (ESD) within documents of the German education system. *Sustainability*, 12(10), 4306. <https://doi.org/10.3390/su12104306>
- Holst, J., Grund, J., & Brock, A. (in review). *Whole Institution Approach: Measurable and highly effective in empowering learners and educators for sustainability*.
- Holst, J., & Singer-Brodowski, M. (2022). Nachhaltigkeit & BNE im Hochschulsystem: St  rkung in Gesetzen und Zielvereinbarungen, ungenutzte Potentiale bei Curricula und Selbstverwaltung. Kurzbericht des Nationalen Monitorings zu Bildung f  r nachhaltige Entwicklung (BNE). Freie Universit  t Berlin. <https://doi.org/10.17169/refubium-35828>
- Huan, Y., Liang, T., Li, H., & Zhang, C. (2021). A systematic method for assessing progress of achieving sustainable development goals: A case study of 15 countries. *The Science of the Total Environment*, 752, 141875. <https://doi.org/10.1016/j.scitotenv.2020.141875>
- Ioannidou, A. (2010). Educational monitoring and reporting as governance instruments for evidence-based education policy. In S. K. Amos (Ed.), *International perspectives on education and society* (Vol. 12, pp. 155–172). Emerald. [https://doi.org/10.1108/S1479-3679\(2010\)0000012011](https://doi.org/10.1108/S1479-3679(2010)0000012011)

- Kim, R. E. (2023). Augment the SDG indicator framework. *Environmental Science & Policy*, 142, 62–67. <https://doi.org/10.1016/j.envsci.2023.02.004>
- Kioui, V., & Voulvoulis, N. (2019). Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes. *Sustainability*, 11(21), 6104. <https://doi.org/10.3390/su11216104>
- Klafki, W. (1996). *Neue Studien zur Bildungstheorie und Didaktik: Zeitgemäße Allgemeinbildung und kritisch-konstruktive Didaktik*. Beltz Verlag.
- Kolmos, A., Hadgraft, R. G., & Holgaard, J. E. (2016). Response strategies for curriculum change in engineering. *International Journal of Technology and Design Education*, 26(3), 391–411. <https://doi.org/10.1007/s10798-015-9319-y>
- Krah, J. M., Reimann, J., & Molitor, H. (2021). Sustainability in Brandenburg study programs. Perspectives for anchoring sustainability in higher education curricula. *Sustainability*, 13(7), 3958. <https://doi.org/10.3390/su13073958>
- Kvamme, O. A. (2021). Rethinking Bildung in the Anthropocene: The case of Wolfgang Klafki. *HTS Theologies Studies/Theological Studies*, 77(3), 1–9. <https://doi.org/10.4102/hts.v77i3.6807>
- Lingard, B. (2013). The impact of research on education policy in an era of evidence-based policy. *Critical Studies in Education*, 54(2), 113–131. <https://doi.org/10.1080/17508487.2013.781515>
- Marron, R. K., & Naughton, D. (2019). Monitoring Progress Towards SDG Target 4.7 in Europe: Proposed Framework and Tools.
- McCool, S. F., & Stankey, G. H. (2004). Indicators of sustainability: Challenges and opportunities at the interface of science and policy. *Environmental Management*, 33(3), 294–305. <https://doi.org/10.1007/s00267-003-0084-4>
- McKenzie, M., Bieler, A., & McNeil, R. (2015). Education policy mobility: Reimagining sustainability in neoliberal times. *Environmental Education Research*, 21(3), 319–337. <https://doi.org/10.1080/13504622.2014.993934>
- Meadows, D. H. (1997). Places to intervene in a system. *Whole Earth*, 91(1), 78–84.
- Nationale Plattform BNE c/o BMBF. (2017). Nationaler Aktionsplan Bildung für nachhaltige Entwicklung: Der deutsche Beitrag zum UNESCO-Weltaktionsprogramm. Retrieved from https://www.bmbf.de/bmbf/shareddocs/downloads/files/nationaler_aktionsplan_bildung_fuer_nachhaltige_entwicklung.pdf?_blob=publicationFile&v=2
- Nazir, J., Pedretti, E., Wallace, J., Montemurro, D., & Inwood, H. (2011). Reflections on the Canadian experience with education for climate change and sustainable development. *Canadian Journal of Science, Mathematics and Technology Education*, 11(4), 365–380. <https://doi.org/10.1080/14926156.2011.624673>
- Otto, I. M., Donges, J. F., Cremades, R., Bhowmik, A., Hewitt, R. J., Lucht, W., Rockström, J., Allerberger, F., McCaffrey, M., Doe, S. S. P., Lenferna, A., Morán, N., van Vuuren, D. P., & Schellnhuber, H. J. (2020). Social tipping dynamics for stabilizing Earth's climate by 2050. *Proceedings of the National Academy of Sciences of the United States of America*, 117(5), 2354–2365. <https://doi.org/10.1073/pnas.1900577117>
- Pham-Truffert, M., Metz, F., Fischer, M., Rueff, H., & Messerli, P. (2020). Interactions among sustainable development goals: Knowledge for identifying multipliers and virtuous cycles. *Sustainable Development*, 28(5), 1236–1250. <https://doi.org/10.1002/sd.2073>
- Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S. E., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., von Bloh, W., Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kumm, M., Mohan, C., Nogués-Bravo, D., et al. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37), adh2458. <https://doi.org/10.1126/sciadv.adh2458>
- Rieckmann, M., Mindt, L., & Gardiner, S. (2017). *Education for sustainable development goals: Learning objectives*. UNESCO.
- Rockström, J., Gupta, J., Qin, D., Lade, S. J., Abrams, J. F., Andersen, L. S., & Zhang, X. (2023). Safe and just earth system boundaries. *Nature*, 619(7968), 102–111. <https://doi.org/10.1038/s41586-023-06083-8>
- Sachs, J. D., Lafortune, G., Fuller, G., & Drumm, E. (2023). Implementing the SDG stimulus. In *Sustainable development report 2023*. Dublin University Press. <https://doi.org/10.25546/102924>
- Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six transformations to achieve the sustainable development goals. *Nature Sustainability*, 2(9), 805–814. <https://doi.org/10.1038/s41893-019-0352-9>
- Singer-Brodowski, M., Brock, A., Etzkorn, N., & Otte, I. (2019). Monitoring of education for sustainable development in Germany – insights from early childhood education, school and higher education. *Environmental Education Research*, 25(4), 492–507. <https://doi.org/10.1080/13504622.2018.1440380>
- Singer-Brodowski, M., von Seggern, J., Duveneck, A., & Etzkorn, N. (2020). Moving (Reflexively within) structures. *The Governance of Education for Sustainable Development in Germany*. *Sustainability*, 12(7), 2778. <https://doi.org/10.3390/su12072778>
- Singer-Brodowski, M., & Holst, J. (2022). Nachhaltigkeit & BNE in der Frühen Bildung: Chancen durch Partizipation und ökologische Kinderrechte, Bedarfe bei der Ausbildung von Fachkräften. Kurzbericht des Nationalen Monitorings zu Bildung für nachhaltige Entwicklung. <https://doi.org/10.17169/refubium-35735>
- Sinnes, A. T., & Eriksen, C. C. (2016). Education for sustainable development and international student assessments: Governing education in times of climate change. *Global Policy*, 7(1), 46–55. <https://doi.org/10.1111/1758-5899.12256>
- Spall, S. (1998). Peer debriefing in qualitative research: Emerging operational models. *Qualitative Inquiry*, 4(2), 280–292. <https://doi.org/10.1177/107780049800400208>
- Spangenberg, J. H. (2017). Hot air or comprehensive Progress? A critical assessment of the SDGs. *Sustainable Development*, 25(4), 311–321. <https://doi.org/10.1002/sd.1657>
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Ingo, F., Bennett, E. M., Biggs, R., Carpenter, S. R., de Vries, W., de Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 348(6240), 1217–c. <https://doi.org/10.1126/science.aaa9629>
- Stepanek Lockhart, A. (2018). Monitoring ESD: Lessons learned and ways forward. In A. Leicht, J. Heiss, & W. J. Byun (Eds.), *Issues and trends in education for sustainable development* (pp. 215–231). United Nations Educational, Scientific and Cultural Organization.
- Sterling, S. (2003). *Whole systems thinking as a basis for paradigm change in education: Explorations in the context of sustainability* (PhD). University of Bath.
- Sterling, S. (2016). A commentary on education and sustainable development goals. *Journal of Education for Sustainable Development*, 10(2), 208–213. <https://doi.org/10.1177/0973408216661886>
- Tilbury, D. (2007). Monitoring and evaluation during the UN decade of education for sustainable development. *Journal of Education for Sustainable Development*, 1(2), 239–254. <https://doi.org/10.1177/097340820700100214>
- UNECE. (2005). *Indicators for education for sustainable development*. Progress report on the work of the Expert Group Retrieved from <https://unece.org/fileadmin/DAM/env/documents/2005/cep/ac.13/cep.ac.13.2005.9.e.pdf>
- UNECE. (2009). Learning from each other: The UNECE Strategy for Education for Sustainable Development ECE/CEP/159. Retrieved from <https://sdgs.un.org/sites/default/files/publications/798ece5.pdf>
- UNECE. (2022). Implementation of the UNECE strategy for ESD across the ECE region (2015–2018). Retrieved from https://unece.org/sites/default/files/2022-09/Implementation%20of%20the%20UNECE%20Strategy_web_final_05.09.2022.pdf

- UNESCO. (2017). Measurement Strategy for SDG Target 4.7: Proposal by GAML Task Force 4.7. Retrieved from GAML4/17 website: <http://uis.unesco.org/sites/default/files/documents/gaml4-measurement-strategy-sdg-target4.7.pdf>
- UNESCO. (2019a). Proposal for monitoring of SDG indicators 4.7.1, 12.8.1 and 13.3.1. TCG6/REF/14. Retrieved from United Nations Educational, Scientific and Cultural Organization website: <https://tcg.uis.unesco.org/wp-content/uploads/sites/4/2019/08/TCG6-REF-14-Proposal-for-monitoring-of-SDG-indicators-4.7.1-12.8.1-and-13.3.1.pdf>
- UNESCO. (2019b). TCG6/REF/4. SDG indicator 4.7.1: Proposal for a measurement strategy. Retrieved from United Nations Educational, Scientific and Cultural Organization website: <https://tcg.uis.unesco.org/wp-content/uploads/sites/4/2019/08/TCG6-REF-4-4.7.1-Proposal-for-measurement-strategy.pdf>
- UNESCO. (2020). *Education for sustainable development. A roadmap*. UNESCO.
- UNESCO. (2021). *Berlin declaration on education for sustainable development*. UNESCO.
- United Nations General Assembly. (2015). 70/1. Transforming Our World: The 2030 Agenda for Sustainable Development. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
- United Nations General Assembly. (2017). Education for sustainable development in the framework of the 2030 Agenda for Sustainable Development: Resolution 72/222.
- United Nations General Assembly. (2023). Political declaration of the high-level political forum on sustainable development convened under the auspices of the General Assembly A/HLPF/2023/L.1. Retrieved from https://hlpf.un.org/sites/default/files/2023-09/A%20HLPF%202023%20L1.pdf?_gl=1*krm5r*_ga*Mjc5NDQ5NDA4LjE2MDMxNDUzNDU.*_ga_TK9BQL5X7Z*MTY5NjM0NTIzNi4xMjEuMS4xNjk2MzQ3Nzk1LjAuMC4w
- Unterhalter, E. (2019). The many meanings of quality education: Politics of targets and indicators in SDG 4. *Global Policy*, 10(S1), 39–51. <https://doi.org/10.1111/1758-5899.12591>
- Van Poeck, K., Östman, L., & Block, T. (2020). Opening up the black box of learning-by-doing in sustainability transitions. *Environmental Innovation and Societal Transitions*, 34, 298–310. <https://doi.org/10.1016/j.eist.2018.12.006>
- Vladimirova, K., & Le Blanc, D. (2016). Exploring links between education and sustainable development goals through the lens of UN flagship reports. *Sustainable Development*, 24(4), 254–271. <https://doi.org/10.1002/sd.1626>
- Wals, A. E. J., & Benavot, A. (2017). Can we meet the sustainability challenges? The role of education and lifelong learning. *European Journal of Education*, 52(4), 1–10. <https://doi.org/10.1111/ejed.12250>
- Weiss, M., Barth, M., & von Wehrden, H. (2021). The patterns of curriculum change processes that embed sustainability in higher education institutions. *Sustainability Science*, 16(5), 1579–1593. <https://doi.org/10.1007/s11625-021-00984-1>
- Xiao, H., Liu, Y., & Ren, J. (2023). Synergies and trade-offs across sustainable development goals: A novel method incorporating indirect interactions analysis. *Sustainable Development*, 31(2), 1135–1148. <https://doi.org/10.1002/sd.2446>

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Holst, J., Singer-Brodowski, M., Brock, A., & de Haan, G. (2024). Monitoring SDG 4.7: Assessing Education for Sustainable Development in policies, curricula, training of educators and student assessment (input-indicator). *Sustainable Development*, 32(4), 3908–3923. <https://doi.org/10.1002/sd.2865>