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## Sustainable Schools: Changing Society Towards Sustainability

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RESEARCH ARTICLE OPEN ACCESS

# Sustainable Schools: Changing Society Towards Sustainability

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## ABSTRACT

A change in mindset has taken place in educational institutions, characterised by a growing awareness of sustainability and environmental aspects. Inspired by the UNESCO Global Action Programme, various ministries have allowed to be certified as a School of Sustainability at different levels, albeit on a voluntary basis and without substantial integration to date. As a good example, the implementation process towards a certified School of Sustainability was monitored to promote a change towards sustainability. It was a holistic process that encompassed various areas of school life. Sustainability was not only related to normal school lessons but anchored cross-sectionally. A strategy was developed and opportunities were identified to overcome major challenges to promote long-term change and to permanently integrate principles of sustainability into everyday school life. Projects were defined and divided into three complexity levels of implementation according to the 17 Sustainable Development Goals. The cross-sectional education for sustainable development (ESD) was established as a holistic school development approach. The school developed itself into a sustainable organization so that what has been learned is put into everyday practice. The everyday school setting with sustainability multipliers became key to changing the mindset of families and thus society as a whole towards greater sustainability. As demonstrated, a concrete implementation concept helps educational institutions to find financial resources and organisational structures, whereby staff qualification and mandatory (not voluntary) certification is key to achieve 'ESD for 2030'.

## 1 | Introduction

Sustainability has developed more strongly than almost any other topic in recent years (Statista 2024). Early on, the term *Sustainable Utilisation* was used in connection with forestry. Trees could only be felled to the extent that they could grow back to conserve resources in the long term (von Carlowitz 1713; Teichert et al. 2024). Nowadays, the various definitions of the term *Sustainability* have fundamental similarities. Firstly, sustainability is always focused on the present and the future and therefore has a temporal reference. Secondly, resources,

material/intangible goods, economic/ecological units, etc. should be protected, especially if they are not renewable. Thirdly, the continued existence of a reference object should be ensured in the short and long term.

Sustainability comprises three dimensions, which include economic, social, and ecological goals (United Nations Department of Economic and Social Affairs 2020). Sustainable development requires social change, and thus, education for sustainable development (ESD) plays a central role in achieving this goal (Federal Ministry of Education and Research 2020). The UNESCO

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Global Action Programme from 2015 to 2019 (UNESCO 2015) pursued the goal of bringing about long-term systemic change in the education system and transforming ESD from a project into an established structure. Through ESD, every individual realises that their actions have consequences not only for themselves and their immediate environment but also for others. Everyone can contribute to making the world a better place. This mindset is crucial to initiating change and tackling urgent global problems (Barth 2021; Federal Ministry of Education and Research 2022a).

After several years of successful implementation of the UNESCO Global Action Programme on ESD (UNESCO 2018) and the 17 Sustainable Development Goals (SDGs) (United Nations Department of Economic and Social Affairs 2020), the new programme *Education for Sustainable Development: Towards achieving the 17 SDGs* (ESD for 2030) was launched in 2021 (Byun 2020). This new UNESCO programme underlines the importance of ESD in achieving the global 2030 Agenda for Sustainable Development. The 17 SDGs set a pioneering direction for the future of our world (Federal Ministry of Education and Research 2022b; UNESCO 2021). In total, 193 countries have committed themselves to enabling all people to live in dignity by 2030 while ensuring the long-term preservation of natural resources (World Hunger Help 2024).

Schools play a key role as multipliers in creating a sustainable future, as they shape a large part of young adults with influence on their everyday lives and further development. Given the many sustainability crises such as climate change, species loss, and growing social injustice, school education has an impact on their knowledge, attitudes, emotions, and values and can therefore help them to shape the future (Grund and Brock 2022). However, students must develop skills and value orientations themselves. Therefore, education for sustainable development (ESD) requires action-oriented, transformative pedagogy (Rieckmann 2024). It follows the didactic principles of learner-centredness and accessibility, discovery and networked learning, action and reflection orientation, transformative and transgressive learning, participation orientation, vision orientation, and the connection of social, self-related, and method-oriented learning with subject-related learning (Lamanauskas and Malinauskienė 2024; O'Grady 2023). Learning environments that support reflection, participation, and critical thinking among students are necessary for structural, qualitatively profound transformative learning processes to take place (Rieckmann 2024).

The topic of sustainability is largely included in school curricula for individual subjects. However, it does not take up much space (Ministry of Education and Culture 2022). Although various ministries in Germany offer voluntary certification programmes such as the 'School of Sustainability' (Ministry of the Environment, Climate, Mobility, Agriculture and Consumer Protection 2023b), there is no obligation for schools to participate. While this non-mandatory framework allows for substantial integration in line with 'ESD for 2030', it raises questions about commitment, effectiveness and comparability. Implementation depends largely on the contribution and commitment of multipliers, that is, teachers who agree to intensively accompany the certification process and on students who support the change.

Schools are advised and financially supported in the certification process through teaching materials, appropriate training courses, event programmes, and cooperation with ESD experts outside of schools.

This study contributes to the scientific foundation of school transformation processes in the context of sustainable development. It systematically and quantitatively analysed the comprehensive implementation process of school sustainability strategies within the framework of the desired certification as a School of Sustainability. For a holistic school development approach, it was hypothesized that key is the development of an evidence-based implementation model with project measures according to the 17 Sustainable Development Goals (SDGs) categorised as low, medium, and high content and organisational complexity. Exemplarily, two projects were examined in depth and critically discussed on the basis of the quality criteria of the National Action Plan for Education for Sustainable Development and their position within the 2030 Agenda.

## 2 | Methods

### 2.1 | Quantitative Project-Based Methodology

A project-based learning and teaching framework was used to promote, acquire, and develop a range of skills in the students and a deeper knowledge through active engagement with real and relevant problems and challenges (Seidel and Gotzen 2024). The project-based method focuses on active, self-directed, and cooperative learning in which the outcome is open. As a project carried out in teams in class, students worked on a sustainability task within a set period to present practical results at the end. It required the organisation of both the individual work process and the group work process. Project-based learning is a quantitative method as it is characterised by clear objectives and measurable results. The quantitative method is evident in project-based learning in six phases. Although project-based learning is often accompanied by qualitative methods, a quantitative methodology was systematically integrated (Supporting Information S1). At the beginning of a project, specific goals were defined, which were concretised by measurable indicators. These indicators included, for example, product quality, student and teacher satisfaction, or learning success based on partial results. The time limit of a project made it possible to precisely record the amount of time spent, while the consumption of resources such as materials or working time was also quantified. Progress was continuously documented and analysed, for example, in the learning diaries of students. At the end of the project, a tangible result or product was created, for example, through objectively assessed feedback or tests. Individual or group performance was measured based on criteria such as the quality of the work results or compliance with deadlines. Thus, progress and success were objectively demonstrated (Almulla 2020; Balleisen et al. 2024).

The stages of the quantitative project-based methodology were set as follows:

1. Project idea and definition: The idea of realising a specific sustainability project began with a task, an idea, and a topic. Project goals and boundaries were defined.

2. **Project planning:** The implementation of the project was preceded by comprehensive project planning with the support of the students so that joint ideas for the sustainability project were developed. Teamwork had to be organised, and work plans, schedules, and timetables had to be developed, that is, the structure of the project was formed and documented. In addition, milestones were agreed upon, for example, at which point in time which hurdle must be reached. It was advantageous to involve as many different people as possible in the project, such as sponsors, experts, institutions, and colleagues.
3. **Project implementation and control:** The project-based method had a student-centred approach, which meant that students took responsibility for their learning and allowed for interdisciplinary learning, as the sustainability projects can be integrated into all subjects. They were actively involved in project design and implementation, learnt to identify and discuss problems, collected data, and developed solutions. Changing plans in the event of unexpected problems and dealing with them were important aspects of project control.
4. **Decision-making process:** Monitoring a project guarantees its progress, and the solutions found were peer-reviewed to achieve substantiated, informed decisions.
5. **Reflection, evaluation, completion, and maintenance:** At the end of the project, students reflected on their experiences and the results achieved. This encouraged critical thinking and learning from successes and mistakes. The assessment was carried out through self-reflection and feedback from peers, including teachers. The sustainability project, well-integrated into the life of the school but ongoing, has to be nurtured and maintained in defined intervals.
6. **Dissemination:** The outcome was made visible to others. Work in the area of public relations, for example, scientific publication, homepage, press, and exhibition, was important tasks to be handled for motivation, transparency, and tolerance.

## 2.2 | Quantification of Achieved Goals

For certification, important steps must be defined and progress achieved must be measurable. A specific (S), measurable (M), attractive (A), reasonable (R), and time-bound (T) method, termed SMART (Eremit and Weber 2015), was used to quantitatively evaluate the project goals. This evaluation process was peer-reviewed by the Ministry of Education and Culture.

## 2.3 | Certification Process

Several ESD multipliers were appointed within the school community, who constantly accompanied and promoted the certification process. The application for certification was made to the Ministry by submitting a self-disclosure of the educational institution including a letter of motivation (Ministry of the Environment, Climate, Mobility, Agriculture and Consumer Protection 2023a). The self-disclosure contained a brief

description of the previous school activities in the area of ESD and information on five fields of action (Ministry of Education and Culture 2022; Ministry of the Environment, Climate, Mobility, Agriculture and Consumer Protection 2023a).

## 3 | Results

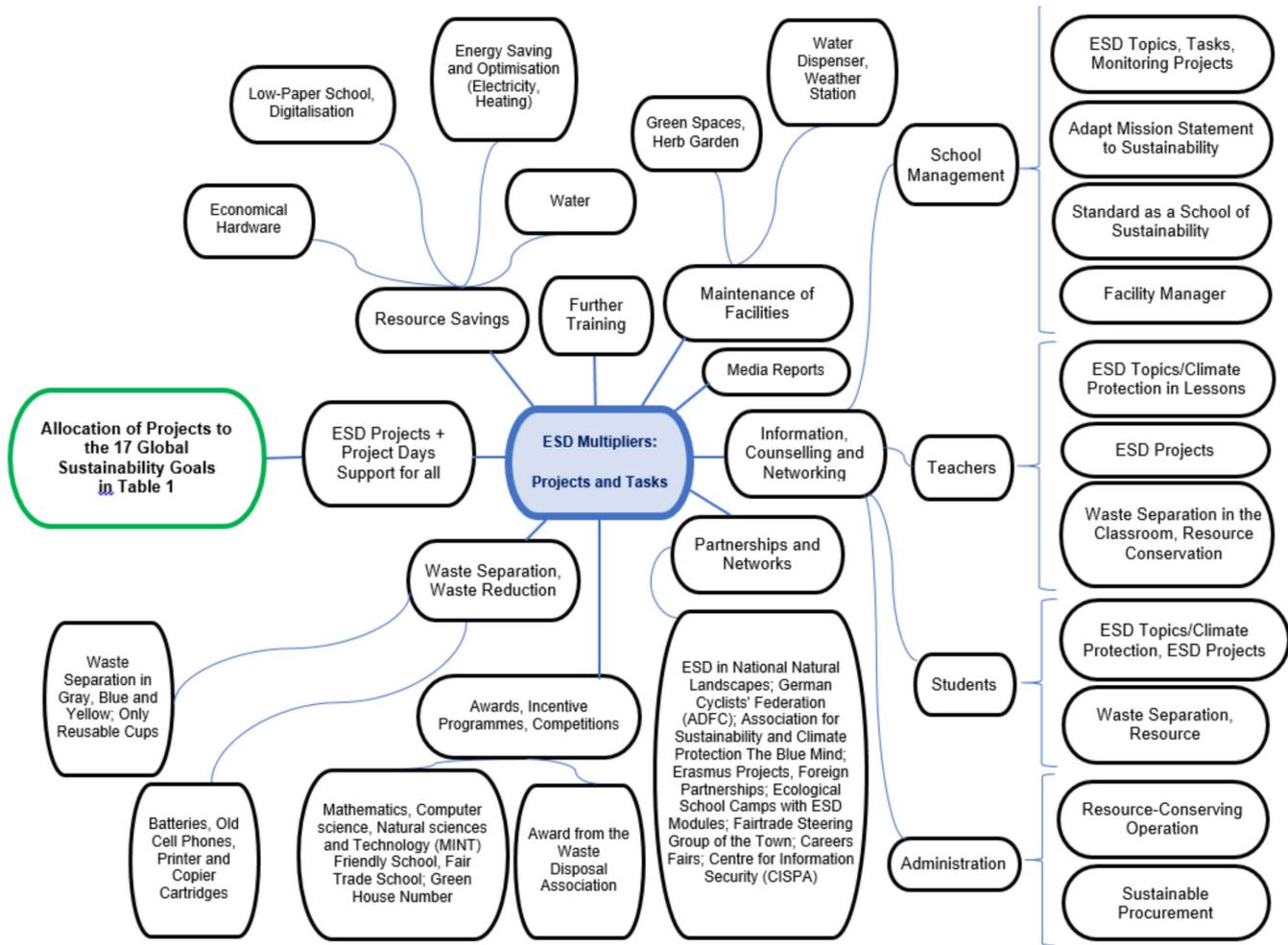
### 3.1 | Incentives for Certification

The benefits and reasons that motivate educational institutions to participate in a certification process for sustainability are as follows (Basheer et al. 2024; Bonilla-Jurado et al. 2024; Reimers 2024).

1. **Quality improvement:** Certification helps educational institutions to improve their quality in terms of sustainability by setting clear standards and criteria. The feedback received helps to identify weaknesses so that the topic can be continuously optimised.
2. **Reputation:** Certification as a *School of Sustainability* improves the reputation and standing of the educational institution and can increase the confidence of parents, students, teachers, and the public in the quality of the educational institution.
3. **Competitiveness:** In the increasingly competitive educational environment, certification helps the educational institution to stand out from others and increase its attractiveness. This can have a positive impact on student enrolment and the financial stability of the school.
4. **Compliance with standards:** Through certification, schools ensure that they meet 'ESD for 2030' educational standards and guidelines for sustainable development. This is particularly important to comply with government regulations and ensure the quality of the educational experience for students.
5. **Professionalisation:** Teachers and staff remain proactively active in change management and are supported through further training opportunities.
6. **Social responsibility:** Educational institutions can demonstrate their commitment to sustainability issues and act as multipliers to promote awareness of this important topic and transfer and communicate sustainability to society as a whole.

### 3.2 | Strategy for Implementation

Projects, sub-projects, goals, and tasks were defined (Figure 1). The SMART method (Eremit and Weber 2015) was used to effectively achieve project goals. It represents five criteria (i.e., specific, measurable, attractive, reasonable, and time-bound) by which a goal is to be achieved. Specific means that the objective is formulated clearly and unambiguously so that everyone involved knows exactly what is to be achieved. The specificity gives a clear direction. Measurable means that there are concrete criteria that can be used to assess or measure whether progress and ultimately the goal has been achieved. Attractive means that the goal is motivating and achievable for everyone involved. It should not be too easy or unrealistically difficult so that they are committed to



**FIGURE 1** | Evoking projects, sub-projects, goals, and tasks of ESD multipliers compiled as a network.

working towards the goal. Reasonable means that the goal is realistic and can be realised with the available resources and framework conditions and makes sense in terms of the overall project. Time-bound means that the goal has a clear deadline by which it is to be achieved. The time limit helped to keep the focus and to better plan the work steps. The appointed four ESD multipliers continuously supported the projects and tasks and promoted the certification process. In the course of the first projects, more and more teachers became involved in the certification process and agreed to become multipliers who have one paid reduction hour per week, but this is often not enough. The respective teacher in each project was required to ensure that each project succeeded.

Projects identified as relevant were allocated to the 17 SDGs (Table 1) (Sharma and Andreou 2018). They were divided into three categories, that is, easy to implement, moderately difficult to implement, and complex to implement, based on specific challenges (specified in Supporting Information S2). As a strategy, the easy-to-implement projects are recommended to be started first, which trigger motivation through success and fast results and progress, followed by more complex projects. These projects can be adapted according to the age group and resources of the school. The simpler projects require less time and resources, while the more complex projects require long-term planning and cooperation. These projects offer students the opportunity to actively engage with the 17 SDGs and make a positive contribution

to their community and beyond. School projects targeting the 17 SDGs are therefore often multi-dimensional and help to achieve several goals simultaneously, reflecting the complexity and interconnectedness of the challenges.

Young people who are confronted with more sustainability in their educational institution tend to behave more sustainably (Grund and Brock 2022). Numerous skills of the students were improved through practicing project-based learning and decision-making, problem-solving, cooperation, communication, self-directed and self-regulated learning, and self-efficient time management (Seidel and Gotzen 2024). Project-based learning was accompanied by a great commitment on the part of the teaching staff. In the following, the implementation of project-based learning was exemplified by two projects in detail. The project *Healthy Snacks* falls into the moderately-difficult-to-implement category, and the project *Forest Classroom* with the follow-up projects falls into the complex-to-implement category.

### 3.3 | Moderately-Difficult-To-Implement Project *Healthy Snacks*

The SDGs were associated with this project as follows. For SDG 2 and SDG 3, the students learnt to cook, prepare healthy food,

**TABLE 1** | Allocation of projects to the 17 SDGs (World Hunger Help 2024) divided into three categories, that is, easy to implement (green dot), moderately difficult to implement (orange dot), and complex to implement (red dot); the two projects discussed are in bold.

17 SDGs	Projects allocated and color-coded depending on complexity of implementation
<p>1. No Poverty</p> 	<ul style="list-style-type: none"> <li>● Support for the homeless through biscuit-baking campaigns</li> <li>● Support of Caritas by donations in kind from teachers</li> <li>● Various fundraising campaigns (e.g., Christmas café)</li> </ul>
<p>2. Zero Hunger</p> 	<ul style="list-style-type: none"> <li>● School cooking in cooperation with food-sharing</li> <li>● Sustainability working group at the technical college</li> <li>● Food rescue project</li> <li>● Seminar subject Healthy Nutrition</li> <li>● Raised bed in planning</li> </ul>
<p>3. Good Health and Well-Being</p> 	<ul style="list-style-type: none"> <li>● Teacher sport (yoga)</li> <li>● Addiction prevention</li> <li>● AIDS event</li> <li>● First-aider training for students and school paramedics</li> <li>● Seminar subject Herbal Medicine</li> <li>● Herb bed</li> <li>● Healthy teacher breakfast</li> <li>● Cafeteria and kiosk only with snacks that comply with the German Nutrition Society (DGE) recommendation</li> <li>● International Nonprofit Bone Marrow Donor Center (DKMS) typing campaign</li> <li>● <b>Cookery book Staying Healthy at School and University</b></li> <li>● Cosy student lounge in the cafeteria area</li> <li>● Oases of peace in the green areas of the schoolyard in planning</li> </ul>
<p>4. Quality Education</p> 	<ul style="list-style-type: none"> <li>● Visit to a training and job fair</li> <li>● Book exchange shelf</li> <li>● Cinema week on important sustainability topics</li> <li>● Mobile phone garage for every classroom in planning</li> <li>● Exercise trail</li> <li>● Career orientation week</li> <li>● Seminar subjects on Sustainability</li> <li>● Annual sustainability project week</li> <li>● Science, Technology, Engineering, and Mathematics (STEM)-friendly school</li> <li>● <b>Forest Classroom with follow-up projects</b></li> </ul>
<p>5. Gender Equality</p> 	<p>Refers to all projects</p>
<p>6. Clean Water and Sanitation</p> 	<ul style="list-style-type: none"> <li>● Water dispenser with still and sparkling water, fairtrade coffee</li> </ul>
<p>7. Affordable and Clean Energy</p> 	<ul style="list-style-type: none"> <li>● Participation in a programme for the sustainable and healthy development of schools (EWA-Plus)</li> <li>● Energy-saving lamps in planning</li> <li>● Fuelling station for e-bikes in planning</li> <li>● Charging station for e-cars</li> <li>● Solar system</li> </ul>
<p>8. Decent Work and Economic Growth</p> 	<ul style="list-style-type: none"> <li>● Stock market simulation game</li> </ul>

(Continues)

TABLE 1 | (Continued)

17 SDGs	Projects allocated and color-coded depending on complexity of implementation
9. Industry, Innovation, and Infrastructure 	<ul style="list-style-type: none"> <li>● Cooperation with the Competence centre for e-mobility</li> <li>● Cooperation with the university STEM campus and student laboratory for cyber security (CISPA)</li> <li>● Art project 'turning old into new' (reusing old canvas surfaces) in planning</li> </ul>
10. Reduced Inequalities 	<ul style="list-style-type: none"> <li>● Educational experience days in the biosphere reserve</li> <li>● Project on Catching up after Corona</li> </ul>
11. Sustainable Cities and Communities 	<ul style="list-style-type: none"> <li>● Waste collection campaign Picobello (winner of the 2023 ideas competition)</li> <li>● Recycled toilet paper, paper towels, and copy paper</li> <li>● Greenhouse number</li> </ul>
12. Responsible Consumption and Production 	<ul style="list-style-type: none"> <li>● Reusable cups and bottles with the school logo</li> <li>● Visit to the beekeeper</li> <li>● Giveaway and swap market</li> <li>● Critical city tour</li> <li>● Sale of products made by students</li> <li>● Collection campaigns for recycling (batteries, old mobile phones, plastic lids, etc.) in planning</li> <li>● Fairtrade school and classes</li> <li>● Project SDG Seating for the common room</li> <li>● Open youth workshop</li> </ul>
13. Climate Action 	<ul style="list-style-type: none"> <li>● School cycling campaign (winner of the 2024 ideas competition)</li> <li>● Participation in city company-run</li> <li>● Set of mountain bikes for the school class</li> <li>● Bicycle parking</li> </ul>
14. Life Below Water 	<ul style="list-style-type: none"> <li>● Measures to avoid plastic (reusable cups, cloth bags for borrowed school books, plastic teaching unit)</li> <li>● Visit the marine fish farm in the planning</li> <li>● Stream ecosystem project</li> </ul>
15. Life on Land 	<ul style="list-style-type: none"> <li>● Organic farm visit</li> <li>● Art in the schoolyard in planning</li> <li>● Making insect hotels and birdhouses</li> <li>● Creating a flower meadow</li> </ul>
16. Peace, Justice and Strong Institutions 	<ul style="list-style-type: none"> <li>● German Trade Union Confederation project on co-determination and democracy</li> <li>● Resistance movement exhibition on the namesake of the school Willi Graf</li> <li>● Visit to Verdun</li> <li>● Mediator training and school against racism in planning</li> <li>● School partnerships with France</li> </ul>
17. Partnerships 	<ul style="list-style-type: none"> <li>● Young Biosphere</li> <li>● Association for marine and climate protection The Blue Mind</li> <li>● German National Cyclists' Association (ADFC)</li> <li>● Ecological school hostel Spohns Haus</li> <li>● Fairtrade steering group and adult education centre of the town</li> <li>● Employment agency</li> <li>● Partner companies at the job fair</li> <li>● Erasmus project with Lithuania</li> <li>● Mentorship for learning with refugees in planning</li> </ul>

and carry out healthy shopping planning. The gain in knowledge was intended to counteract civilisation diseases and to ensure that nothing was thrown away. For SDG 4, the topic of nutrition was part of education. For SDG 5, all students learnt to

deal with the topic of healthy eating. For SDG 6, students took care to use water sparingly when preparing food. For SDG 12 and SDG 13, the students paid attention to shopping sustainable, seasonal, healthy, preferably fresh, and inexpensive organic

products as well as less associated plastic packaging and fewer meat purchases.

Over 38 school weeks, a weekly 2-h seminar subject on the topic of healthy eating was offered in the upper school of the grammar school, for which 12 students had registered. These students are between 17 and 20 years old. A computer room and a large kitchen with three kitchenettes were available. The aim was to create and prepare wholesome recipes, which should be summarised in a cookery book with their own illustrations, published in the school magazine, and offered in the break catering at the kiosk. The ideas and wishes of the students were collected in a brainstorming session, and it was decided to develop recipes for snacks. Salads, dips, wraps, sandwiches, baked goods, desserts, and shakes were to be created. Firstly, extensive research on the internet was carried out, with each group selecting a recipe from six given areas, which could be modified individually. There were three cooking groups, each with four students. The roles of group leader and buyer changed every week. Each cookery group planned and performed the shopping on the day before and brought the ingredients for cooking to school. All recipes were calculated for four people. The teacher provided instruction in kitchen hygiene. The students decided that the four groups should prepare the recipes each week so that all students would always receive a balanced and healthy meal.

A dip was always offered with a baked good. If a recipe was not successful, it was modified and prepared again the following week. Seasonal planning was welcome, for example, students decided to bake cinnamon waffles before Christmas, which were sold to students and teachers to fill the graduation fund for the graduation ceremony. All recipes were documented by the respective group in the group file, and the respective cooking results were photographed with a camera. Care was taken to ensure that the illustrations were attractive. The work in the test kitchen was completed after 32 weeks.

A print format template in DIN A4 landscape was created in the plenary session and each group inserted information about the ingredients and preparation, supplemented by illustrations. A publisher was found to print the cookery book at a price of less than €7 so that the measurable result was not only an electronic but also a printed version. The cookery book had a large spiral binding and a hard cover so that it was easier to turn and place upright when selecting recipes. Special care was taken to ensure that the double-sided printed pages were made of sturdy, washable paper. The correction, visual adaptation, and design of the cover and the recipe overview took 6 lessons. A title for the cookery book was determined. The achieved milestone was the sale of the cookery book (Figure 2) to students and teachers.

### 3.4 | Complex-To-Implement Project *Forest Classroom*

The project *Forest Classroom* was mainly associated with SDG 4 'Quality Education', but also took into account SDG 15 'Life on Land', SDG 10 'Reduced Inequalities', SDG 5 'Gender Equality', SDG 3 'Good Health and Well-being', and SDG 11 'Sustainable Cities and Communities' (access to green spaces). One of the main aims of the forest classroom was to create an

extracurricular learning space where students can experience and explore nature and learn at the same time. Theoretical learning content was intended to be transferred to practical and real-life situations in a new setting.

The project was planned for 2 years. In the first year, preparations for the project began. The organisational framework and communication with the potentially involved partners took place. The project was initiated by the city, which specifically approached the school. Following an internal evaluation, the school decided to include a forest classroom in its educational programme, realised in cooperation with the town, the former forester, and the forest. The forester was responsible for coordination and communication with the township (mayor, building authority) and external organisations such as Saarforst, tradesmen, and craft firms. The necessary framework conditions for the extracurricular learning location were evaluated and a section of the city forest suitable for the project was selected together with the city. It was important for the school that the forest classroom was within walking distance of the school. The school-internal project group was in close contact with the partners and not only supported the students with the pedagogical processing of the project but also accompanied it on-site and actively worked together with the learners and the cooperation partners on its implementation.

In the second year, the project was implemented. A responsible project team was determined within the school, and the group of students was identified who were to work on the construction. The school form of training preparation was chosen as the high proportion of practical work in this phase strengthens the vocational orientation of a socially disadvantaged learning group. These students were mostly still minors aged 16–17, and many had a migrant background. Language problems were the main issue. The goal of this vocational preparation was to obtain a secondary school leaving certificate. The students were taught by vocational preparation teachers and started to work together with the partners. Building the forest classroom was the main project, which was followed by smaller sub-projects for the design and utilisation of the forest classroom. The forest classroom and the associated projects were designed to encourage active participation, in which the learners also tackle and plan themselves. The authentic learning environment was designed to give learners a deeper understanding of nature and environmental protection. After initial measurements, part lists, and material requirements were compiled. Parallel to the organisational preparations, the former forester contacted various trades, the forestry department, and various craft businesses to support the project. The site was cleared, and trees were felled. Once the forest site had been prepared, the felled trees were processed to prepare components for the construction. Forestry work such as felling, storing, and debarking was carried out with the apprentices. The next step was to lay the concrete foundations and work on the components together. This was followed by the assembly of the hut and the subsequent topping-out ceremony. The construction of the forest classroom as a sustainable extracurricular learning centre located within 10 min of walking distance was finished. It was created with seating, blackboards, and teaching materials that can be used by a wide variety of learning groups in the long term (Figure 3).



## Gesund unterwegs in Schule und Studium

### Schichtjoghurt

#### Zutaten:

- 500 g Naturjoghurt (3,5%)
- 1 EL Honig
- 8 EL Haferflocken
- Nüsse nach eigener Wahl
- 1 Handvoll (ca. 150 g) frisches Obst (Himbeeren und Blaubeeren)



10 Minuten



#### Zubereitung:

1. Obst waschen und verlesen.
2. Joghurt mit Honig verrühren.
3. Ein Drittel des Joghurts gleichmäßig in Gläser verteilen.
4. Anschließend 2 EL Haferflocken pro Glas darauf verteilen und die zweite Schicht Joghurt draufgeben.
5. Zum Schluss das Obst und die Nüsse obendrauf platzieren.

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### Paprika-Feta Dip

#### Zutaten:

- 1 rote Paprika
- 1 Knoblauchzehe
- 100 g Feta-Käse
- 70 g Bio-Naturjoghurt (3,5%)
- ½ TL Oregano
- 1 TL Olivenöl
- Je 1 Prise Pfeffer und Rohrzucker



45 Minuten



#### Zubereitung:

1. Backofen auf 250°C (Ober-/Unterhitze) vorheizen und Backblech mit Backpapier auslegen.
2. Paprika waschen, aushöhlen und vierteln.
3. Paprika in den Ofen geben und so lange garen bis die Haut leicht angebräunt ist.
4. Paprika abkühlen lassen, Haut abziehen und in grobe Stücke schneiden.
5. Knoblauch schälen, zerkleinern und Feta in grobe Stücke schneiden.
6. Alle Zutaten in einen Mixer geben und gut durchmischen.
7. Mit Pfeffer, Zucker und Olivenöl würzen.

8

FIGURE 2 | Measurable delivery of the project *Healthy Snacks*: Cookery book *Staying Healthy at School and University* (book consisting of 32 pages).

A discarded shipping container was integrated into the forest ecosystem to be used as a storage room for furniture, equipment, and teaching materials. The toilets in the neighbouring sports hall could be used, which did not require any additional installations. An associated school garden sub-project was started, for which students were jointly responsible for harvesting and caring for the plants. By working in the garden, the students gain practical experience in growing and caring for plants to anchor healthy eating and sustainable agriculture firmly in their consciousness. This will motivate and contribute to a better understanding of lessons on biology, nutrition, and the complex networks in nature and the environment. All this made the forest classroom and the associated garden a safe, functional, and attractive place to learn.

The forest classroom offers great potential for interdisciplinary teaching. With the help of various pedagogical tools (e.g., learning diaries, experiments, soil sample analyses, and movement-oriented games), different learning groups were offered an outdoor learning programme that not only combined different vocational and general education subjects but also integrated the topic of climate protection in various facets. For example, information trails with various information boards were created on the site. The boards were differentiated so that different learning groups benefited from them. For example, the development cycle of the fox tapeworm is described in detail on one page of the display panels. This is important for the topic of parasitism in upper school biology lessons. The reverse side of the display board contains information about the forest ecosystem and its animals. This topic is interesting for the middle school. Further learning stations were planned and integrated for various subjects such as biology, music, and foreign languages. Outdoor learning not only promoted physical health but also encouraged a variety of learning content to be transferred from the classroom to nature. This allowed to be explained and experienced vividly, directly on site, and on a real object, which makes content and learning more tangible and therefore more sustainable for the learners.

As a special feature, in addition to experiencing and linking the learning content itself, a milestone was also set in the direction of vocational orientation. The planning and organisation were deliberately shifted to pre-vocational training. It aimed to promote and impart a sustainable vocational orientation to prepare students for starting an apprenticeship or profession. It was intended to encourage young people who have had little success in their previous school careers. Practical relevance (Bilgram and Viehöfer 2020) is therefore of great importance. The students taking part in the project were directly involved in the planning and realisation and gained extensive knowledge about the theoretical content of the construction project. Through direct contact with the partners, the students were able to bridge the gap between theory and practice and actively participated in the practical realization. This not only promoted individual inclinations and talents but also social and human skills.

## 4 | Discussion

The commitment, knowledge, and skills of teachers remain crucial in the certification process despite the wealth of information and resources on possible sustainability projects provided both by the Ministry and on the Internet. These resources provide

a solid foundation and many ideas, but it is the teachers who integrate these projects into everyday school life and make them alive and tangible for students. In this way, schools can become places where sustainable development is not only taught but also lived. In this school development process, the school space becomes a central place for changing society towards sustainability, with teachers playing an important role as multipliers and students gaining awareness for sustainability. The change towards greater sustainability at a school is associated with and driven by a change in education style, individual behaviour, deadlocked ways of thinking, reflection on values, the discovery of team spirit, new types of commitment, and future prospects, as evident from the following examples.

All projects must be approved in advance by the school administration and meet the certification guidelines. The SMART individual goals were evaluated using the four-eyes principle (Supporting Information S3). The four-eyes principle means that a second person reviews a decision, assessment, or control. The goal is to avoid errors, increase objectivity, and create transparency (KDZ—Center for Administrative Research 2025).

### 4.1 | Evaluation of the Project *Healthy Snacks*

The project *Healthy Snacks* was submitted to the school administration as a seminar subject (2h per week) and the SMART method was discussed in relation to the project during a meeting. Applying the SMART method to the healthy eating project, resulting in a cookery book, provided a structured way of setting clear and achievable goals. The specificity was given, as the specific goal to run a healthy eating cookery course and produce a cookery book ensured that all students had the same vision. This minimised misunderstanding and helped to concentrate on the essential content. Nevertheless, there were occasional difficulties, for example, when students did not listen properly when the teacher announced sub-objectives. The measurability was given, as the success criteria were defined by concrete indicators such as the number of recipes prepared, the feedback from students on the cookery course, or the quality and completeness of the cookery book. This made it possible to objectively assess progress and the final result. Sometimes the learning success or creativity of the students was difficult to quantify. A combination of qualitative methods such as feedback and quantitative indicators such as the number of finished recipes was able to compensate for this. The attractiveness or achievability was given, as the goals were designed in such a way that they motivated the students without overstraining them. The reasonableness or relevance was given, as the achievement was highly relevant for students, that is, it was not only meaningful in terms of content but also promoted important skills such as nutritional education, teamwork, and creativity. The time-boundness was given, as the project was completed in time for the school year, and the goal was achieved.

Integrated practical learning opportunities promote a holistic education. The healthy eating project was a valuable addition to regular school lessons. It was an exciting and instructive experience and showed the students that healthy eating is not only important but can also be simple and delicious. They not only learnt new culinary skills but also developed a deeper



**FIGURE 3** | Measurable delivery of the project *Forest Classroom*: The building under construction and completed.

understanding of healthy eating and its importance in everyday life. Theoretical knowledge about healthy eating, which the students acquired in the subject lessons of health, was put to practical use. Their understanding of macro- and micronutrients was deepened by having to consider these principles directly when preparing meals. Students were able to demonstrate their creativity and problem-solving skills by preparing snacks independently. They learned to adapt the recipes they had chosen and improvise when certain ingredients were not available. The project encouraged cooperation and communication between the students. In small groups, they had to distribute tasks, coordinate, and find solutions together, which strengthened their teamwork skills and demanded initiative. A key aim of the project was to raise awareness of healthy eating. Students were already intensively involved in the selection and combination of ingredients when shopping to create balanced and nutritious snacks. This led to a critical examination of their eating habits and motivated many to make healthier choices. In the end, the students had the opportunity to reflect on their experiences and give feedback. Many were positive about the practical approach and highlighted that they had learned a lot about healthy eating. The reflection also helped them to better understand the importance of snacks for their concentration and performance in everyday school life. The course had the potential to have a long-term positive impact on their dietary behaviour. By learning to prepare healthy and tasty snacks themselves, they were encouraged to make conscious nutritional choices in the future and inspire their families.

Despite these positive experiences and the enthusiasm for the cookery course, some students expressed the problem that they would probably not be able to implement the newly learned eating habits at home. Old habits are deeply ingrained, and it takes effort to break them. Changing diet requires discipline and perseverance. This is particularly difficult if the whole family is not pulling in the same direction. At home, parents often decide what to buy and how to prepare meals. If the parents themselves do not practice a healthy and sustainable diet, it is difficult for the students to implement their new knowledge. Sometimes, parents also lack the understanding or willingness to change their eating habits. Without support and encouragement from the family environment, motivation can quickly wane. The daily grind and convenience can revive old habits. Some students complained about higher shopping costs. Healthy and sustainable food can be more expensive and harder to find than unhealthy alternatives. A wholesome and sustainable diet often requires more time to plan and prepare meals. Due to a lack of time, many families prefer to resort to quickly prepared ready meals, which are often healthier and lead to obesity and diet-related diseases (Mazzocchi et al. 2022).

The compilation and printing of the cookery book was a success. Creating their own book gave them a sense of pride and self-efficacy. Thanks to the knowledge and recipes, the students now have the tools at hand to create healthy snacks in the future. This supports the intention of sustainability. The creation of the cookery book promoted media skills as well as the use of digital tools and software for text and image editing. Many students and teachers bought the visually appealing cookery book for themselves and as a gift. The recipes were presented to the tenant of the kiosk and cafeteria with the hope that in the future

more and more healthy salads and wraps will be offered by purchasing sustainable (i.e., organic, regional, and seasonal) food. Offering sustainable and organic school food is of high importance (Batistela dos Santos et al. 2022; Bauer and Morlock 2024).

## 4.2 | Evaluation of the Project *Forest Classroom*

The SMART method provided a helpful framework for clearly structuring and gradually implementing the project *Forest Classroom*. The specificity was given, as the project goal was the construction of a roofed wooden house in the forest. The tasks from felling the trees to building the forest classroom were concrete, which helped everyone involved to recognise the direction and scope of the project. Nevertheless, there were sometimes unclear task allocations and communication problems, which were resolved through regular planning meetings. The measurability was given, as the progress was documented and monitored through specific milestones such as the cutting of the trees, completion of the basic construction, and installation of the roof. The commitment of the students and the quality of the work could also be made measurable through feedback or regular reflection. The attractiveness was given, as the involvement of numerous sponsors (such as the city, forest, forester, craft companies, and teachers) made the project both motivating and realisable. The students experienced practical work and developed skills that delivered tangible results. Regular interim targets, which visibly demonstrated small-scale progress, helped to minimise any potential loss of motivation. The reasonableness was given, as the project was particularly relevant for the school-based form of vocational training preparation, as it promoted ecological education, manual skills, and teamwork. It also addressed social values such as sustainability and a sense of community. Comprehensive safety instructions and supervision by specialists such as the forester reduced risks. Early material planning and the involvement of supporters and sponsors secured the necessary resources. The time-boundness was given, as the time frame was set at 2 years, which enabled continuous planning and implementation. This time limit helped to monitor progress and achieve milestones on time. Nevertheless, there were weather-related delays that had to be made up for.

The project showed that the participating students took a concrete step forward in their career orientation through the project and direct contact with various professions such as forester, carpenter, concrete worker, etc. Not only did their inclinations develop during the project, but their self-image also changed favourably. The previously frequently assumed role of the disoriented young person changed for many students. Many of them realistically concretised their career plans for the future. Some of the learners stated that they would like to take up one of the above-mentioned professions in their professional future and have already taken steps to actively look for a job. In addition to combining theoretical and practical knowledge in the setting of this unusual school location, other projects centred around the forest classroom focus in particular on teaching vocational skills. In addition to the subject-specific learning content, the students should also gain their first impressions of the professional practice of the partners involved in the project. Through practical and sensory experiences, they should develop their first professional inclinations

and interests and deepen these in the form of joint and individual tasks.

The most substantial finding of the project was that the students became more active and engaged and were able to develop further their potential and decision-making skills in their respective roles as supportive and indirectly involved actors. The students moved from the passive student role, which many students in this type of school like to take on, into the active role of craftsmen and foresters. It was noticeable how the group of students became absorbed in their tasks through their participation in the process and the high proportion of practical work, and how they freely engaged in activities outside of school according to their inclinations. This involvement, participation, and co-determination of the students is participation in action (Holst and Hantke 2024). Observing this development motivated teachers to bridge the gap between theory in the classroom and practice or nature. The sensory experience associated with the forest classroom and the change in the setting itself brought about major changes in the learning groups.

Since less than a quarter of young people see themselves as able to make an effective contribution to solving sustainability problems through formal education (Grund and Brock 2022), this forest project made a difference and taught the students that it is possible to live sustainably. As further references to sustainability are still most likely to appear in the context of related subjects such as geography, biology, health, economics, and politics, this project contributes to the establishment of a cross-cutting anchoring of sustainability (Grund and Brock 2022). In the future, the forest classroom will be an integral part of the curricular and pedagogical work and thus occupy a place in the timetable of many classes and forms of school. Further subjects will be established, and teachers will have the opportunity to choose the forest classroom as a methodically meaningful learning space for their student groups. Implementing a forest classroom is an ongoing process that requires constant evaluation and development. The school community should regularly evaluate the success of the forest classroom, gather feedback, and make adjustments to ensure it meets student needs and is successful in the long term. In addition, the care and maintenance of the forest classroom are critical to its long-term success. Students should learn to share responsibility for caring for it, cleaning it, and performing maintenance.

Some current drawbacks can be solved in the future. One of the main drawbacks of a forest classroom is that it can be used predominantly in the warmer months. In the spring and summer, temperatures are pleasant, and students can learn outdoors without major restrictions. Nature is particularly lively during this time, offering a wealth of learning opportunities, such as observing plants and animals, conducting ecological experiments, or simply learning a specialized lesson in a pleasant forest atmosphere. In autumn, the forest classroom can also be used as long as the weather conditions remain mild. However, the weather becomes more unpredictable, and frequent rainfall can make it difficult to use. Damp ground and wet leaves increase the risk of slipping, which can pose a safety risk. During the winter months, the use of a forest classroom is severely restricted. Cold temperatures, snow, and ice make it uncomfortable and sometimes

dangerous to spend long periods outdoors. Students and teachers would have to dress warmly, which can affect freedom of movement and concentration. In addition, teaching materials and equipment such as tablets could be damaged by moisture and cold. Aside from weather conditions, other factors can affect the use of a forest classroom. For example, insects such as mosquitoes and ticks can be a problem in the warmer months and make being in the forest unpleasant or even risky to health. Pollen allergies can also cause discomfort in some students and affect lessons. The duration of daylight is another important aspect. During the short winter days, natural light can arrive later or disappear quickly, reducing the time spent learning outdoors. Forest classroom lessons require sufficient daylight to work effectively and see the surroundings well.

The level of engagement among students was rated very high in the projects discussed, which was reflected in good to very good grades on their report cards. These grades may not be published in detail, but they also include behaviour and knowledge in the area of sustainability. In the German school system, the 15-point grading system is used in the upper secondary school level. Performance in the project *Healthy Snacks* increased from an average grade point of 8.5 (satisfactory) to 12 (good) over the course of the school year, representing a substantial improvement. Regarding the potential for scalability of the 'Healthy Snacks' project, it should be noted that the project cannot be expanded to a higher number of students because the kitchen space is limited. In the project *Forest Classroom*, the average grades increased by one level due to the students' commitment and strong motivation. The project *Forest Classroom* will be a topic every year, as it concerns the care and maintenance of the forest classroom.

### 4.3 | Transformative Potential of School Education

The effectiveness of project-based learning as a method for actively involving students in learning processes was explained by the motivational nature of projects based on real-world problems (Almulla 2020). This was an important finding for school sustainability projects such as the projects *Healthy snacks* and *Forest Classroom*. Project work can promote a high degree of personal responsibility, creativity, and problem awareness. However, the question arose as to how success was defined and measured in such studies. It must be assessable who actually participated actively in the project and who did not.

The focus was often laid on short-term learning effects or motivational gains such as a boost in motivation or better test results (Rieckmann 2024). It was less often examined whether these changes were long-lasting or led to a sustainable change in behaviour because such studies involve considerable effort to observe sustainable changes in behaviour or personality development of students monitored over longer periods of time—often beyond their school years. The time students spend in secondary schools is limited because they often attend certain school types for only 2–3 years. Hence, teachers are not able to track their development systematically over a longer period. In addition, sustainable developments and long-term behavioural changes or attitudes are difficult to quantify objectively due to the multilateral influences and thus methodological difficulties.

However, this long-lasting dimension would be particularly important for the evaluation of school sustainability projects to answer the question of whether a one-time project is sufficient, or a long-term school structure is required, or a repetition to have a lasting effect.

Despite systematic and methodological difficulties in measuring long-term effects and sustainable changes in behaviour, project work is an essential component of ESD. Even in short-term projects, it opens up learning spaces in which technical knowledge, value-oriented thinking, and concrete action are linked—and it is precisely this connection that is crucial for a sustainable society. The transformative potential of school education, when taking into account underlying social conditions, was recognized as an overarching aspect of ‘ESD for 2030’ (Reimers 2024). With regard to SDG 10 (Reduced Inequalities) in particular, it becomes clear that educational projects are particularly relevant when they systematically promote justice, for example, through barrier-free offerings, cultural participation, or the targeted inclusion of disadvantaged groups. The project *Forest Classroom*, providing access to nature and making environmental education tangible, can serve as such an inclusion example as discussed. Such sustainable school projects are transferable to schools with sufficient equipment, committed leadership, dedicated staff, or favourable locations that are able to carry out such projects. The risk of unintentionally reinforcing existing educational inequalities must be minimized.

#### 4.4 | Certification Process

The school was visited by the jury of the ministry’s certification process after the first year. The 17 SDGs had to be met in various school areas. The jury was impressed by the diverse projects and actions and the planning of future projects in the field of ESD (Figure 1). After the second year, the certification took place with a ceremonial presentation of the certificate. Sustainability projects are now an essential part of school education, as they teach students important knowledge and values to protect the environment and promote a sustainable lifestyle. The hypothesis that the key to a holistic approach to school development lies in the development of an evidence-based implementation model with project measures in line with the 17 Sustainable Development Goals (SDGs), which are categorised according to low, medium, and high content and organisational complexity, has been fulfilled.

#### 4.5 | Selfless Commitment of Teachers as Key

The success of sustainability projects depends largely on the commitment of the teachers and the available financial resources (Teichert Volker 2023). Teachers who are enthusiastic about sustainability and are willing to invest time and energy beyond regular class time can drive such projects forward decisively (Sinakou et al. 2023). Lack of motivation, commitment, and lack of knowledge and ideas on the part of teachers can lead to projects stagnating or even failing. A quantitative study showed that there are large gaps in the qualification of teachers in the area of sustainability, as two-thirds of German teachers have never been confronted with the topic of ESD during their

studies and a further 22% have rarely been confronted with it (Grund and Brock 2022). Many teachers do not feel adequately prepared to support their students in developing the skills needed for a more sustainable future (Parry and Metzger 2023). According to a survey of school principals (Anders 2024), the greatest challenges in promoting sustainability and ESD in schools are a lack of time and staff (72%), prioritization of other demands on the school (71%), lack of financial resources (54%), and a strong focus of everyday school life on examinations and performance targets (40%).

Teachers who engage beyond the classroom create an inspiring learning environment. These additional activities are time-consuming and often require a high level of personal commitment, as they cannot always be integrated into regular working hours. This engagement beyond regular classes is not only time-consuming but also emotionally demanding. Teachers who are committed to sustainability must remain motivated, even when they encounter obstacles or suffer setbacks. They must be able to inspire and motivate their students to become active and take responsibility. Often it is about achieving a deep understanding and a sustainable change in behaviour among students, which is a challenge that requires patience and perseverance. Teachers who do not have the motivation or interest for such commitment can severely hinder the progress of sustainability projects. If the necessary enthusiasm is lacking, projects are often only implemented half-heartedly or neglected altogether. Students sense this reluctance and lose interest. Sustainability projects can quickly lose momentum and fizzle out in their impact. In addition, such an attitude can also affect the entire school climate and reduce the general willingness to commit to sustainable goals. Support and recognition of committed teachers, including by school management, are therefore of great importance (Cebrián et al. 2022; Dunlop et al. 2022; Forssten Seiser et al. 2023; Gericke 2022; Mogaji and Newton 2020). Schools should create frameworks that make it easier for teachers to get involved in sustainability projects beyond the classroom. This includes training, the provision of resources, and especially a culture of appreciation and support. Collaboration with colleagues and the exchange of ideas and best practices can also help to keep motivation high and successfully implement sustainability projects (Remy 2023). This is very important because teacher training in ESD was rated as the worst in most educational sectors (Holst et al. 2024).

Teachers play an indispensable role in teaching the concepts of sustainable development and putting them into practice. Their ability to explain complex issues understandably and to demonstrate the relevance of sustainable development in everyday life is crucial to success in learning. This is about imparting theoretical knowledge, promoting practical skills, and a deep understanding of the challenges and solutions in the field of sustainability. The commitment of teachers is a key factor. Teachers who are passionate and committed to sustainability can inspire and motivate their students to get actively involved. They act as role models and multipliers who show what sustainable action can look like in practice and what positive effects it has on the environment and society. Furthermore, the competence of teachers in the area of sustainability is crucial. A sound education and regular training enable them to nourish students with the latest scientific findings and pedagogical methods. This

enables them to design high-quality educational offerings that promote both the transfer of knowledge and the development of skills and attitudes in the sense of sustainable development. Only through the active participation and continuous training of teachers can sustainability projects be successfully implemented and sustainably anchored in the school culture. This requires not only individual commitment and organizational talent but also the support of the school management and educational policy to provide the appropriate framework and resources.

The role of teachers as key players in the transformation process towards greater sustainability in education was rightly emphasized (Rieckmann 2024). Their commitment was often the driving force behind internal school changes (change management) and pedagogical innovations. A critical examination of the structural conditions under which teachers operate is needed. Systemic educational conditions in particular (which are strongly focused on performance comparisons, standardization, and results orientation) can marginalize sustainable development. For example, if social skills (such as reflective thinking, participation, or interdisciplinary thinking) are rarely included in exam formats and curricula, the space for sustainability-oriented educational approaches may be limited in everyday school life. To be effective, sustainable education must not only be considered an additional learning objective, but also be anchored as an integral part of the education system (Reimers 2024). This calls for policy recommendations that go beyond voluntary certification. Curricula would have to be reformed, exam formats adapted, and further training opportunities for teachers strengthened to systematically promote sustainability. In addition, schools should be structurally supported with resources, project work periods, and the anchoring of ESD in school law. This way, teachers are serious actors capable of taking action within a supportive system.

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### Ethics Statement

The research did not involve human participants and/or animals.

### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The research findings presented in this study are supported by data included in the main text.

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## Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.