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Education for sustainable development in physical education: Program development by use of intervention mapping

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There is little information on the development of school-based programs to change students' sustainability behavior. The goal of this article is to describe the systematic development and the content of a program that includes education for sustainable development in regular physical education. The Intervention Mapping approach was used as a methodological framework for program design. Participatory workshops with relevant stakeholders and experts were part of the process. Considering the physical education curriculum with its multiple objectives, four main behavioral outcomes were derived: Reduction in clothes consumption, change in diet, change in dealing with trash and increased usage of bike/public transportation. Behavior change methods were specifically selected to be suitable for physical education. The developed practical applications are in line with the physical education curriculum. It is reflected on the use of intervention mapping as a methodological framework for program design in the specific field of sustainability behavior and the equally specific setting of physical education. Benefits and limitations of the developed program are discussed.

KEYWORDS

sustainability behavior, behavior change, intervention development, educational program, teaching material, climate change

Introduction

Sustainable development (SD) is a current and much-discussed topic in society and science that aims to satisfy the present generation's basic needs without endangering future generations (World Commission on Environment and Development, 1987). It is understood as a process of constant change (Hauff, 1987), in which the three dimensions "economic—social—environmental" exist side by side, but constantly influence each

other and can therefore only be considered as a whole (Overwien and Rode, 2013). Aspects of SD are being discussed at all levels in politics (e.g., biannual UN climate change conference), science (Lade et al., 2020), and regarding individual behavior (e.g., in consumption behavior and transportation). However, implementation of SD approaches is still slow while acute problems such as climate change become increasingly pressing. Notwithstanding, SD is a process that takes time, also because it is a task for society as a whole (Henze, 2016). Dealing with climate change is a particularly important issue for SD, as it has serious effects on the social and economic dimension. Scientists agree on the dramatic status that the earth is heating up and is predicted to heat up further as a result of human actions (Powell, 2016; Steffen et al., 2018; Timothy et al., 2019). The heating of the earth leads to various changes in the planetary boundaries, a term introduced by Rockström (2009). According to his hypothesis, when the thresholds of the planetary boundaries exceed a certain limit, they can no longer regenerate, which would have a great influence on the life of humans, animals and plants on earth (Rockström, 2009; Collste et al., 2021; Folke et al., 2021). In 2015, he calculated that some boundaries (rate of biodiversity loss, climate change and human interference with the nitrogen cycle) have been surpassed already (Rockström, 2009).

There are several approaches, such as promoting renewable energies and improving social systems and education, to bring SD forward worldwide in the Agenda 2030 (General Assembly United Nations, 2015). Most authors and politicians agree that education must be a driving force behind change in society (Leicht et al., 2018). There are various educational programs, e.g., Environmental Education (EE) and Education for Sustainable Development (ESD). EE focuses on environmental aspects of SD and can be seen as a part of ESD (Bolscho and Hauenschild, 2006). The concept of ESD was established in 1992 at the United Nations Conference on Environment and Development in Rio de Janeiro (Vereinte Nationen, 1992). It represents a broader framework that also includes the development of social skills with responsibility toward oneself and others, political and economic understanding, and participation in processes of change (Hauff, 1987; Bolscho and Hauenschild, 2006; Michelsen et al., 2013; Overwien and Rode, 2013), and thus addresses all three dimensions of SD. Politicians, educators, and practitioners adopting ESD want to enable people to think and act in a sustainable way (United Nations Educational, Scientific and Cultural Organization, 2013, 2014). They also want to enable people to become responsible decision-makers so that they understand the effects of their own actions on the world (UNESCO, 2015). Examples for related competencies are autonomy, cooperation, and the ability to decide and act fairly (De Haan, 2008). ESD is also firmly anchored in the Sustainable Development Goals adopted by the UN in 2015 (General Assembly United Nations, 2015). ESD is a very complex concept, and concrete actions therefore often focus on specific thematic topics, such as climate change. Specifically, an ESD program focusing on the thematic area of climate change is expected to address a host of topics such as mobility, consumption, nutrition, and lifestyle (Klann and Nitsch, 1999; Henze, 2016).

In implementing ESD, schools have the possibility and opportunity to play an important role. Teachers meet their students on a weekly basis and can have a great impact on the children's education with the content they teach and the methods they use in class (Klafki, 1991). In addition, school reaches all children. Many countries around the world, e.g., Germany (Rieckmann, 2016), Sweden (Fredriksson et al., 2020), Scotland (Watson, 2015), and Thailand (Didham and Ofei-Manu, 2012), have included ESD in their school curricula as part of their national plans for SD (United Nations Educational, Scientific and Cultural Organization, 2014). ESD is embedded in the mission statements of schools as well as in the curricula of individual subjects in some countries (Curriculum Committee for Physical Education, 1999; Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). In Germany, among other countries (National Council for Curriculum and Assessment, 2017), most curricula (depending on the federal state) require ESD to be included in physical education (PE) (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). PE offers special opportunities for ESD because the students come into direct contact with the physical and social environment (Weizsäcker, 1968). Learning in motion, or active learning, is especially promising, as existing literature shows. Learning in motion, or active learning, is especially promising, as existing literature shows. In a literature review, Bidzan-Bluma and Lipowska (2018) found interventional and longitudinal studies that show a positive impact of learning in motion on cognitive functions of children. Furthermore, it was shown that physical activity improves cognitive control, memory and students' executive attention (Kubesch et al., 2009; Chaddock-Heyman et al., 2014). For a long time, there have been programs that link learning e.g., mathematics or languages with movement, because this way children's attention span is longer and they learn holistically (with the body and the brain) (Frischenschlager and Gosch, 2012). As one curriculum example, the Bavarian curriculum wants students to learn to use natural resources carefully and sustainably when practicing sports in nature (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020) and explicitly demands the following contribution to ESD from PE: "Especially when exercising outdoors, students learn to appreciate their natural surroundings and a clean environment, experience them as worth protecting, and practice mindful and responsible interaction with nature and the environment" (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). In general, however, there are differences between the curricular guidelines on the one hand and the actual implementation of ESD in the classroom on the other hand (Olsson et al., 2016; von Seggern, 2018). Although it forms part

of the curriculum, in both cross-curricular and partly subject-specific ways, around 35% of students in Germany do not come into contact with ESD (Grund and Brock, 2018). One reason for this is the existing lack of clarity in terminology as there is disagreement about the definition of ESD and its professional implementation in education (von Seggern, 2018). Another barrier toward the implementation of ESD is the lack of teaching examples (Olsson et al., 2016; Waltner et al., 2020). This is why scientists and politicians call for "developing exemplary materials for the subject-specific implementation of ESD" to make it easier for teachers to include ESD in their classes (von Seggern, 2018).

Despite the described suitability of PE for the implementation of ESD, there is little material available for connecting PE and ESD. In German schools, projects or teaching units for ESD are often implemented well when climate-related topics are temporarily addressed. This is often planned for special project days, or when units find their way into school subjects that naturally deal with SD topics (e.g., biology or geography) (Becker et al., 2013; Sprenger and Nienaber, 2018). There are many German language materials for schools to deal with ESD, environment and climate (Kyburz-Graber et al., 2010; Deutsche UNESCO-Kommission e.V, 2020; Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz, 2020). However, only a few are combined with movement games, sports or physical activity outside the classroom (Amt der Steiermärkischen Landesregierung, 2019). Furthermore, the existing materials are rarely scientifically developed and the transfer to PE with its special features is a challenge that has not yet been overcome (Schack et al., 2008).

For the development of suitable teaching materials that can be applied in PE, it seems beneficial to proceed systematically, as this increases the probability of successful implementation (Kok et al., 2016). There are various approaches, such as the Medical Research Council (MRC) framework for developing and evaluating interventions or the Matrix Assisting Practitioner's Intervention Planning Tool (MAP-IT; O'Cathain et al., 2019), and the Intervention Mapping (IM) approach by Bartholomew Eldredge et al. (2016). The IM was originally developed for health promotion programs and therefore is often used for the design of health interventions (Bartholomew Eldredge et al., 2016). The IM protocol is a tool to develop interventions in six iterative steps. It makes use of existing behavior change models and theories and systematically leads developers in the design of an intervention. This increases the probability that the set goals can be achieved (Kok et al., 2016). The aim of the systematic approach is (1) to ensure that all relevant aspects of intervention development are taken into account in order to define goals that can be achieved, and (2) to help other scientists understand the process and use the information to develop new, refined or adapted interventions. A target group-specific needs analysis is to be carried out at the beginning, which forms the basis for the following steps (Bartholomew Eldredge et al., 2016). Through the participation of various stakeholders in the development process, it is ensured that most aspects of the intervention setting and the target group are taken into account (Bartholomew Eldredge et al., 2016). There are many studies in the school setting that have used IM (Singh et al., 2006; Leerlooijer et al., 2011; Lloyd et al., 2011; Lindqvist and Rutberg, 2018). The Dutch Obesity Intervention in Teenagers was systematically developed to prevent severe weight gain in students. The development is based on the IM and was adapted in some aspects. A randomized controlled trial shows that the intervention has positive long-term effects. also developed a school-based intervention concentrating on obesity in students. They describe steps 1–4 of the IM and conclude that the IM fits to their intention very well. Equally, there are health intervention programs that have been developed for PE by use of IM (Verbestel et al., 2011; Ten Hoor et al., 2016). Additionally, IM is also used to develop interventions that do not aim to promote health, but deal with other topics such as social inclusion (Parnell et al., 2015) and partner violence (Kalokhe et al., 2019). The innovative adaption of IM in various topics, such as ESD or EE, thus appears as a highly promising opportunity.

This article describes the development, design and content of the Klima bewegt! Program, which aims to enhance the implementation of ESD in PE in German schools. For this purpose, an innovative didactical program should be developed which fulfills the curricular requirements of PE by combining traditional activity- and movement-related contents with ESD contents. The program should provide physical activity, exercises and games and respective teaching materials focusing on the thematic topic of climate change, aiming at changing students' individual sustainability behavior. This article is based on the structure of the IM protocol. It specifically focuses on the first four steps of the IM framework, which is considered to be of great advantage as it allows for describing the development and the content of the program in more detail. This, in turn, makes it easier for other researchers to understand the program and its development, which finally facilitates the replication and, if necessary, the adaptation of the program. Providing more details regarding the development and content also serves to enhance and facilitate discussions within the research community about the attribution of the effectiveness of programs once they have been implemented.

In the materials and methods section, the four steps of the IM protocol are described along with concrete explanations what has to be done in each of the four steps. Additionally, potential adaptations that were made within the IM protocol with regard to the specific purpose of implementing ESD in PE are also described. The results section then illustrates the products of each of the four steps, culminating in the presentation of the content of the Klima bewegt! Program. Finally, in the discussion section, advantages and barriers that

were experienced while using the IM protocol for program development are addressed and potential problems in the implementation are discussed along with proposed solutions.

Materials and methods

Description of the intervention mapping approach

The IM approach (Bartholomew Eldredge et al., 2016) consists of six main steps: (1) create the logic model of the problem, (2) define program outcomes and objectives—logic model of change, (3) develop the program design, (4) conceptualize the program production, (5) create the program implementation plan and (6) develop the evaluation plan. This article focuses on the first four steps of IM to describe the systematic development of the program in detail. In the following, steps 1 through 4 of IM are briefly described based on the IM guidebook by Bartholomew Eldredge et al. (2016). Additionally, adaptations for every step of the process that were necessary with regard to the Klima bewegt! Program are illustrated.

Step 1: Logic model of the problem

At the beginning of the IM process, a planning group is established to work on the protocol's tasks. Step 1 of IM focuses on analyzing the problem that is to be addressed in the intervention. This is done by conducting a needs assessment, which comprises the assessment of the problem itself, behavioral and environmental causes of the problem and the respective associated determinants of the behavioral and environmental causes. The needs assessment is based on a literature search and stakeholder consultation. The product of step 1 is a logic model of the problem. In the health promotion context, the model describes the mentioned aspects of the health problem with regard to a specific target group as well as its impact on quality of life. A further task of step 1 is to depict the intervention context. This encompasses the description of the target population, setting and community. At the end of step 1, the superordinate program goals are defined.

In our project, a logic model of the problem was created with the input of the planning group, as proposed by the IM. However, for this intervention, we focused specifically on behavioral causes of the problem and excluded environmental factors. This was due to the setting of PE and our aim to develop material to be usable in regular PE lessons, which naturally address student behavior instead of changing environmental structures. A literature search was conducted to get a deeper knowledge of the problem in the target population, behavioral factors and the respective determinants. Since we do not address a (health) problem that has direct consequences for the individual and their overall quality of life, our problem definition was different from the original IM logic model of the problem. We defined the students' behavior in terms of sustainability as the problem that should be directly addressed by the program. In addition to the tasks of IM, our needs assessment included the investigation of existing ESD at school in general and in the specific field of PE. This was done to get a deeper knowledge of the requirements of the setting and target group.

Step 2: Program outcomes and objectives—Logic model of change

The second step of the IM protocol includes the definition of program outcomes and objectives based on the findings of step 1. This involves considerations on how the determinants of behavior need to be addressed by the individual and the environmental factors to reduce the problem. Performance objectives are defined, which represent small sub-goals to achieve the overall objective, which is referred to as the outcome. By creating a matrix, the performance objectives are then combined with the determinants from the selected model or literature. These combinations represent the respective change objectives. They help the planning group understand what they need to do to accomplish improvements in outcomes. Using the performance objectives and the behavioral and environmental determinants, a logic model of change is created.

Again, in Klima bewegt! we explicitly focused on behavioral determinants and excluded environmental determinants. The identified change objectives therefore exclusively refer to the individual behavior of the students.

Step 3: Program design

The program design starts with the logic model of change from step 2 and ends with an initial concept and design of the intervention program. In step 3, the planners generate initial program ideas such as delivery, themes, scope and sequence of the interventional units. The goal is to find and create theory- and evidence-based behavior change techniques (referred to as "methods" in IM) and respective practical applications that are suitable to achieve the change objectives identified in step 2. In IM, "methods" are connected to parameters that should be taken into account when using the respective method. For example, the method "active learning" requires the parameters "time, information, and skills" (Bartholomew Eldredge et al., 2016). These parameters were considered in the development; however, they are not listed here individually with the sense of simplification.

In addition to the methods provided in the IM guidebook (Bartholomew Eldredge et al., 2016), we screened the literature for further methods, i.e., we considered the Behavior Change Technique Taxonomy (Michie et al., 2013, 2015) as well as Kolb's Experiential Learning Cycle (Kolb, 1984). Furthermore, in addition to what is required by the IM, we provide short descriptions of specific exercises that were derived

from the methods and applications in order to enhance comprehensibility and reproducibility.

Step 4: Program production

The program production benefits from steps 1–3. In step 4, the program structure, organization and all necessary materials are planned and produced. They need to be suitable for the target group and setting. In order to achieve effects in behavior change, the detailed program, topics, media (including materials) as well as organizational and social forms in PE must be oriented toward the identified change objectives and the goals of the intervention.

Stakeholder workshops

For the project Klima bewegt! we decided to establish an extended planning group for the four IM steps of program development. We, two researchers, invited persons of all program-relevant stakeholder groups and held four half-day workshops within 4 months with a team of experts in PE (four PE teachers), experts in sustainable development education (two educational workers in ESD), representatives of the target group (three students) and two further researchers from neighboring disciplines, such as German didactics, who had planned school-based interventions for PE and German lessons in the past.

The first workshop was held in an early stage of the project. It was utilized to get to know each other, set goals for the stakeholder group and inform them on the project and the tasks ahead. In the second workshop, we had two main phases of so-called world cafés. The goal of the world café was to reveal content issues of sustainable development within the German curriculum. Every stakeholder could choose one café table out of four and discuss different topics (some tables were equipped with more than one topic). This process was done four times, so that every participant visited each table. The topics of the café tables were: "buying clothes"; "consumption of meat," "ready meals," and "deep-frozen food"; "transportation"; "media use"; "waste"; "heating and nature experience." During the development process of the program, the topics changed due to the interest of the target group and the findings of the literature research in step 1. In the third workshop, we brainstormed with the entire group on the question "How do we move from an arbitrary collection of exercises to a coherent concept that also does justice to ESD and likely causes direct behavior change?" The most important points identified by the stakeholder group were the practicability of the concept, e.g., through a kit of exercises that can be put together by teachers, implicit learning and holism in the structure (school route, at school and at home). We then discussed challenges, such as curriculum, material requirements, and the acquisition of teaching skills that we may encounter during the course of the project. These inputs of the stakeholder group were of high importance for defining the program design in step 3 of IM. The fourth workshop had silent working phases within three subgroups. Every group worked on a different question regarding the program production (step 4). Group one, including students and teachers, identified the exercises which they expected to be particularly popular in PE. Group two, including experts from ESD and researchers, compiled which components the final program should have. The third group, including researchers and students, worked on the concept for the intervention. They collected ideas on how the intervention could be implemented in the future and what should be taken into account in planning.

The workshops can be seen as an extended form of stakeholder consultation, which is advised in step 1 of IM. Furthermore, in the workshops, IM steps 1–4 were supported in a participatory way. For process evaluation, every member of the planning group completed a standardized questionnaire at the end of each workshop, including items regarding participation, importance of the topics covered, solutions found and the methods used.

Results

In the following, the results of the intervention development are described systematically according to the IM approach by processing from step 1 to step 4.

Step 1—Logic model of the problem

By performing a needs assessment and a stakeholder consultation, each component of the logic model of the problem was identified. Furthermore, our needs assessment included investigating existing ESD at school and in PE. The goals for the program were defined.

Education for sustainable development at school and in physical education

In a German study, only about 35% of pupils were found to be exposed to the topic of sustainability (Grund and Brock, 2018). Pupils in the study had a higher level of sustainability-related knowledge, a more positive attitude toward ESD and they demonstrably behaved more sustainably compared to Asturian (Spanish) students ($p < 0.001$) (Grund and Brock, 2018). A Swedish study compared knowledge, attitude and behavior regarding ESD of sixth- and ninth-grade students with and without an ESD focus of their schools. Sixth-grade students from schools with an ESD approach showed significantly ($p < 0.05$) higher values in the environmental dimension (Olsson et al., 2016). In grade 9, the control group showed significantly higher values in the social level ($p < 0.05$) (Olsson et al., 2016). Therefore, the ESD effect in

schools is in some cases limited (Olsson et al., 2016). This can have various reasons, e.g., students' transfer knowledge and understanding of the complexity of climate change are low, as several studies have shown (Boon, 2009; Shepardson et al., 2009, 2010; Stevenson et al., 2014). Especially the greenhouse effect and the reasons for climate change seem to be unclear (Boon, 2009; Shepardson et al., 2010). We chose to include this aspect of environmental knowledge in our program. Zecha (2010) shows that environmental knowledge is comparatively high in Bavarian students (14–15 years old) (Germany). Therefore, it seems important to offer topics and methods that enable students to reflect on their own attitudes and induce behavioral changes in addition to imparting knowledge. The literature search did not identify any studies on ESD in PE.

Problem in the target population

Literature shows only a limited number of empirical studies that take a close look at the sustainability behavior of children and adolescents. Nevertheless, several behavioral factors regarding the young individuals' climate-related behavior were found. Despite the demands many young people (12–17 years) make on politicians to change climate politics (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit [BMU], 2019), they often behave thoughtlessly or not sustainably, e.g., in terms of individual consumption (Francis and Davis, 2015). According to Francis and Davis, they shirk personal responsibility and set other priorities such as price and convenience ahead of behaving environmentally responsibly (Francis and Davis, 2015). The Eurobarometer (Directorate-General for Communication and co-ordinated by the Directorate General for Communication, 2019) shows that the youngest group (15–24 years) tends to have the lowest percentage in climate action compared to the other age groups (25–39; 40–54; 55+ years) in aspects like reducing and separating trash or considering the carbon footprint on food and clothes. Trash consumption and carbon footprint on food can be seen as changeable for young people and therefore we chose to include these outcomes in our program. A large German study further shows that more than half of the participating 4,644 students use public transport (52% in summer/61% in winter) or motorized vehicles (6% in summer/10% in winter) to get to school (Müller et al., 2008). Most of them walk if the distance is less than 1 km and they mostly ride a bicycle if they live no more than 5 km from the school (Müller et al., 2008). If we look at the social dimension of sustainable development, a Swiss study on engagement for developing countries shows that barely 10% of young people (8–14 years old) are actually active (e.g., students waive their pocket money and donate it to a development project). Nearly 30% of those surveyed see a commitment as unnecessary or useless. The majority (about 60%) intend to get involved (Herzog and Thomas, 2001). In summary, literature shows that children and adolescents often tend to behave in a non-sustainable way. Although climate change is a current societal topic, especially for the young (Tucci et al., 2007; Phillips et al., 2018; Albert et al., 2019; Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit [BMU], 2019; Fridays for future, 2020), it seems that many young people lack knowledge on climate-relevant issues, or on alternative behaviors. Further, the intention-behavior gap (Sheeran, 2002) might be another reason for unsustainable behavior. For effective behavior change, it is therefore important to identify and address behavioral determinants.

Determinants of environmental and sustainability behavior

First, a common understanding of the terms environmental and sustainability behavior was established. Environmental "behavior involves adopting attitudes and behaviors aiming to minimize any adverse effects on natural environment"(do Paço and Laurett, 2018). Sustainable behavior is understood as "ensuring that this generation meets its needs without compromising the ability of future generations to meet their own needs; taking into account three main dimensions: economic, social and environmental"(do Paço and Laurett, 2018). We chose to focus on sustainable behavior, since behavioral aspects that go beyond the narrower scope of environmental behavior were to be included in the intervention.

Determinants of behavior can be derived from behavioral models as well as from empirical studies. To identify the determinants that we need for our program (in step 2), we screened theoretical models and appropriate literature. Since we did not want to start at the motivational level but one step ahead, it is important to find determinants that refer to the level of norm activation. In this section, the part of the process is described that takes place before deciding on which are the determinants of behavior that should be focused on (in step 2). According to behavioral models, knowledge and attitude have a major indirect influence on behavior (Fietkau and Kessel, 1981; Matthies, 2005; Bondell et al., 2018). Personal and social norms are also known as influencing factors of behavior (Schwartz and Howard, 1981; Ajzen, 1991; Matthies, 2005). The above-mentioned determinants correspond to models of environmentally friendly behavior (e.g., The model of Responsible Environmental Behavior) (Hines et al., 1986) and general behavioral models [e.g., Theory of Planned Behavior (TPB)] (Ajzen, 1991; Matthies, 2005; Bogner and Wiseman, 2006; Bondell et al., 2018). The Influence Scheme of Environmentally Friendly Everyday Actions according to Matthies (2005) aims specifically at creating a framework model for environmentally responsible behavior and was chosen as the basis for Klima bewegt! (**Supplementary Figure 1**). Despite the fact that this model does not refer to sustainability behavior, it seemed most appropriate for our project. The Influence Scheme of Environmentally Friendly Everyday Actions was designed with insights from intervention research and based on previously tested models in a practice-oriented manner

(Matthies, 2005). The model is based on various behavior models such as the Norm Activation Model of Schwartz (1977), Theory of Reasoned Action (TRA) (Flanders et al., 1975) and TPB (Ajzen, 1991). The Influence Scheme of Environmentally Friendly Everyday Actions is built on the assumption that a weighing of moral, social and other costs and the cost-benefit ratio always precedes the decision for environmentally responsible or environmentally harmful behavior. Studies show that students at this age act norm-oriented (Killen et al., 2013; Hidding et al., 2017). The activation of norms, thus, can be an important process for changing environmental behavior (Schwartz, 1977; Matthies, 2005). The evaluation phase is in turn influenced by motivation (personal ecological norm, normative social norm and other motives), which is preceded by awareness of the problem, awareness of one's own skills and awareness of the relevance of one's own behavior (Matthies, 2005). According to this model, environmentally harmful habits have a constant influence.

With regard to empirical studies, many determinants of the models named above were supported in their importance for sustainability behavior. In this paragraph, the determinants, occurring in the model from left to right, are briefly described. Stevenson et al. (2014) found that climate change knowledge has a positive correlation with believing in anthropogenic climate change (Stevenson et al., 2014). She discusses the fact that "climate literacy efforts can overcome worldview-driven skepticism among adolescents, making them a receptive audience for building climate change concern" (Stevenson et al., 2014). Regarding commitment for developing countries, knowledge about the countries and their living conditions is statistically related ($p < 0.01$) to the willingness to engage (Herzog and Thomas, 2001). These two examples and some other studies (Gifford and Nilsson, 2014) show that the influence of knowledge on pro-environmental behavior is important.

Awareness of consequences is shown to be an important determinant of environmental behavior (Wiidegren, 1998). Social norm, also called subjective norm (Ajzen, 1991), can be named in the context of important determinants in regard of pro-environmental behavior (Hunecke et al., 2001; Rhodes et al., 2002). It is shown that the personal norm, i.e., attitude, has a greater influence on behavior than the social norm (Hunecke et al., 2001). Hunecke et al. (2001) show that the personal ecological norm correlates with environmental behavior. However, there are differences, depending on costs. The example of ticket prices for public transport shows that low costs cause a stronger correlation between attitude and actual behavior (Hunecke et al., 2001). In environmental consumerism, the attitude-behavior gap can be observed very clearly (Gupta and Ogden, 2006; Fischer et al., 2017). Ajzen and Fishbein (2005) state that attitudes are important determinants of behavior, but "for a wide range of behaviors, and for many individuals, broad implicit attitudes will lack predictive validity" (Ajzen and Fishbein, 2005). In order to fill the gap between attitude and behavior, scientific studies should try to work with the values and intentions of the target group (Fischer et al., 2017). Likewise, studies show that the intention-behavior gap could not be clarified so far (Sheeran, 2002). Intention only partially explains the variance in behavior. Internal factors (e.g., self-regulation), but also external factors (e.g., time, money, accessibility) can be causes of these problems (Sheeran, 2002; Fink et al., 2021).

In addition to the models' determinants, literature points to further determinants that have an influence on sustainability behavior. With regard to environmental and sustainability behavior, connectedness to nature is an aspect that is investigated (Otto and Pensini, 2017; Barrera-Hernández et al., 2020; Grund and Brock, 2020). Additionally, emotions regarding SD have an impact on sustainability behavior (Bamberg and Möser, 2007; Raeisi et al., 2018; Grund and Brock, 2020). According to a study of Grund and Brock (2020), emotions regarding SD are the second important indicator of sustainability behavior. Other aspects, such as industrialization (Collado et al., 2015), were not given primary consideration in our setting, because want to keep our focus on the behavior of the students. Likewise, with our program, we have little impact on the school as an organization. Nevertheless, our program can serve as inspiration for the school to address the issues of climate protection and sustainability. In the best case, our PE program would be part of a whole institution approach that encompasses the entire school and its structures. Setting for the intervention.

The Klima bewegt! intervention was planned to be implemented in a school setting. It involved public schools in urban areas, namely schools in the cities of Munich and Augsburg (Bavaria, Germany). The intervention was planned to be conducted by the classes' regular PE teachers during PE lessons. It was designed for sixth- and seventh-grade students (aged 11–13 years) in secondary (Realschulen) and grammar schools (Gymnasien). It is expected that in these grades, children have already developed a basic knowledge of SD topics, since in fifth-grade geography lessons, they are taught about themes such as "The uniqueness of planet earth" and "Conventional and ecological agriculture" (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020).

While concentrating on PE as interventional setting, several PE-specific aspects must be considered. In Bavaria, PE in sixth and seventh grade is generally performed for 90 min a week (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). In sixth-grade, there are additional 45 min per week that can be but do not need to be used for PE. Most regular PE lessons are held indoors, but teachers are free to hold their lessons outdoors (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). The German education system has a multi-level structure throughout the country (Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs, 2019). It consists of pre-school education, primary education, secondary level 1 and

2, tertiary education and continuing education (Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs, 2019). The curricula are published by each federal state itself, so there may be small deviations (Eckhardt, 2019). The curriculum for Bavaria is divided into grade-specific competencies (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). One part of the curriculum is comprehensive for all subjects and the other part is subject-specific (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). There is also a specific curriculum for PE that describes the competencies that students should achieve in PE in the respective grade levels (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). The intervention was planned to combine ESD and PE content so that the PE curriculum is still fully implemented.

Program goals

The needs assessment showed that students want to engage and improve in the area of sustainability, but approaches are needed to provide access to knowledge and behavioral opportunities.

According to the needs assessment and the results of the stakeholder workshops, we decided to concentrate our program on four climate-related topics: clothing, nutrition, trash and mobility. Considering the documented behavior of young people in terms of consumption, trash production and mobility (Directorate-General for Communication and co-ordinated by the Directorate General for Communication, 2019), it became clear that changes in these behaviors are important to achieve a sustainable lifestyle. In the view of our workshop experts, these behaviors are also those that can be changed by the students themselves, without the mandatory support of parents. This results in the following program goal:

After participating in the Klima bewegt! program in regular PE, students will show an improvement in sustainability behavior, especially in the topics of clothing, nutrition, trash and mobility.

Step 2: Program outcomes and objectives—Logic model of change

According to the IM protocol, in step 2 we first defined the program outcomes that are to be achieved with our intervention. They were based on the products of step 1 and derived from the overall program goal defined earlier. Further, a discussion in the stakeholder workshop on the most important outcomes guided our choice. According to the expertise of our workshop team and current literature, the behavioral outcomes are also oriented toward topics that the target group is interested in and within which the students are potentially motivated and able to change their own behavior. The program aims to provide opportunities for behavior change in everyday life at home and at school. From the set behaviors, we derived performance objectives that further specify the behavioral outcomes:

Behavioral outcome 1. Reduction of clothes consumption;
- Performance objective 1a. To refrain more frequently from purchasing new clothes;
- Performance objective 1b. To buy ethical and sustainable clothes;
- Performance objective 1c. To exchange clothes/wear second-hand clothes;

Behavioral outcome 2. Change in diet;
- Performance objective 2a. To abstain from meat more often;
- Performance objective 2b. To buy seasonal products;
- Performance objective 2c. To buy regional products;

Behavioral outcome 3. Change in dealing with trash;
- Performance objective 3a. To avoid buying packaged products;
- Performance objective 3b. To throw away less food;
- Performance objective 3c. To not throw trash into nature;
- Performance objective 3d. To separate trash into the correct trash can;

Behavioral outcome 4. Increased usage of bicycle/public transportation;
- Performance objective 4a. To ride/travel to school by bicycle/public transportation;
- Performance objective 4b. To ride/travel by bicycle/public transportation in their free time;
- Performance objective 4c. To ask parents for less car transportation.

We derived the following five theoretical determinants from the Influence Scheme of Environmentally Friendly Everyday Actions (Matthies, 2005): D.1 Awareness of the problem/knowledge; D.2 Awareness of the relevance of own behavior; D.3 Awareness of own skills; D.4 Personal ecological norm; D.5 Social norm. By linking performance objectives (goals) and determinants (from the model), we defined change objectives. The resulting matrix can be found in **Supplementary Table A**. For example, by linking the performance objective "2b Buy seasonal products" with the determinant "D.1 Awareness of the problem", the change objectives "know what seasonal products are," "be aware of the lower CO_2 consumption of seasonal products," and "know where seasonal products can be bought" are derived.

Step 3: Program design

Step 3 included finding and creating methods and applications for the pursuit of the change objectives from step 2 as well as defining an initial concept and design for the program.

Methods and applications for change objectives in Klima bewegt!

In our workshops, we collected ideas for PE-specific topics and practical applications in PE. An example of a topic could be basketball, while a practical application is the way to teach basketball, like training for bouncing the ball. The topics were supposed to be convertible within our performance objectives (step 2), while the practical applications were supposed to be closely tied to PE and its methods. In order to find practical applications that fit our change objectives, a matrix was created (**Supplementary Table B**). In this matrix, methods, applications, and their descriptions can be found. Each part of a unit matches the respective change objective. The methods originate from theoretical models (Bartholomew Eldredge et al., 2016) and are confirmed in empirical studies (Michie et al., 2015; Bartholomew Eldredge et al., 2016).

In the following paragraph, all methods from **Supplementary Table B** are briefly described in order of appearance, except for active learning, which, since it is a basic method, is described first.

Active learning can be found in the Elaboration Likelihood Model (Petty et al., 2009) as well as in Bandura's Social Cognitive Theory (Bandura, 1977). We applied active learning as basic method of behavior change (Bartholomew Eldredge et al., 2016) to achieve change objectives that are affected by determinants D.1 (Awareness of the problem/knowledge) as well as D.3 (Awareness of their own skills). Active learning, including goal-driven and activity-based experiences (Bartholomew Eldredge et al., 2016), supports students' learning. Researchers and practitioners are convinced that "students gain a much deeper understanding of science when they actively grapple with questions than when they passively listen to answers" (Waldrop, 2015). PE offers a good platform for this method, since activity-based experiences are a regular component of PE lessons.

Using imagery from theories of information processing (Steen, 2007; Wright, 2012) helps to achieve change objectives that are affected by determinant D.1 (Awareness of the problem/knowledge). Objects and pictures are used to create a mental link between images and facts (Bartholomew Eldredge et al., 2016).

Communication in the form of discussion is used as method to achieve change objectives that are affected by determinants D.1 (Awareness of the problem/knowledge) and D.4 (Personal ecological norm) originating from the Elaboration Likelihood Model (Petty et al., 2002, 2009). In our intervention, we frequently included discussions in order to address change objectives affected by determinants D.1–D.5. Within discussions, we integrate further methods to achieve a combination of reflection and discussion. Further, discussions awake emotions, which can support behavioral change (Bamberg and Möser, 2007; Raeisi et al., 2018; Grund and Brock, 2020).

Arguments are used to achieve change objectives that are affected by determinant D.1 (Awareness of the problem/knowledge), e.g., considering reducing clothes consumption by making reasonable assumptions and drawing associated consequences, including change of perspective (Bartholomew Eldredge et al., 2016). Arguments, as a method, are selected from the Communication-persuasion matrix (McGuire, 2001) and are also found in the Elaboration Likelihood Model (Petty and Wegener, 1998; Petty et al., 2009).

We applied consciousness raising to achieve change objectives that are affected by determinant D.2 (Awareness of the relevance of their own behavior). The method originating from different well-known theories, such as the Health Belief Model (Rosenstock, 1974), the Precaution-adoption Process Model (Weinstein et al., 1998a,b) or the Trans-theoretical Model (Prochaska et al., 2015), informs the learner about causes and consequences of a problem or problem behavior and provides alternatives.

Goal setting motivates students to commit to and reach the set goal (Latham and Locke, 1991, 2007). We therefore decided to use this method to address change objectives affected by determinant D.3 (Awareness of own skills).

We further applied self-reevaluation and environmental reevaluation from the Trans-theoretical Model in order to achieve change objectives that are affected by determinants D.4 (Personal ecological norm) and D.5 (Social norm) (Prochaska et al., 2015). Self-reevaluation helps learners combine a cognitive and affective evaluation of their self-image with desirable and undesirable behavior. Environmental reevaluation is understood as the combination of affective and cognitive evaluation of how personal behavior can affect one's social environment (Bartholomew Eldredge et al., 2016). Self-reevaluation or environmental reevaluation are sometimes also part of discussions.

We used upward and downward comparison to achieve change objectives that are affected by determinant D.5 (Social norm). For example, students are to compare their individual or group CO_2 emissions and their consumer choices. To set individual goals or group goals, it is considered helpful to provide opportunities for social comparison (Festinger, 1954; Suls et al., 2002).

Direct experience is expected to help achieve change objectives that are affected by determinants D.1 (Awareness of the problem/knowledge) and D.4 (Personal ecological norm) (Maibach and Cotton, 1995). Students are encouraged to increase their knowledge by interpreting their experiences (Bartholomew Eldredge et al., 2016). Similar to active learning, direct experiences are typical in the PE context. For example, students become aware of trash in nature while jogging through nature and collecting trash. This method is further part of Kolb's Experiential Learning Model, which is often applied in Outdoor Education programs (Kolb, 1984).

Guided practice, rooted in Social-Cognitive Theory and theories of self-regulation, should help achieve change objectives that are affected by determinant D.3 (Awareness of their own skills) (Bandura, 1977; Kelder et al., 2015). It motivates learners to continuously practice and repeat a behavior. Further, learners' experiences are discussed, and feedback is provided.

We applied the identification of oneself as role model as an additional method (Michie et al., 2015). We used this method in order to achieve change objectives that are affected by determinant D.2 (Awareness of the relevance of their own behavior) in the field of mobility.

We further applied self-monitoring of behavior following theories of self-regulation in order to achieve change objectives that are affected by determinant D.3 (Awareness of their own skills) in the field of mobility (Bandura, 1977; Creer, 2000). We intend to motivate learners to document their behavior in order to sustainably remember the experience (Bartholomew Eldredge et al., 2016).

First concept and design of the program

We developed a school-based intervention, so we had to consider the curriculum, school holidays and teaching styles. Our program is supposed to include eight units, each for 90 min PE per week. Six of the units are supposed to be held indoors, two for outdoors. The two outdoor units can be used flexibly during the intervention timescale after the first three introductory lessons. The intervention starts with three introductory lessons that explain the basics of climate change and climate justice, so that all students are at the same level of knowledge when it comes to the specific climate-related topics. With the six consecutive units, we have thus created a framework that can be adapted to situational requirements, such as the weather conditions.

In stakeholder workshops we discussed methods of PE and their use for our intervention. Typical sports activities used during PE lessons in grades six and seven in Bavarian schools found in the curriculum and named by the planning group gave orientation for our intervention program (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). The six "sporting fields of action" were in our biggest interest, because we had to cover the fields that are widely used in regular PE lessons at the time of our intervention. Running, jumping, throwing (field of action 1), play and compete with and without a ball (field of action 3), moving on and with equipment (field of action 4) and expressing yourself physically and creating movement (field of action 5) could be covered. Moving through water (field of action 2) is not covered because not every school has access to a swimming pool. Moving on ice and snow (field of action 6) was also not considered, since it refers to seasonal activities that cannot be followed in every region in Germany.

In this step of intervention development, we have brought the general methods into the PE context to develop the practical strategies. For example, we designed the method "discussion while running in pairs" and thus took the PE context into account.

Step 4: Program production

Approaching the program production

Initially, exercise descriptions were created. The exercise descriptions include the climate-related topic and the sporting field of action in brief. Then the content and the learning and action goals of the unit are briefly described. Additionally, for each unit there is a table with a description of the successive exercises and the required materials. Finally, there are suggestions and variations describing how an exercise can be modified with regard to, for example, intensity and duration. All materials were revised by members of the stakeholder group to determine whether we managed to achieve our defined goals of the respective IM steps in each unit, the change objectives, and whether the descriptions were designed in a practical and understandable way.

The collection of units with their materials consists of quiz cards, information cards, sketches, puzzles, and other exercise materials. Additionally, a teacher information sheet for each unit was created. These provide teachers with further information on the subject of climate change, since they are often not trained in this content in addition to PE.

Structure of the units

We combined a sporting field of action with a climate-related topic in each case to fulfill the content-related requirements of regular PE. Every unit has the same structure and starts with warm-ups in a cognitive and physical way, which include simple exercises. The warm-ups further serve as an introduction to the unit-specific topic. Examples of exercise descriptions are presented in **Supplementary Table B**. The warm-ups are mainly used to address determinant D.1 Awareness of the problem/knowledge.

Next, the units have a main activity, which includes complex exercises with active learning, direct experience and other methods named in step 3. Here we try to address D.1 to D.5 toward the topic of the unit. Some exercises are combined with a team sport like basketball. Once we developed such an exercise, we tried to open it up for other team sports (soccer, handball, etc.) so that the teachers can decide in which team sport they want to train their students. This activity is followed by a reflection. During this phase, students have the opportunity to discuss or talk about issues that concerned them during the unit. The group's process in the previous work phase is also discussed. At the end of each unit, cool-down phases take place and nearly every unit ends with a

final period of reflection. The reflections are mostly filled with discussion as a method to promote the reflection of an issue in an informal debate. Additionally, mobilizing social support and providing opportunities for social comparison, self-reevaluation, and environmental reevaluation are part of the reflections.

Contents of the units

Each unit has its own focus, but repetitions are regularly incorporated to increase and consolidate knowledge, attitude and behavior. The focal points were selected from our behavioral outcomes. The first teaching unit offers students an introduction to the subject of climate change. In this lesson, students learn about the greenhouse effect and the causes and consequences of climate change. The second unit illustrates the role of humans in climate change. In particular, the students learn about the causes and consequences of migration. Unit 3 focuses on class, school, regional and global justice. Unit 1, 2, and 3 should follow one another directly as they serve as the introductory lessons to the topic of climate change. In addition, these units were planned as a period of acclimatization to the different implementation of PE. None of them directly address one of our four behavioral outcomes but they form the basis for understanding the following units. Topics related to climate-friendly nutrition are discussed in lesson four. The fifth unit focuses on the climate issue of consumption with specific regard to clothes. The sixth unit deals with mobility. Travel routes to school, modes of transportation used during leisure time and holidays and the amount of land dedicated to transport are the topics of this unit. Trash is the climate-related topic of the seventh unit. The eighth unit focuses on environmental perception. In these last two units, students experience nature and the school's environment.

During the program production phase, we compiled several material folders containing all the descriptions, materials and information as well as usage guidelines to enable PE teachers to autonomously apply the program in PE class.

Discussion

This article describes the systematic development and the content of an intervention that aims to integrate ESD into PE in German schools. IM was used as a methodological framework.

While the IM approach is often adapted for specific purposes, we faced some challenges in applying IM to our Klima bewegt! study (Lindqvist and Rutberg, 2018; Belansky et al., 2009; Lloyd et al., 2011). These will be discussed in the following, referring to each step of the IM.

In step 1, we had to adapt the Logic Model of the Problem due to the SD context in our program. The aspect of quality of life, which normally must be considered within the model, is not suitable for the Klima bewegt! project, since this aspect of IM refers to the individual. In the case of environmental behavior, we focused on the benefits for society as a whole, and in this case, behavioral change has no direct impact on the quality of life of the individual. The decision to define student behavior as the problem in the model is supported by IM. It proposes to define behavioral outcomes as program goals if the health outcomes can only be reached in the long-term (Bartholomew Eldredge et al., 2016), which is also true for our SD outcomes.

In addition, we have deviated from the IM with regard to the degree of participation. In IM, stakeholder consultation is advised in step 1 and stakeholders should be involved in every step (Bartholomew Eldredge et al., 2016). However, they act more as consultants than decision makers do. With our stakeholder workshops, we used an extended form of stakeholder consultation. Following Laverack's "parallel tracking," we implemented a mixture of bottom-up and top-down approaches (Laverack and Labonté, 2000; Laverack, 2008). We thereby made room for topics that our stakeholders considered important, while also defining certain contents and goals by ourselves. According to King (2012), in we worked in an evaluator-driven manner. In retrospect, it might have been profitable to make more collaborative decisions. If the stakeholders had taken over the role of decision makers largely, we might have taken different directions in terms of content and implementation strategies with the potential for a further increase in acceptance and engagement (Jagosh et al., 2012). Some literature on participatory research show that stakeholders who are involved in a research project show a higher acceptance of research and technical issues and are therefore more interested in being involved in surveys or other studies (Ismail, 2009). A larger stakeholder group might also have been an advantage. A higher number of stakeholders might create more discussion material and be more representative for their group (Ismail, 2009). Overall, we still applied a stronger participatory approach than IM demands. For further programs, it could be profitable to enable even more participation. The positive feedback of the workshop participants also showed that this participatory approach is practical and has a high benefit. Results of the process evaluation indicated that the stakeholder felt to be highly involved. We evaluated three of the four workshops. On average, 9 out of 12 stakeholders agreed that they had the opportunity to express their opinions clearly. The other participants indicated that they were able to contribute their opinions as well. Likewise, 8 of the 12 participants felt that they were able to participate very well in the decision-making process. Even if the main decisions remained with us, our implementation can be classified in a high level of participation (Wright et al., 2010) and can serve as a role model for follow-up projects.

In step 2, we defined the expected behavioral outcomes, while we completely omitted the environmental outcomes. This

decision was already made in step 1, when we realized that PE as our framework does not allow for many environmental influences. Likewise, we were particularly interested in students behavior for our study, for which we developed the change objectives using the determinants of model.

In step 3, the program design, we went beyond the requirements of IM by describing all applications in detail in an extra column. We valued it as important to provide a description of the application to actors in the field. This way, the reader gets a clearer idea of the implementation in the setting of PE. A further deviation from IM was the usage of additional literature. It was important for us to partially back up our methods with literature that is closer to our context, like Outdoor Education. For example, the relevance of direct experience is supported by Outdoor Education literature (Kolb, 1984; Cook and Cutting, 2014). Additionally, classifying the methods as they relate to applications becomes more comprehensible. Further, we added units to the main intervention program, which is also due to the special topic of SD and climate change. To our understanding, the intervention program needed several introductory units to facilitate an entry into the topics of climate change. It requires prior knowledge of the problem of climate change, because only then can students understand why sustainability behavior is necessary at all. Prior knowledge may already be present in individual school classes, originating from other subjects or project days. In this case, the introductory units are not necessary and can be omitted. The introductory units were not included in the process of IM because they do not reflect the approach of IM. The first three units could not be represented in performance objectives, since they do not directly aim at behavioral change. During the process, it became clear that the units do not fit into the scientific framework but are necessary to put the program into practice. The description of the introductory units can be found in **Supplementary Table C**.

In step 4, the program production, we basically followed the IM protocol. However, the program descriptions, materials and further teacher information are quite extensive, as in our intervention teachers will implement the developed program in PE. They will be introduced to the materials but not trained elaborately as it is our goal to not take much of their highly limited time away by participating in our project. Furthermore, we want to publish the materials in a way that will allow interested teachers to use and implement them without investing extra time in attending training sessions.

Strengths and limitations

To our knowledge, Klima bewegt! is the first study that systematically combines PE and ESD. The development of the intervention can be regarded as successful because we were able to achieve the scientific aim of a systematic development by identifying our behavioral objectives. Likewise, practical goals such as a sufficient exercise time and fulfilling the purposes of the PE curriculum were achieved. It should be emphasized that PE content and ESD topics are on the same level in our program, the exercises do not neglect PE contents, and both aspects are addressed simultaneously. Our detailed descriptions of the applications are a great advantage in practice. Thus, actors in the field do not need additional material to be able to understand, or, in a best case scenario, adapt, and further develop the program. While this program is currently designed for ages 12–14, experienced teachers can easily modify it for slightly younger or older age groups, as there are hints in the exercise descriptions for such purposes.

A limitation with regard to the program is that environmental factors were not included. It is known that people in the children's environment, such as parents, peers and teachers (Chawla and Cushing, 2007; Matthies et al., 2012; Collado et al., 2019), and the school environment itself, e.g., organizational factors and the school area (Higgins et al., 2005), influence the children's environmental behavior. Since we refer to PE as our interventional setting, these factors were not considered. However, it would be beneficial to consider these important environmental aspects in a whole-institution approach project with separate interventions (Collado et al., 2019). Secondly, the PE setting itself sets limits for an intervention. Organizational factors, such as time to change clothes, the way to the gym and other aspects, attract the attention of the students and shortens active time. Such aspects can then distract them from the content of the units and pose a challenge for the teacher and the pursued goals. Thirdly, our intervention program did not enable us to address all the planned change objectives due to time constraints. We have nevertheless decided against a longer implementation period because the acceptance might have dwindled owing to the wealth of topics to be covered in PE (Staatsinstitut für Schulqualität und Bildungsforschung [ISB], 2020). Fourthly, ESD is a highly complex approach, including various thematic topics as well as competency goals, so that some compromises had to be made due to the aforementioned limitations. Furthermore, specific skills (e.g., system thinking skills) which have been shown to be important for a deep understanding of climate change issues, could not be systematically addressed. We look at ESD as lifelong learning and therefore consider our program as one of many components in this process. Fifthly, the use of The Influence Scheme of Environmentally Friendly Everyday Actions could be questioned. Although it has been shown that children at the age of our target group may act norm-oriented in general (Killen et al., 2013; Hidding et al., 2017), there are no existing studies that have examined whether

children also do so in aspects of sustainability. Although it can be assumed that evidence from social science (Killen et al., 2013; Rizzo et al., 2017) on norm-oriented action is transferable to the field of sustainability behavior, this should be examined in future studies.

Data availability statement

All developed materials for teachers can be found here: https://www.sg.tum.de/sportdidaktik/praxismaterialien/klima-bewegt/. All materials and videos are in German.

Author contributions

CB and SS designed the study and interpreted the results. SS and FM engaged in the funding acquisition. CB wrote the original draft of the manuscript. SS, JB, and FM supervised the cooperation. All authors contributed to the revision of the manuscript and read and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2022.1017099/full#supplementary-material

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