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Empowering Students to Create Climate-Friendly Schools

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Abstract: In Germany, there are over 32,000 schools, representing great potential for climate protection. On the one hand, this applies to educational work, as understanding the effects of climate change and measures to reduce GHG emissions is an important step to empower students with knowledge and skills. On the other hand, school buildings are often in bad condition, energy is wasted, and the possibilities for using renewable energies are hardly used. In our "Schools4Future" project, we enabled students and teachers to draw up their own CO_2 balances, identify weaknesses in the building, detect wasted electricity, and determine the potential for using renewable energies. Emissions from the school cafeteria, school trips, and paper consumption could also be identified. The fact that the data can be collected by the students themselves provides increased awareness of the contribution made to the climate balance by the various school areas. The most climate-friendly school emits 297 kg whilst the school with the highest emissions emits over one ton CO_2 per student and year. Our approach is suitable to qualify students in the sense of citizen science, carry out a scientific investigation, experience self-efficacy through one's own actions, and engage politically regarding their concerns.

Keywords: whole-school approach; education for sustainable development; self-efficacy; climate protection concepts; political simulation; living labs; energy efficiency; CO_2 emissions

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1. Introduction

For many years, young people were generally considered to be largely conformist and politically uninterested, but the Fridays for Future movement initiated by Greta Thunberg has triggered a noticeable change. That this now global youth awakening is not just a subjective feeling is evidenced, for example, by the 18th Shell Youth Study, in which researchers have regularly documented the views, moods. and expectations of young people in Germany since 1953. The most recent study, conducted in fall 2019, is aptly titled "Youth 2019–A generation speaks out" and proves that the importance of political engagement has been increasing noticeably for a few years now. The study concludes that due to numerous crisis-related developments and global disruptions, young people are now expressing their concerns much more strongly than in the past. This is reflected above all in an increased commitment to environmental and climate issues, as well as a general awareness of themselves and others. They clearly demand from the older generations that the course must be set now so that the younger generation has a chance of a good future [1]. Many of the older generation also feel solidarity with the movement and have supported Fridays for Future in many ways [2,3]. Agencies have helped with publicity, scientists have provided their expertise, and many musicians have offered to perform at events for free.

However, most young people can witness in their everyday lives in many areas that changes happen far too slowly and that insufficient measures are implemented. This is particularly evident in the place where children and young people spend the most time: in school buildings.

Although many municipalities throughout Germany have recognized the relevance of climate protection measures and in some cases have set very ambitious targets for implementing climate protection locally, the level of energy retrofits in many schools is still inadequate. An analysis of around 500 energy performance certificates for public buildings carried out in 2021 showed that only 14% of buildings can be considered to have a relatively good energy balance of under 70 kWh/m^2/a. In the case of schools, only 10% just about ended up in the "green zone" [4]. This is particularly noteworthy as public buildings are a key factor in achieving climate targets. The greatest potential lies in heating systems, building insulation, lighting, and the use of renewable energies. However, municipalities often lack the financial resources to reduce the high investment arrears. Yet schools are places where the young generation spends many hours every day being prepared for their future. Brand and Salzgeber therefore describe functional school buildings as an essential prerequisite for an efficient education system [5]. According to Kliche et al., schools can play a crucial role in this and be pioneers of decarbonization and social transformation [6].

Non-action on climate protection measures in schools can also have an impact specifically on the mental health of children and adolescents, which is increasingly being researched scientifically [7,8]. Cianconi et al. have recorded newly emerging terms of mental illnesses in this context (eco-anxiety, eco-guilt, eco-psychology, ecological grief, solastalgia, and biospheric concern) [9], making it clear that preventive measures are needed to counteract these new clinical findings.

It is therefore important for young people, in conjunction with positive narratives about the goals of a socio-ecological transformation, to counteract "doomscrolling", "eco distress", and "climate anxiety", i.e., depression and resignation about an alleged unstoppable climate catastrophe, through collaborative actions and by participating in concrete climate protection measures at their own schools.

Therefore, within the Schools4Future project, a project design was developed that combines aspects of the concept of education for sustainable development (ESD) and the whole-institution approach together with political simulation and the concept of living labs.

2. Background

The approach of the Schools4Future project not only focuses on the reduction of greenhouse gas (GHG) emissions in schools but also on the comprehensive involvement of students in the transformation toward a sustainable future. Therefore, two aspects that represent the socio-political framework of the Schools4Future project will be explained in the following sections. First, there is the development of environmental and climate protection protests in connection with the Fridays for Future movement. They impressively demonstrated the willingness of young people to advocate for a sustainable future and led to a broad social as well as scientific and legal foundation of climate protection in Germany. Furthermore, the National Action Plan on Education for Sustainable Development in Germany and the whole-institution approach of the UNESCO World Programme form the educational policy basis from which the project design of Schools4Future was partially derived.

2.1. Fridays for Future in the Context of the Development of Environmental and Energy Protests

When comparing the position of the Fridays for Future movement with that of the activists from the anti-nuclear movement during the 1970s, considerable differences can be observed regarding the relationship between politics and state organs. The legal battles fought by the anti-nuclear movement were much more conflictual and required a great deal of time and money. During this time, networks had to be built up, which made it possible to cooperate with lawyers, sometimes over many years. In this way, lawyers specialized in the respective legal areas of the opponents of nuclear power emerged who accompanied the activists in their lawsuits, for example, by taking legal action against bans on meetings or suing against planned nuclear facilities [10]. A look at the chronicle of this period shows that protests were regularly characterized by massive deployment of the police and other

state organs, which also used force to assert themselves against the protesters through the use of water cannons and batons [10]. Subsequently, there were further legal disputes accordingly. Against the background of earlier disputes between protesters and the state organs, it is remarkable that current surveys among the activists of Fridays for Future show that a great deal of trust in the police prevails [11]. Compared to earlier protest movements, the new youth movements have a much more positive relationship with the state and its institutions than the protest movements of the 1970s.

Of particular importance is the relationship between scientists and Fridays for Future. For what has never happened before in the history of science, the youth movement Fridays for Future has brought about: in March 2019, more than 28,000 scientists signed a declaration stating that the concerns of Fridays for Future "are justified and supported by the best available science" [12]. The scientists thus legitimized the climate protests and made it clear that the demands can be justified by the best available knowledge. This is where the close cooperation between Fridays for Future and Scientists for Future began, which continues to this day, and is also what enabled the rigorous claims of Fridays for Future: politics must take the latest findings of climate research (of the IPCC) much more seriously and implement them more ambitiously.

In this respect, Fridays for Future today has a (socio-political) foundation that is open to the protesters. This is also shown by a legal–historical and politically very remarkable process, in which the national policy was requested by the highest court to do more for climate protection. The decision of the German Federal Constitutional Court (BVerfG) of 24 March 2021 is clear and takes politics in the duty to improve climate protection so that the freedom rights of future generations are protected. The highest German court therefore obliged the legislature to regulate the reduction targets for GHG emissions for the period after 2030 in a much more concrete and ambitious way (Beschl. v. 24.03.2021, Az. 1 BvR 2656/18). Following the ruling of the German Federal Constitutional Court, the legislature amended the Climate Protection Act and defined more ambitious climate protection targets.

2.2. The Whole-Institution Approach to Implementing Education for Sustainable Development

The Fridays for Future protests have drawn attention to the urgent need to address climate change and related environmental problems. An education system that takes climate change issues into account can help raise awareness of these challenges and build skills to develop sustainable solutions.

In this regard, the National Action Plan on Education for Sustainable Development (ESD) in Germany [13] makes it clear that society, and with it the German education system, is undergoing a transformation process toward a future that is characterized by sustainability. Schools are required to play a decisive role in this process. However, they must also develop themselves further and adapt to the new structural requirements. Whereas schools used to focus on preparing students for jobs in the industry, new learning formats and patterns must now be found. Silke Weiß describes the necessary paradigm shift by saying that the paradigm of faster, higher, further, better, and in competition must be replaced by the paradigm of cooperation and joint action as well as mutual support and appreciation. Creativity and knowledge of one's own strengths are more important than good grades, she said, because these are needed to meet global challenges through courageous creators [14]. In this sense, the development of potential through the experience of self-efficacy is an important factor. If schools are to prepare the children of today for the world of tomorrow, the formation of these future competencies must become more central to education, and the teaching of corresponding values is becoming important for educational content [15,16].

The broad spectrum of knowledge to be imparted makes it clear that the promotion of ESD cannot be guaranteed by a single school subject. Knowledge transfer for climate protection must therefore find its way into schools in a variety of ways [17]. Starting at the schools themselves to assess the status quo and develop climate protection measures is a promising strategy [18]. Schools, as places where the next generation is educated,

should also be aware of the impact of everyday school life on climate change. However, it is precisely the integration into the systemic contexts of ESD that requires teachers and students to have a deeper understanding of the causes and consequences of climate change and their willingness as well as competence to participate in measures to address climate change themselves.

This approach of realizing one's own possibilities for action and identifying potential and implementing measures with the various actors is pursued by the whole-institution approach. This is a focus of the UNESCO World Programme of Action on ESD [19]. In terms of content, the whole-institution approach is about pursuing a concept to advance a holistic transformation of teaching and learning environments worldwide. In Germany, the whole-institution approach plays an important role as a central cross-cutting theme for the realization of the National Action Plan on ESD. This provides for all school partners to be involved in the planning and implementation of ESD activities. The aim is to enable co-design and self-efficacy experiences. Therefore, it is about a community experience involving school management, teachers, students, parents, custodians, representatives of local politicians and administration, and civil society partners such as school support associations and non-governmental organizations [16].

In the case of schools, it is common to speak of the "Whole School Approach", which refers to a pedagogical approach that takes an integrated view of all aspects of school life. This includes the pedagogical concept, the curriculum, the learning media, and the various activities of the school. The goal is to ensure that sustainability is not only addressed in the classroom or promoted with selective activities but that the school as a whole is rethought. Schools can be particularly effective if they work holistically as a whole institution, including their non-school partners. It is about doing what is said and resolving the discrepancy between the values represented and the values lived.

The whole-school approach is important because a school that addresses climate change in the classroom but makes no efforts to save energy and resource use has no credibility as an institution. Holistically thinking, this also means that participation as an essential component of democracy, as a principle for students, should also be recognizable in everyday school life. Contemporary whole-school approaches have attracted the attention of governing bodies and researchers because they have the potential to stimulate organizational change regarding various aspects. However, whole-school approaches tend to examine the effectiveness of individual components in isolation, for example, regarding physical activity or active travel to school. There is therefore a need to design and implement interventions that can achieve change from a holistic perspective [20].

3. Materials and Methods

The aim of our research was to investigate whether and how self-efficacy experiences can be gained through climate protection measures. In step 1, a CO_2 assessment tool was developed that students can use by themselves to analyze the relevant aspects (building, mobility, nutrition, and procurement) and the emission reduction potentials. In addition, climate protection concepts were developed in order to derive concrete projects from the CO_2 balance. It was investigated as to whether this structured approach was accepted by the students.

They were also trained to become politically active. The calculation of the school's carbon footprint and the creation of climate protection concepts empower the students with knowledge and targets and thus form the foundation for political engagement. What options do schools have and which actors are relevant in order to be successful in terms of the whole-school approach?

Step 2 therefore explored how the school community can experience self-efficacy through political power. What can the school implement itself and what does it need from politicians? In this regard, the school authority is an important factor, as the students and teachers can only implement their own measures to a limited extent. Measures for heating technology, insulation, or lighting can usually only be implemented by the school

authorities. For the implementation of an intervention concept based on the principles of the whole-school approach, it is important that the school environment, the cities, and the municipalities as owners and operators of the school buildings are also involved.

In this way, problems can also be approached for which the students lack the financial resources or technical skills (e.g., for the installation, operation, and maintenance of renewable energy technology).

The approach we have chosen, and which will be described in detail in this section, incorporates all the developments described above; it addresses the increased commitment of students to climate protection, gives them access to politics, and connects the students' everyday school life with scientific findings on climate protection.

Through concrete action, they experience self-efficacy, which should help to counter feelings of climate anxiety, such as hopelessness, guilt, anger, worry, and fear through a positive experience of change.

This mixed method approach was tested in twelve German schools as case studies. The schools were selected based on different criteria: geographical diversity, school type, social milieu, and general need for renovation. While most of the work was carried out with a small group of voluntary students and teachers at each school, the activities at the schools usually involved the entire school, for example, in the form of a public school event, and beyond.

3.1. Self-Efficacy through CO_2 Assessments and Development of Climate Protection Concepts

It is important for students to gain self-efficacy in implementing their own climate protection measures because this empowers them to take action and make a positive impact. By developing a sense of agency and ownership over their own actions, students can become more engaged and committed to promoting sustainability. A good starting point is to determine the status quo of the school and thus calculate the current carbon footprint.

To determine the CO_2 consumption of the school, an innovative Excel-based CO_2 assessment tool for students was developed within the Schools4Future project. The tool helped to generate a learning environment, which had been an important factor in generating learning success in other projects [21]. The tool is designed to be used by students and therefore offers easy handling, yet complex calculation options. The tool contains three relevant areas: (1) mobility, (2) heating and electricity, and (3) food in the school canteen and consumables (paper). On each page, there is a brief instruction for quick data entry. For example, regarding electricity, the tool distinguishes between electricity production from PV and electricity use. For carbon footprint assessment, the electricity use is usually taken from the electricity bill and therefore includes all consumption from lighting, electric appliances, and IT as well as electric pumps for the heating system. The calculations (e.g., the conversion of kilowatt hours to CO_2 emissions) are completed automatically, thus showing that the advantages of Excel are fully exploited here. The emission factors used are integrated into the summary and the calculations are traceable. This ensures transparency, while also enabling adaption of the freely available tool to schools in other countries given prior adaptation to the country-specific emission factors [18,22].

Descriptive figures have been integrated to immediately visualize the results and through this make them more comprehensive. On an extra sheet, all results of the single areas are summarized and the emissions per student are calculated. The tool also automatically generates the results in pie charts and bar charts. Relatively modest support by teachers, school staff, and authorities is needed to collect the specific data in the first place (e.g., providing the electricity and gas bills, information on the size of the photovoltaic systems, the amount of paper used, and a list of all school trips conducted in one year). The tool easily shows where particularly high greenhouse gas emissions occur, where the potential exists, and how these can be addressed. If a further CO_2 balance is drawn up after the implementation of concrete measures (such as the changeover to vegetarian food in the school canteen), successes can be shown and motivate the school community to implement further measures [18,22].

3.2. Self-Efficacy through Active Climate Protection and Political Engagement

Based on the whole-school approach, the highest possible impact is achieved when social science methods are used in addition to mathematical/data-driven methods.

To empower students with regard to their political action, we developed a design based on the didactic method of political simulations, which combines political simulation with the concept of living labs. The following is an explanation of our conceptual approach. According to Meyer, simulation games are complex roleplays in which opposing interests are tested in a playful way. They can vary greatly in scope and duration and represent a reconstruction of reality [23]. A conflict is placed in the center and an (artificial) decision situation is brought about. The simulation games are part of the policy simulation, which is intended to simulate a political decision-making process. It is an experiment in which the goal is to gain knowledge about cause–effect relationships, based on which social phenomena can be better understood. In this sense, experimental policy simulations are a model-like imitation of a real system, which serves to gain a better understanding of complex system processes. Initial studies on this method show that learning success is highest when the participants themselves are active in a kind of roleplay [24]. Klippert developed ten ready-made simulation games on various issues, especially for school lessons [25], which we were able to use as a guide for our project design. Klippert's topics range from dealing with socially marginalized groups and environmental protection to representing interests in the workplace and development policy. Students can learn communication, negotiation, and decision-making skills through interaction using this method. In the interaction phase, the students have the opportunity to put into action what they have learnt in the preparation phase [26]. With this in mind, we chose our project design so that the roleplay would result in a real exchange and interaction in the political arena. To this end, the students were trained to take political initiatives themselves and to actively represent them in front of political parliaments. Of course, access to a local parliament is much easier than to a national or regional parliament. For our project content, the decision-making powers of the local parliaments in the cities and urban districts are significant, as the municipalities are responsible for a large part of the decisions that affect the school building and its surroundings. We therefore combined the concept of policy simulation with that of the living labs. This is because a living lab is characterized by a collaboration between science and civil society in an experimental setting where researchers conduct interventions in the sense of "real experiments" to learn about social dynamics and processes [27]. Policy simulation is about studying how the dynamic system changes over time and making predictions about the states of the system [28], in our project, it is much more important to provide an understanding of policy processes and to enable self-efficacy about them. This resulted in a highly promising participatory learning approach [29] that includes energy technology/engineering and energy economy learning content as well as social and political science learning content.

The methodology of our work involved implementing a whole-school approach and education for sustainable development (ESD) in pilot schools. Figure 1 shows how the whole-school approach was implemented in the project design with regard to the stakeholders of the project. The project aimed to qualify and empower students through a collaboration between scientists and students, with knowledge transfer as a first step. Individual teachers can be closely involved in organizing the group or at a later stage of the project and facilitate knowledge transfer by using teaching material provided by the project team. In the second step, the scientists support the students in the CO_2 assessment, the creation of climate-protection concepts, and some easy-to-implement climate-protection measures. These hands-on experiences further enhance qualifications and increase the self-efficacy of students. At this stage, the whole school should be aware of the ongoing project; all students and school employees are involved in the mobility survey, while the school custodians, school secretary, school director, and the school canteen are required to obtain the data for the CO_2 assessment. In the next stage, additional activities are carried out at the school level, such as climate protection days, in which all classes, teachers, and other school

employees should contribute and participate. Further activities that can raise awareness among the whole school and parents are public presentations of the CO_2 assessment results and climate protection concepts.

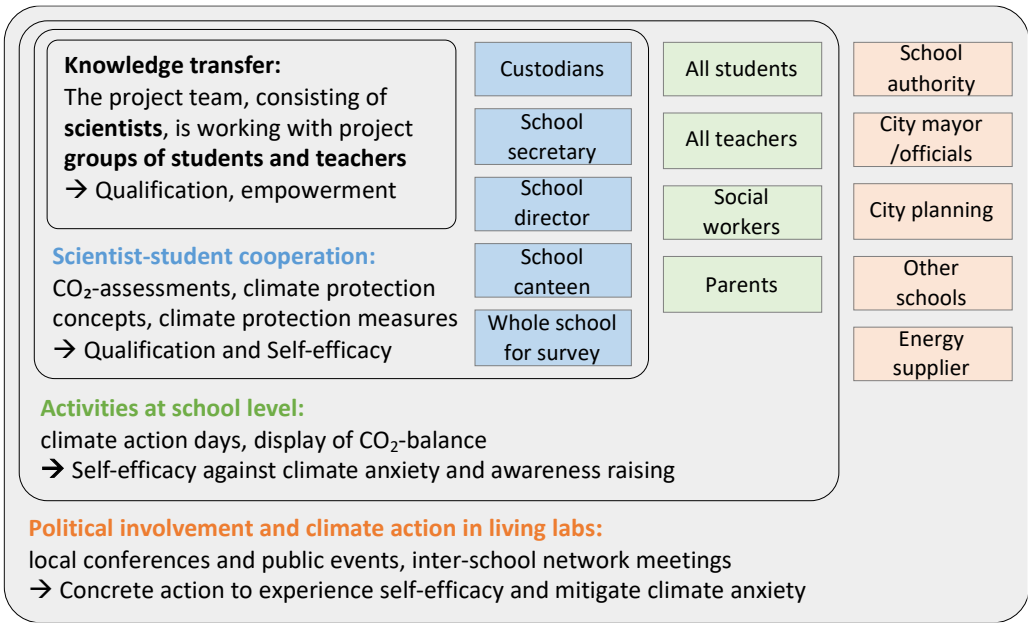

Figure 1. Involved stakeholders in the Schools4Future project at the individual schools.

In addition, the project provides support to students to also become active outside the school by networking and becoming politically active. Petitions, citizen applications, public relations, or local conferences are ways to present demands to local decision-makers and further involve the surroundings of the school.

In order to test these methods, the concept of living labs in combination with political simulations was used to analyze whether the students experience self-efficacy and feel empowered with regard to climate protection and whether climate protection measures were implemented at the school (such as the replacement of inefficient lighting).

4. Results

With reference to the project design and the steps described above, in this section, the results of the CO_2 assessment of all 12 schools are presented and the success factors of the different approaches are emphasized. They also show which schools have implemented measures on the basis of the GHG assessment and on the basis of the climate protection concept drawn. This section also presents what was observed among the students when they became politically active. In the end, the connection with the whole-school approach is shown and how the combination of different methods can lead to a successful approach.

4.1. Comparison of the Carbon Footprint Assessment

All 12 pilot schools completed the calculations of carbon footprint, and the main results are compared herein for the first time. In most schools, students used the tool by themselves. Support was given by the custodians, school authorities, and the secretariat to obtain the data. In addition, there was at least one teacher in each school who was responsible for the project. In the pilot schools where the carbon footprint assessment was carried out by a larger group or by younger students, the teachers played an important role in the coordination of the work and communication and therefore had an important share in the success of the project. The tool offers the possibility to enter the data in a very flexible way. Therefore, the schools also proceeded very differently, and the time span used for the carbon footprint assessment ranged from one week to over a year depending on

how the schools organized the assessment [18]. The tool is innovative and unique in that it allows students without prior knowledge and training to create a CO_2 balance of their school including all relevant sectors. These areas, ranging from heating and electricity to mobility, food, and paper consumption, can be seen in Figure 2. The tool automatically generates figures which can be used for the CO_2 balance report.

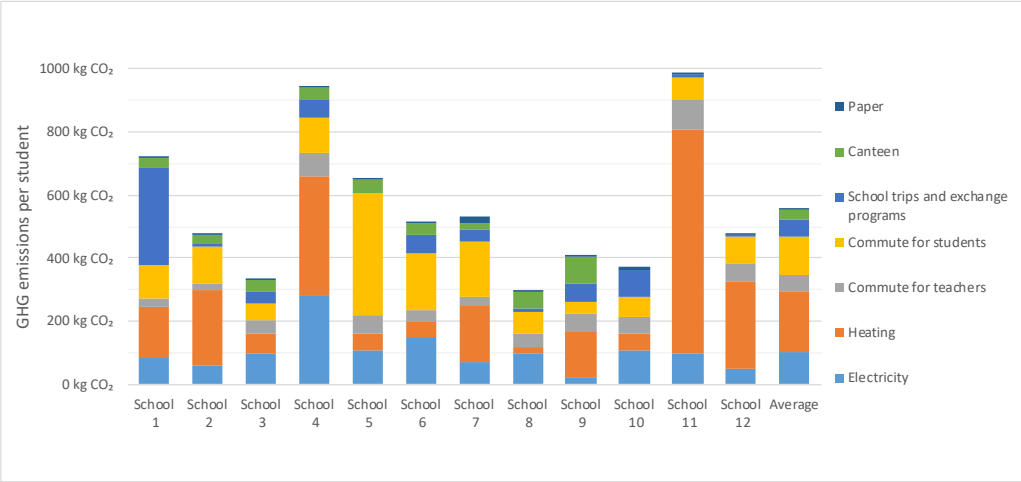

Figure 2. Comparison of GHG emissions per student for different schools.

A more detailed description of the tool including the print screen and the CO_2 assessment process can be found in our previous publication [18].

The results of the carbon footprint assessments of the twelve pilot schools/case studies are also shown in Figure 2. The very large differences in the carbon footprint in different areas are not unusual, as schools have different preconditions and circumstances. A very relevant factor is the age of the building (and the time of the last refurbishment of the building), which leads to higher or lower greenhouse gas emissions, the type of school, and its location as we have previously demonstrated [22]. To be able to compare the different schools, the CO_2 emissions per student were calculated for this paper. Not surprisingly, the emissions deriving from building energy use surpassed the emissions related to the other sectors on average and in most schools.

A comparison of the CO_2 balances of schools illustrates the range of CO_2 emissions. The most climate-friendly school emits only about 300 kg of CO_2 per student per year, while the least climate-friendly school emits almost 1000 kg of CO_2. The theoretical case of a school that has the most climate-friendly values in all areas comes to only 100 kg of CO_2 per student per year. Even though the figures that were collected during the Schools4Future project are not representative of all schools in Germany, initial conclusions can still be drawn about the carbon footprint of schools. The last column shows the average value for the 12 schools, amounting to 565 kg CO_2 per student. Here, it must be considered that no school that had been newly built or extensively renovated in recent years was part of the project. However, the very low carbon footprint for heating in some schools can be attributed to a very low emission factor for district heating for some schools and one school being equipped with a wood chip plant.

4.2. CO_2 Assessments Are a Starting Point for Climate Action

The preparation of the CO_2 balance enabled the participating schools to develop climate protection measures, plan action steps, and start implementing them in concrete terms. At many pilot schools that participated in the Schools4Future project, measures were initiated on the basis of the CO_2 balance. In one school, students were shocked to discover how high the emissions from meat dishes were and, together with the cafeteria management, adjusted the menu so that meat is now only served two days a week. At another school, an idea was tested to avoid food waste by flexibly adjusting portion sizes.

To reduce energy consumption, the fit of windows was improved at one school by replacing the sealing lips. In terms of mobility, a travel concept was created at several schools to avoid air travel and switch to more climate-friendly modes of transport for class trips. In addition to implementation projects, awareness-raising measures were also implemented at many schools. In workshops, teachers developed ideas on how the topic of climate protection can be integrated more strongly into lessons. It quickly became clear that the topic of climate change can be addressed not only in geography or biology lessons but also in other subjects such as art or mathematics. Even foreign languages offer opportunities to convey climate protection knowledge.

4.3. Qualification and Self-Efficacy Can Stimulate Political Activity

Schools can make an important contribution to reducing their own greenhouse gas emissions, but the greatest potential can only be realized by the school authorities, e.g., the city or municipality. To increase the pressure for immediate and short-term actions, it is therefore important to communicate with local actors, formulate political demands, and make the concerns public, in addition to one's own climate protection efforts.

In the Schools4Future schools, the concept of political simulations was used to explain political influence to the students and to test the possibilities of political influence in a real-world environment. The aim was to show the students which groups of actors are relevant and which different strategies are conceivable to pursue their own interests. Political simulations offer a great opportunity to support students to develop a deeper understanding of political contexts and to get them interested and excited about a specific topic, like in our case of climate protection and energy consumption.

Since school authorities play an important role in climate protection at schools, it makes sense to present the results of the CO_2 assessment to the decision-makers in their own city. School authorities gain insight into the state of the school, for example, in the area of energy consumption, transport connections, or the nutrition and procurement concept. Based on the CO_2 balance, potentials can be identified, and measures can be planned and implemented. In order to make the demands heard, some schools have learnt to submit citizens' applications and thus become politically active. In response to the citizens' application, one student received an invitation to a city council meeting to actively represent the results in front of the local parliament. Here, the student made concrete demands and presented the gaps and weaknesses in the schools directly to regional decision-makers like the mayor. In one case, this measure resulted in a school receiving money for bicycle stands after submitting an application.

The students thus learn in a playful way, but in a real-world environment, how political influence works and how demands can be emphasized, and they experience self-efficacy since actions can also be followed by deeds (as in the case of the bicycle stands). They experience the impact of their actions.

The researchers who accompanied the process of the policy simulation in combination with living labs observed and evaluated the individual steps. Insights into the functioning of social dynamics and processes were gained.

Students also learn to represent their own interests, form their own opinions, and therefore gain self-confidence. In addition, these political simulations also foster important skills such as critical thinking, teamwork, and communication skills. It has been shown that students gain confidence in their own abilities, and their understanding of how democratic processes work is strengthened.

Another approach chosen to make their own interests public is climate protection days organized by individual schools. At several schools, relevant actors of the city were invited, such as energy suppliers, the mayor, employees of the facility management, public transport companies, the press, etc. The students were able to discuss their own interests based on the CO_2 balance. Here, too, the students were able to present the existing potential, show obstacles, and present ideas for climate protection measures. These events were very well attended, had a great response in the press, and in all cases led to follow-up actions,

e.g., meetings with the city's facility management. At the same time, the climate protection days were a good opportunity to communicate the results to the school community, to get more students, teachers, and parents on board, and to plan a long-term climate strategy. In one of the participating schools, for example, they take climate protection seriously, and some schools have set themselves goals of being climate neutral by 2040 or even earlier.

Figure 3 shows on the left the phases of policy simulations according to Klippert [25] and Asal/Blake [26], as already prepared by Lohmann [24]. In addition, it has been supplemented by the approach used in the Schools4Future project. It is easy to see that the method we have chosen in the project design integrates the phases of policy simulation.

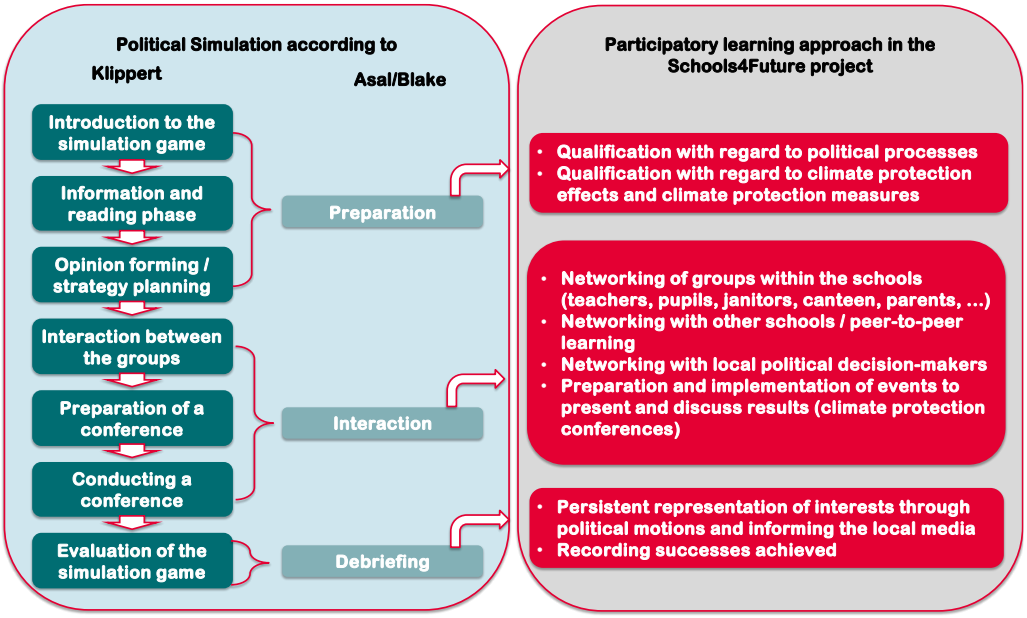

Figure 3. Phases of policy simulation and phases in the Schools4Future project—own illustration based on Lohmann [24].

4.4. Whole-School Approach in Combination with Living Labs Works

The experience from the Schools4Future project shows that the chosen approach to combine the concepts of the whole-school approach with the concept of living labs helps to create a stimulative learning environment with hands-on experiences which leads to real-life results and politically active students. Students learn how political processes work, voluntarily use their free time to organize events, write citizen applications, and implement concrete climate reduction efforts.

5. Discussion

During the project period, several participating schools achieved the goal of political action. Strategies to engage politically have been developed in some schools. Of the 12 schools, 3 have submitted their own applications to policymakers, and 5 schools have held events to which local politicians were invited. Moreover, 10 of the 12 schools have been involved in school committees and presented their results and proposed measures through them. Five schools invited the local press to communicate their results to the public and to point out deficits to local politicians. In total, there were about 25 reports in the local press in the school locations.

These figures demonstrate the success that students have achieved through their commitment. However, it is difficult to make these successes comparable. We argue that it makes sense to apply the strategy of the whole-school approach, and we suspect that there is a connection between the success experienced through self-efficacy and the involvement of different stakeholders in the sense of the whole-school approach. In order to prove this, these two variables would have to be operationalized and made measurable. It could be

very interesting for future studies to scientifically prove this correlation. The SWE scale for general self-efficacy expectations by Schwarzer/Jerusalem (2003) [30] can be used to measure self-efficacy. This scale can be used to measure beliefs in subjective controllability or competence expectations in various challenging situations. Since this scale, as well as our method design, was developed based on Bandura's (1977) [31] social–cognitive learning theory and the concept of positive situation–action expectations contained therein, it could be a suitable measurement instrument. A fitting measurement instrument would still have to be developed to measure the realization of the whole-school approach. One basis for this could be the number and intensity of stakeholder groups involved.

6. Conclusions

The combination of teaching students how to use a tool to calculate school CO_2 emissions with teaching them how to influence elected decision-makers politically contributed significantly to the success of the project. The mixed methods used in the project, from the CO_2 assessment tool to the concept of political simulation/living labs, allowed the researchers participating in the project to gain deep insight into the potential of the political mobilization of students. Before participating in the project, the students were not aware that they had political rights and opportunities to exert influence, even if they were not yet eligible to vote because of their age. The teachers were also previously unaware that their students had opportunities to participate in local politics in this way. The Schools4Future approach has proven to be valuable to increase climate protection in schools and to make self-efficacy tangible for students (and teachers).

Our results show that it makes sense to involve the entire school community in a sustainable climate protection process at schools. Students and teachers can then experience the success of climate protection at their own school particularly well. Ecological awareness is built up and strengthened and important action skills are acquired. In addition, the involvement of students and teachers in the modernization measures strengthens their motivation to continue working for climate protection and strengthens their political skills by giving them insight into political decision-making processes at all levels.

Now, the legislature in particular is asked to implement measures at schools and to meet the demands of the younger generation. Through energy retrofits, schools can not only make an important contribution to climate change mitigation, decrease greenhouse gas emissions, and save resources but also reduce the costs of operating the building in the long run, which can also lead to structural budget improvements for the municipality. Thus, climate protection in schools is much more than just reducing harmful emissions, as all pillars of sustainability are relevant here. In addition to ecological aspects, social, economic, and educational aspects also play an important role. Furthermore, municipalities can actively fulfil their role as pioneers and role models in climate protection and demonstrate in practice how climate protection can be implemented in concrete terms. They can send an important signal to schools and thus the entire school community: we show how it can be achieved and how to make an effort not to burden the next generation excessively. A key finding of our work is that climate protection in schools is a joint task [16].

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