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Learning Prerequisites for Education for Sustainable Nutrition

High School Students' Human-Nature Relationship and Conceptions of Sustainable Nutrition

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Agricultural sustainability doesn't depend on agritechnology.
To believe it does is to put the emphasis on the wrong bit of 'agriculture.'
What sustainability depends on isn't agri- so much as culture.

(Raj Patel: The Value of Nothing: How to Reshape Market Society and Redefine Democracy)

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1 Introduction

On September 25, 2015, the government leaders of the 193 member states of the United Nations adopted the Agenda 2030 in New York, setting 17 Sustainable Development Goals (SDGs) to ensure a life in dignity for all people by the year 2030. The SDGs take into account the ecological, social, and economic dimensions of sustainable development (United Nations General Assembly, 2015). In the same year, the Paris Agreement on Climate Change was adopted at the international climate conference (COP 21) in Paris and ratified by 195 countries in the following two years. The contracting states committed themselves to the goal of "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (United Nations, 2015, Article 2.(a), p. 3). These internationally agreed goals and binding agreements, which almost all of the world's states have committed themselves to, bear witness to the paramount importance of sustainable development, at least formally, on governmental agendas globally.

The political goals of the United Nations stand in contrast to mounting scientific evidence indicating that we will not be able meeting the SDGs without exceeding critical planetary boundaries and will fail to meet the 1.5°C Paris Agreement goal unless the lifestyle of most human societies and the political strategies to satisfy the basic needs of the population change fundamentally (O'Neill et al., 2018). The planetary boundaries describe the Earth's ecological limits, whose transgression endangers the Earth system's stability and thus the basis of human life (Rockström, Falkenmark, et al., 2009). According to the current status, four of the nine boundaries have exceeded their safe operating space. Two of the remaining five variables have not yet been quantified, which means that no reliable statement can be made about them (Box 1.1; Steffen et al., 2015). The current global food system is considered to be one of the primary causes of planetary boundary transgressions (Campbell et al., 2017; Gordon et al., 2017; Rockström et al., 2020; Willett et al., 2019) and one of the world's largest greenhouse gas emitting sectors (IPCC, 2019). Chapter 1.1 provides a detailed presentation of the environmental impacts of the current food system, taking into account social and economic aspects.

Box 1.1 Current status of the planetary boundaries

Biogeochemical flows	Climate change	Atmospheric aerosol loading
Stratospheric ozone depletion	Ocean acidification	Freshwater use
Biosphere integrity	Land-system change	Novel entities

Beyond the zone of uncertainty (high risk)
In the zone of uncertainty (increasing risk)
Below boundary (safe)
Boundary not yet quantified

Note: Biogeochemical flows are divided into phosphorus and nitrogen cycling that both exceeded their planetary boundary. Biosphere integrity is divided into genetic diversity (extinction rate) and functional diversity. The status of the latter has not yet been quantified. Source: Steffen et al., 2015.

Therefore, meeting the SDGs and the Paris Climate Agreement requires a rapid global transformation toward a sustainable food system. There are various suggestions for achieving such a transformation. Some scientists point to the potential of technical innovations in the novel food sector (e.g., cultured meat; Alexander et al., 2017; Dupont & Fiebelkorn, 2020) or the adaptation of sustainable dietary habits from other cultures, such as the consumption of insects (entomophagy; Fiebelkorn, 2017; Tabassum-Abbasi et al., 2016) to reduce ecological damage and ensure global food security. Although the consumption of insects and cultured meat can reduce the environmental impact of our food consumption, this alone does not fully compensate for the environmental problems caused by the current food system (Alexander et al., 2017; Willett et al., 2019). Accordingly, the EAT-Lancet Commission on Food, Planet, Health (henceforth, the 'EAT-Lancet Commission'), consisting of 37 health, agriculture, politics, and ecology experts from 16 countries, emphasizes the importance of political levers without which a transformation of the global food system will not be possible (Willett et al., 2019). For society to support political decisions, it is essential to sensitize consumers to sustainable nutrition. Furthermore, it is becoming evident that even in rich countries of the Global North, such as Germany, existing policies are insufficient to meet the Paris Climate Agreement (Wuppertal Institut, 2020). Consumers will assume a significant position in transforming the existing food system; their influence is exerted through their dietary behavior, especially their purchasing decisions. In this context, education for sustainable development (ESD) is seen as one of the key instruments for achieving the SDGs as it "empowers learners to make informed decisions and responsible actions for environmental integrity, economic viability and a just society for present and future generations" (Rieckmann, 2017, p. 7). Education provides a unique opportunity to equip entire generations of young people with the skills to adopt a sustainable diet and transform the food system. Even if students do not yet have the financial means to make large-scale purchasing decisions, they represent an important future consumer group and can also act as multipliers for their peers, families, and local communities (Damerell et al., 2013; von Braun, 2017).

To develop appropriate and effective teaching concepts that encourage students to change their dietary behavior in a sustainable way, we must first understand students' learning prerequisites. This dissertation addresses three crucial issues, which to date have received insufficient research interest.

Firstly, a large number of studies suggest that the human-nature relationship represents a critical factor in determining pro-environmental behavior (PEB), such as following a sustainable diet. However, the psychological and cultural factors that promote human-nature relationships in young people are still relatively under-researched. In many indigenous cultures of Latin America, the human-nature relationship is of great importance. Given the potential of the human-nature relationship to promote a more sustainable diet, a quantitative study was conducted to compare Ecuadorian and German students' relationship to nature and the psychological factors that affect it (research focus I).

Secondly, young people's intention to eat sustainably has rarely been addressed in academic research. Understanding the psychological factors that promote the intention to eat sustainably is fundamentally important for developing didactic concepts that foster sustainable eating behavior. For this reason, a quantitative study was conducted in a sample of high school students, examining various (environmental) psychological factors to identify the strongest predictors of sustainable dietary intention and vegetarianism; the latter representing a concrete example of sustainable dietary behavior (research focus II).

Thirdly, relatively little is known about students' conceptions of sustainable nutrition. As students actively construct new knowledge structures based on pre-existing conceptions (Piaget, 1974, 1983; Posner et al., 1982), identifying students' existing conceptions is essential for developing appropriate teaching and learning arrangements and achieving learning success on sustainable nutrition. A qualitative study was conducted to understand high school students' conceptions of sustainable nutrition and the relevance that they attribute in this context to the five dimensions of sustainable nutrition (health, environment, economy, society, and culture[1]; research focus III).

1.1 Sustainable nutrition to meet the SDGs and the Paris Climate Agreement

The current internationally accepted definition of sustainable diets was formulated in 2010 at FAO headquarters in Rome at the international scientific symposium 'Biodiversity and Sustainable Diets - United Against Hunger'.

> Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources. (Burlingame et al., 2012, p. 7).

Although agriculture has made an invaluable contribution to food security in recent decades, it is evident that the current food system is not globally sustainable in ecological, social, economic, and health respects (Burlingame, 2012; Global Panel on Agriculture and Food Systems for Nutrition, 2016; Willett et al., 2019). Indeed, the current food system stands in stark contrast to the goals of sustainable development, defined by the World Commission on Environment and Development (WCED) as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). The 2019 global sustainable development report proposed "building sustainable food systems and healthy nutrition patterns" (Independent Group of Scientists appointed by the Secretary-General, 2019, p. 129) as one of six entry points for sustainable transformation. A food system transformation that includes sustainable dietary patterns is essential to achieve the ambitious SDGs (Box 1.2) and the Paris Climate Agreement, as the following explanations illustrate.

[1] A detailed description of the concept of sustainable nutrition, according to von Koerber et al. (2017), is presented at the end of chapter 1.1.

The most immediate connection between the food system and SDGs is represented by SDG 2: 'Zero hunger'. We now face the paradoxical situation that the food system produces enough food to feed the entire global population, but at the same time, the number of hungry people has steadily increased between 2014-2020 to 690 million (8.9% of the world population; FAO et al., 2020). The most affected regions are Asia and Africa, with 381 million and 250 million hungry people, respectively (FAO et al., 2020). The inequality of food distribution is illustrated by the fact that 1.9 billion adults suffer from overweight or obesity, while 462 million adults are underweight (WHO, 2020a). This food inequality mainly affects children under the age of five years, putting them at risk of malnutrition. Around 45% of deaths in this age group are associated with undernutrition, while childhood overweight and obesity often increases in the same countries (WHO, 2020a).

Box 1.2 Sustainable Development Goals (SDGs)

SDG 1. No poverty End poverty in all its forms everywhere	**SDG 10. Reduced inequalities** Reduce inequality within and among countries
SDG 2. Zero hunger End hunger, achieve food security and improved nutrition and promote sustainable agriculture	**SDG 11. Sustainable cities and communities** Make cities and human settlements inclusive, safe, resilient and sustainable
SDG 3. Good health and well-being Ensure healthy lives and promote well-being for all at all ages	**SDG 12. Responsible consumption and production** Ensure sustainable consumption and production patterns
SDG 4. Quality education Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	**SDG 13. Climate action** Take urgent action to combat climate change and its impacts
SDG 5. Gender equality Achieve gender equality and empower all women and girls	**SDG 14. Life below water** Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
SDG 6. Clean water and sanitation Ensure availability and sustainable management of water and sanitation for all	**SDG 15. Life on land** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss
SDG 7. Affordable and clean energy Ensure access to affordable, reliable, sustainable, and clean energy for all	**SDG 16. Peace, justice and strong institutions** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
SDG 8. Decent work and economic growth Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	**SDG 17. Partnerships for the goals** Strengthen the means of implementation and revitalize the global partnership for sustainable development
SDG 9. Industry, innovation and infrastructure Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	

Note: The SDGs directly affected by the food system are highlighted in gray; Source: United Nations, 2017.

Because well-balanced nutrition promotes good health, SDG2 is directly related to SDG 3: 'Good health and well-being'. The Global Panel on Agriculture and Food Systems for

Nutrition stated that “The risk that poor diets pose to mortality and morbidity is now greater than the combined risks of unsafe sex, alcohol, drug and tobacco use” (Global Panel on Agriculture and Food Systems for Nutrition, 2016, p. 16).

Although the global food system produces enough food to sustain 10 billion people, a substantial proportion of those do not have access to sufficient and healthy food (Holt-Giménez et al., 2012). Despite significant progress on poverty reduction in recent decades, poverty is still the main reason for food insecurity and malnutrition. The cost of a diet that reflects global healthy dietary guidelines far exceeds the international poverty line (USD 1.90 purchasing power parity; FAO et al., 2020). Therefore, reducing hunger and malnutrition is directly linked to SDG 1: ‘No poverty’, which is achievable primarily through political efforts (FAO et al., 2020). Small-scale farmers provide 70% of the world’s population with food but suffer disproportionately under unfair trading conditions (Fairtrade International, 2020b). By buying fair trade products, consumers in the Global North can contribute to fighting poverty with their dietary behavior (Fairtrade International, 2020a) while also reducing global hunger and malnutrition.

The key to combating hunger and malnutrition at a global scale is not the general expansion of food production but a more equitable distribution and more sustainable consumption patterns (Hasegawa et al., 2019). A transformation of the food system through politically driven trade and marketing mechanisms (FAO et al., 2020) should focus on the malnourished by ensuring the affordability of healthy diets for people in poverty while reducing excessive consumption and food waste (FAO et al., 2020; Hasegawa et al., 2019). This should be accompanied by changes in food consumption patterns specific to each country (FAO et al., 2020). Reducing food waste and meat consumption is crucial in the fight against hunger and malnutrition (Hasegawa et al., 2019; Weis, 2013). The latter is particularly important given current estimates that livestock consumes one-third of global cereal production and uses about 40% of global arable land (Mottet et al., 2017), but produces only 18% of the world’s calories and 37% of its proteins (Ritchie & Roser, 2019). These resources could be more efficiently deployed to grow food for people. Furthermore, 700 million of the 2 billion ha of grassland used by livestock could be used as cropland and consequently massively reduce food insecurity (Mottet et al., 2017).

The transformation of the food system also plays a major role in achieving SDG 6: ‘Clean water and sanitation’, since estimates by the FAO and the World Water Council (WWC; 2015) indicate that 70% of freshwater is used by agriculture. Livestock is a significant source of agricultural water consumption, responsible for over 8% of global human water use. It also counts as one of the largest sectoral sources of water pollution (Steinfeld et al., 2006). Reduced meat consumption by the Global North would therefore also contribute substantively to achieving SDG 6, although this has to take place alongside rapid expansion of safely managed drinking water and sanitation services (United Nations, 2017).

SDG 13: ‘Climate action’ goes hand-in-hand with the Paris Climate Agreement. The Sustainable Development Goals Report shows that planetary warming is progressing at an

alarming speed (United Nations, 2017). As one of the largest greenhouse gas emitting sectors, the current food system plays a significant role in this development (IPCC, 2019). Livestock farming, in particular, is a major driver of climate change. Calculations of the contribution of livestock to anthropogenic greenhouse gas emissions vary between 14.5% (Gerber et al., 2013) and 51% (Goodland & Anhang, 2009). In addition to reducing meat consumption in the Global North, preferential reliance on regional and seasonal foods will play a key role in achieving SDG 13 and the Paris Climate Agreement. Shorter distances between food producers and consumers can significantly reduce energy consumption and greenhouse gas emissions (von Koerber et al., 2017). Despite the food sectors' great potential to reduce greenhouse gas emissions, drastic changes in the building, mobility, energy, and industrial sectors are essential to meet the SDG 13 and the Paris Climate Agreement (Wuppertal Institut, 2020). Agricultural food production, in turn, depends on the achievement of SDG 13, as advancing climate change leads to losses in crop yields, making the achievement of other SDGs such as SDG 2 (‘Zero Hunger’) increasingly unlikely (FAO et al., 2020).

The Sustainable Development Goals Report draws a disillusioning conclusion with respect to SDG 14 (‘Life below water’), by showing that the share of overfishing of global fish stocks increased from 10% in 1974 to 31% in 2013 (United Nations, 2017). About 58% of fisheries are considered fully exploited, and only about 11% are underfished (FAO, 2016b). Given the fact that approximately 3.1 billion people currently consume about 20% of their daily animal-derived protein through seafood and as a crucial source of essential micronutrients, especially for the world's poorest people, it is not feasible to reduce fish consumption worldwide (Willett et al., 2019). The EAT-Lancet Commission (Willett et al., 2019) therefore recommends a sustainable expansion of global aquaculture production as well as compliance with the Code of Conduct for Responsible Fisheries (FAO Regional Office for Asia and the Pacific, Bangkok, 2019) to reduce the burden on marine ecosystems and ensure food security for poor people. In addition, numerous established (Rittenau, 2018) and novel foods (Adarme-Vega et al., 2012; Jenkins et al., 2009) offer a plant-based alternative to meet the physiological need for proteins and omega-3 fatty acids. It is important to consider these alternatives dietary behaviors because the expansion of global aquaculture production is associated with considerable environmental impacts (Willett et al., 2019).

SDG 15: ‘Life on land’ aims to “protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss” (United Nations, 2017, p. 10). As 50% of habitable land (excludes barren and ice-covered land; Ellis et al., 2010) is used for agriculture, it becomes evident how important the food system transformation is for achieving this SDG. These agricultural areas were created and continue to be developed at the expense of biodiversity-rich ecosystems such as rainforests and savannahs (Campbell et al., 2017). This continual agricultural expansion must be halted or reversed to minimize biodiversity loss. Again, livestock farming is a crucial target as it occupies two-thirds of the total agricultural land (FAO, 2009; Steinfeld et al., 2006). A shift to healthy diets that have an appropriate

caloric intake and include diverse plant-based source foods and low amounts of animal derived products, as recommended by the EAT-Lancet Commission can contribute significantly to reducing agricultural land-use and thus counteract the degradation of ecosystems in accordance with SDG 15 (Willett et al., 2019). The combination of reducing food-competing animal feed, minimizing food waste, and conversion to organic agriculture represents a promising strategy for the conservation of biodiversity as it also significantly reduces pesticide use and combats nitrogen surplus without dramatic land use increase (Muller et al., 2017).

Both the concept of a sustainable diet as defined by the FAO (Burlingame et al., 2012) and the interrelation between the food system and the various SDGs are very complex and, in some cases, difficult to translate into everyday dietary behavior. Taking into account all stages of the food supply chain, von Koerber et al. (2017) developed a comprehensive framework for sustainable nutrition, deriving seven recommendations for action in everyday life. The advice on how people can feed themselves as sustainably as possible includes incorporating (1) plant-based foods, (2) organic foods, (3) regional and seasonal products, (4) minimally processed foods, (5) Fair Trade products, (6) resource-saving housekeeping, and (7) an enjoyable eating culture (for an illustration see Figure 1.1). Similar to sustainable development (UNCED, 1992), the concept of sustainable nutrition takes into account the ecological, social, and economic dimensions. However, it adds a health dimension because nutrition has a strong influence on people's health and a cultural dimension because food habits are culturally ingrained (von Koerber et al., 2017). As in sustainable development (UNCED, 1992), all dimensions are treated as equally important and, according to von Koerber et al. (2017), are positively influenced by a diet that follows the seven recommendations. In the context of this dissertation, sustainable nutrition for Europe signifies a diet according to the concept of sustainable nutrition by von Koerber et al. (2017).

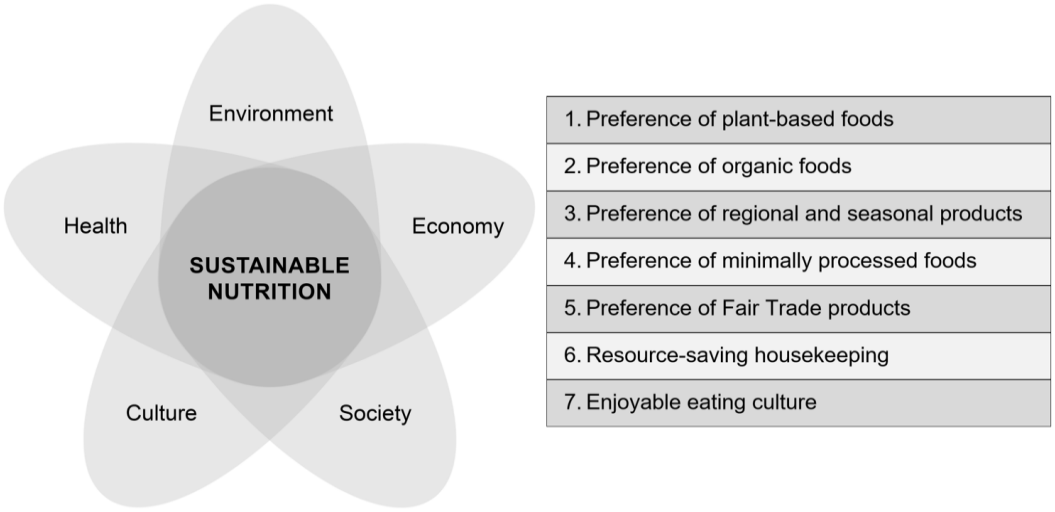


Figure 1.1 Illustration of the dimensions and recommendations of the concept of sustainable nutrition according to von Koerber et al. (2017).

1.2 Sustainable nutrition as a teaching topic for education for sustainable development

As the previous subchapter has already shown, using the example of sustainable nutrition, governmental policies and technical innovations can provide the basis for sustainable development. However, important goals such as the SDGs or the Paris Climate Agreement will remain unattainable if they do not find acceptance among the society and are not accompanied by private sustainable consumption patterns in large parts of the population. Such social transformation is dependent on the development of knowledge, skills, and positive attitudes towards sustainable development (Rieckmann, 2017). In this respect, ESD plays a key role in achieving a sustainable society. This is emphasized by SDG 4 ('Quality education') that aims to "Ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through ESD […]" (Target 4.7 of SDG 4; United Nations General Assembly, 2015. p. 17)

This ESD mission can also be applied to the food sector, which is why the 2019 global sustainable development report urges every country to use, among others, education to "[…] promote food that meets nutritional and environmental standards […]" (Independent Group of Scientists appointed by the Secretary-General, 2019, p. 129).

From a didactic point of view, sustainable nutrition provides a suitable exemplary context for ESD since this topic combines ecological, social, economic, and health aspects to a greater degree than most other topics with a regional-global scope. For this reason, it was declared by the German Commission for UNESCO as the 2012 topic of the year of the UN Decade of Education for Sustainable Development (DUK, 2012).

Examination of the school curricula of Lower Saxony, which, due to the similarity between the school curricula of the federal states, can be considered representative within Germany, reveals that the topic of nutrition is covered only as part of a discussion about one's diet in the context of health education (Lower Saxony Ministry of Education, 2015a). In some cases, it is missing entirely (Lower Saxony Ministry of Education, 2015b, 2015c). Conversely, ESD is associated with environmental conservation or sustainable energy (Lower Saxony Ministry of Education, 2015a, 2015b, 2015c). In the most commonly used biology textbooks, it is striking that nutrition is only discussed in connection with health aspects and without consideration of sustainability aspects (Adamitzki et al., 2020; Baack & Steinert, 2015; Bergau et al., 2015, 2018; Beyer et al., 2016). Both textbooks and school curricula indicate that, despite its potential, nutrition is not yet integrated in ESD in the German teaching practice. As a result, empirical data on students' learning prerequisites in the context of education for sustainable nutrition are scarce. This dissertation aims to address this research deficit.

2 Theoretical framework

This chapter presents the theoretical frameworks underlying this doctoral project. The first part of the chapter focuses on environmental psychology theories addressing factors that might influence the intention to eat sustainably and adopting a vegetarian diet, as a concrete example of sustainable dietary behavior. A review of the extant research literature aims to clarify the various aspects of the human-nature relationship and their relevance for understanding sustainable dietary behavior (research foci I and II). The second part of this chapter is dedicated to theories on students' conceptions with respect to sustainable nutrition (research focus III).

2.1 Psychological factors and knowledge as learning prerequisites for education for sustainable nutrition

This part of the theoretical framework addresses the relationships between various psychological factors and sustainable dietary behavior. A central point for research foci I and II is the competence model for environmental education developed by Roczen et al. (2014). Based on theoretical considerations and empirical observations, it assumes that environmental knowledge and nature relatedness are the driving force for PEB. Following this basic assumption, the model was adapted to the context of sustainable nutrition and extended it with complementary variables (see Figure 2.1). The following subsections describe the structure of the theoretical framework for research focus I and II.

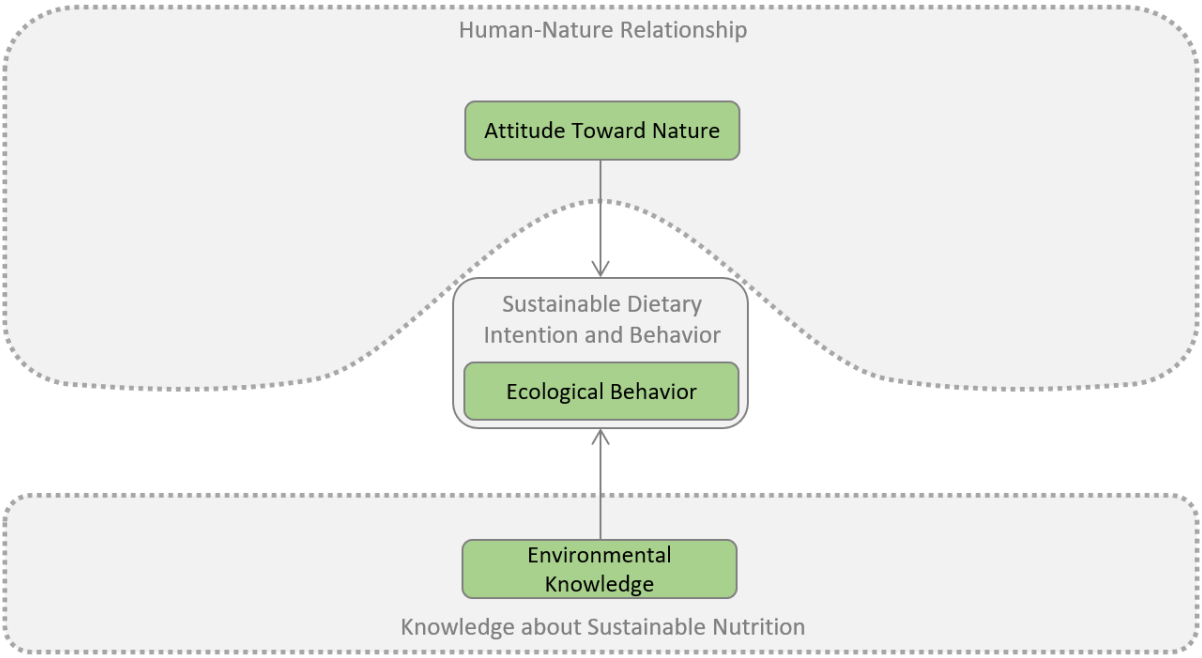


Figure 2.1 The adapted competence model for environmental education as the basis for the theoretical framework.

Note: The variables shaded in green represent the simplified model for environmental education (Roczen et al., 2014). The gray shaded spheres represent the adaptation of the model to the context of sustainable nutrition.

2.1.1 Sustainable dietary intention and behavior

Most of the basic theoretical assumptions guiding this part of the dissertation project stem from environmental psychology, specifically, research focused on identifying the determinants of PEB. Although it represents a broadly sustainable behavior rather than an exclusively pro-environmental one (von Koerber et al., 2017), adopting a sustainable diet qualifies as a PEB in the private sphere (Stern, 2000) because of its positive environmental impact. The theoretical assumptions associated with PEB are therefore applicable in the context of sustainable dietary behavior.

Sustainable dietary behavior is considered in this dissertation on two levels of complexity. On a more complex level, following the holistic definition of sustainable nutrition by von Koerber et al. (2017), sustainable dietary behavior is understood as a diet that follows the principles of sustainable nutrition[2] (see chapter 1.1). Since it was not possible to capture this holistic dietary behavior in the course of this dissertation, and because students have limited control over their dietary choices (parents have financial control over food purchase and food preparation is usually carried out by the mother; Cunha et al., 2016), this dissertation examines only the intention to eat sustainably, not the actual behavior. Given the results of a meta-analysis of 422 correlational studies demonstrating a large sample-weighted average correlation between intentions and subsequent behavior (Sheeran, 2002), intention appears to be an appropriate proxy to infer actual behavior.

On a less complex but still holistic level, actual dietary behavior is considered by examining vegetarianism, which represents one aspect of sustainable dietary behavior. Since it has many beneficial environmental effects (see chapter 1.1), the theoretical assumptions that are pertinent to PEB also apply to this behavior. Vegetarianism lends itself more readily to assessment as a concrete behavior as opposed to an intention. Unlike other sustainable nutrition practices, vegetarianism does not involve additional financial commitment and represents an already widespread dietary preference, especially among teenagers (Spiller et al., 2021). It is therefore assumed that teenagers have relatively strong control over this behavior.

2.1.2 Human-nature relationship

The human-nature relationship is a significant factor in explaining pro-environmental and sustainable behaviors and can be viewed from different perspectives. In the context of this dissertation project, it is considered to include nature relatedness, dispositional empathy with animals, and environmental concern. The following sections of the chapter present these different aspects of the human-nature relationship from a theoretical perspective and illustrate their possible influence on sustainable dietary intention and behavior. The

[2] The principles of sustainable nutrition according to von Koerber et al. (2017) are: (1) plant-based foods, (2) organic foods, (3) regional and seasonal products, (4) minimally processed foods, (5) Fair Trade products, (6) resource-saving housekeeping, and (7) an enjoyable eating culture. For the purposes of this dissertation, the final recommendation was not considered.

fundamental role of values in the human-nature relationship is also addressed. An overview of the human-nature relationship in Ecuador and Germany is provided to justify why this dissertation project examines young people from these two nations concerning their relationship to nature.

Nature relatedness

The concept of nature relatedness refers to the extent to which individuals identify with the natural environment (Nisbet et al., 2009) and is closely connected to the concept of biophilia. Derived from the ancient Greek words *bios* – 'life' and *philia* – 'love for', according to Wilson (1984), biophilia describes the human being's innate tendency to approach other living and natural things and to seek contact with them. Kellert and Wilson (1993) developed the biophilia hypothesis, assuming that the desire to learn from and appreciate the natural environment is evolutionarily anchored within all humans. According to the theory, attraction, identification with nature, and the need for contact with nature are still present in our psychological constitution and essential for human development, since humans have lived close to their natural environment for most of their evolutionary history (Kellert & Wilson, 1993).

Nature relatedness is considered 'trait-like' because it is a relatively stable disposition, both temporally and situationally, yet is not entirely fixed (Mayer & Frantz, 2004; Nisbet et al., 2009). It includes the perceived affective, cognitive, and experiential relatedness of humans to the natural world (Nisbet et al., 2009). Various researchers have studied and operationalized the concept of nature relatedness in complementary ways, focusing on distinct components. Mayer and Frantz's (2004) work concentrates on the affective component, understood as the sense of feeling in community with nature. The cognitive component of nature relatedness refers to the extent to which people include nature within their cognitive representation of the self. This aspect is represented by the concept of 'inclusion with nature' defined by Schultz (2002). The experiential component refers to the individual's physical familiarity with the natural world and their level of perceived comfort being in it (Nisbet et al., 2009). This doctoral project adopts the nature relatedness construct of Nisbet et al. (2009) and regards all three aspects of individual connection with the natural world as equally important.

Based on the multi-component concept of nature relatedness, it can be assumed that nature related people include nature within their cognitive representation of the self to a high extent (Schultz, 2002) and feel emotionally connected to nature (Mayer & Frantz, 2004). From this basic assumption arose the idea that nature related people tend, to some extent, to associate personally with the destruction of the natural environment and are therefore more motivated to protect it (Mayer & Frantz, 2004) by acting sustainably, e.g., following a holistic sustainable or vegetarian diet.

There is indeed is a wealth of correlational research supporting the idea that nature relatedness is a significant factor in explaining PEB (Capaldi et al., 2014; Mayer & Frantz, 2004; Otto & Pensini, 2017; Rosa et al., 2018; Whitburn et al., 2020). Since sustainable

dietary habits and vegetarianism are beneficial for the environment, it is reasonable to hypothesize that nature relatedness also shows positive effects on these behaviors. However, very few studies to date have examined the relationship between holistic sustainable dietary behaviors and nature relatedness.

To date, only Weber et al. (2020) and Weber and Fiebelkorn (2019) have addressed this relationship. They observed that nature relatedness predicted German student biology teachers' intention to eat sustainably. Although no study has yet examined this relationship among high school students, the empirical data available gives reason to expect a positive association between nature relatedness and sustainable nutritional behavior in this sample as well.

Environmental concern

Another vital aspect of the human-nature relationship considered in this dissertation is environmental concern, which describes people's emotional involvement in reaction to environmental destruction (Grunenberg & Kuckartz, 2003). Thus environmental concern represents the affective component of environmental attitudes (Schultz et al., 2005).

Stern and Dietz (1994) suggest that environmental attitudes depend, among other things, on individual values and the importance a person attaches to himself, other people, plants, and animals. Based on this theoretical assumption, Schultz (2001) demonstrated that environmental concern has a three-dimensional structure composed of a person's concern about the effect of environmental destruction on themselves (egoistic environmental concern), on other people (altruistic environmental concern), and on all living things (biospheric environmental concern).

Several studies have shown that biospheric environmental concern is positively related to PEB, while the relationship between altruistic and egoistic environmental concern and PEB or sustainable behavior has not yet been sufficiently evidenced (Milfont et al., 2006; Schultz, 2001; Schultz et al., 2005). One reason for the ambiguity with respect to altruistic and egoistic environmental concern may be cultural differences in the presentation of environmental concern, as has been demonstrated several times (Milfont et al., 2006; Schultz et al., 2005). In contrast to earlier findings, Weber et al. (2020) recently found that altruistic environmental concern exclusively predicted the intention to eat sustainably in German university students. On balance, the available evidence mainly supports a positive relationship between biospheric environmental concern and PEB. However, the study by Weber et al. (2020) is very similar to the subject that is the focus of this dissertation. As such, based on previous findings, it is not trivial to predict what role biospheric and altruistic environmental concerns might play in determining the intention to eat sustainably in German high school students.

Dispositional empathy with animals

Dispositional empathy with animals is derived from the concept of dispositional empathy with nature. The latter is defined as the "dispositional tendency to understand and share the

emotional experiences of the natural world" (Tam, 2013, p. 92). Dispositional empathy with nature as defined by Tam (2013) focuses on suffering animals and plants.

The concept of dispositional empathy with nature is adapted from human empathy research and adopts the assumption that empathy has two foundational, interrelated components. The cognitive component ('perspective taking') refers to the ability to understand emotional experiences by taking the perspective of the affected living being (Schultz, 2000; Tam, 2013). The affective component of empathy, also referred to as empathic concern, involves sharing emotionally in the individuals' experience, especially distress (Gerrig & Zimbardo, 2015; Tam, 2013).

Batson (1987) developed the empathy-altruism hypothesis, which states that people act unselfishly in a situation when they feel empathy toward others (Batson, 1987). Several empirical studies confirmed this hypothesis (Batson, 2014; Batson et al., 2002). In accordance with the empathy-altruism hypothesis, several other studies found that dispositional empathy with nature predicts conservation behavior (Tam, 2013b) and willingness to protect the environment (Berenguer, 2007).

As several studies have demonstrated a link between empathy with animals and sustainable dietary behaviors, especially meat consumption (Kern & Fiebelkorn, 2020; Rothgerber & Mican, 2014; Zickfeld et al., 2018), it was deemed reasonable to focus solely on dispositional empathy with animals in this dissertation.

The value basis of the human-nature relationship

In the context of the theoretical framework of this dissertation, values are understood as motivational, cross-situational goals that vary in importance and serve as guiding principles in a person's life (Schwartz, 1994). They motivate and guide actions, function as a standard for judgment or justification, and are acquired through the socialization of prevailing group values and through specific learning experiences, such as education (Schwartz, 1994).

Due to their action-determining function, values represent a fundamental variable in several theoretical models explaining PEB (Stern, 2000). The value-belief-norm theory, for example, conceives of values as the foundation from which attitudes and beliefs towards the environment, such as environmental concern (Stern & Dietz, 1994) or nature relatedness (Schultz et al., 2004), develop. These attitudes and beliefs lead, directly or indirectly via personal norms, to PEB (Stern, 2000). According to the value-belief-norm theory, egoistic, altruistic, and biospheric value orientations can all positively influence PEB (Stern, 2000; Stern et al., 1993). The empirical evidence shows that biospheric and altruistic value orientations are the primary influences on PEB (Nordlund & Garvill, 2002; Schultz & Zelezny, 1999; Stern et al., 1993).

With respect to egoistic, altruistic, and biospheric value orientations, past studies (Schultz & Zelezny, 1999; Sothmann & Menzel, 2017; Stern, 2000; Stern et al., 1995; Tam, 2013a, 2013b) have often referred to Schwartz's (1992, 1994) theory of basic human values. Schwartz's Portrait Value Questionnaire (PVQ) identifies ten motivational value types, which

can be summarized into four distinct dimensions: self-enhancement, openness to change, self-transcendence, and conservation (Schwartz, 2012). Both the value types and the allocation into the four dimensions have been validated cross-culturally through a series of studies with samples from 82 nations (Schwartz, 2012). Since self-transcendence reflects prosocial values oriented toward the welfare of people in the immediate social environment (benevolence), all people, and nature, including all living beings (universalism; Schwartz, 2012), this dimension represents biospheric and altruistic value orientations (Stern et al., 1995). Several correlational studies have found confirmatory evidence for the hypothesis that self-transcendence values are a basic prerequisite for developing nature connectedness (Sothmann & Menzel, 2017; Tam, 2013a) and biospheric and altruistic environmental concern (Schultz, 2001; Schultz et al., 2005). The self-enhancement dimension represents values orientated toward success, the demonstration of competence (achievement), social status and prestige (power), pleasure, and enjoyment of life (hedonism; Schwartz, 1992). It is, therefore, representative of egoistic value orientations (Stern et al., 1995). In previous studies, self-enhancement has been found to be positively associated with egoistic environmental concern but negatively associated with biospheric and altruistic concern (Schultz, 2001; Schultz et al., 2005).

Given the strength of the evidence that these two value dimensions form an important basis for explaining the human-nature relationship (Schultz, 2001; Schultz et al., 2005; Schultz & Zelezny, 1999; Sothmann & Menzel, 2017; Tam, 2013a), only self-transcendence and self-enhancement were considered in the context of this dissertation project.

The human-nature relationship in Ecuador and Germany

No studies to date have compared the relationship with nature, as experienced by Ecuadorian and German citizens. Nevertheless, some evidence points to potential cultural differences between these nations concerning their relationship with nature.

In terms of the relationship that entire nations have with their natural environment, Ecuador is a pioneer. It was the first country in the world to integrate the rights of nature into its constitution, thus acknowledging nature as a legal subject (Asamblea Constituyente de Ecuador, 2008). In its constitution, Ecuador refers to the original indigenous philosophy of '*Buen Vivir*', which describes a way of living in harmony with nature and other human beings (Lalander, 2016). This principle breaks with the Western paradigm of economic growth to achieve a good life and offers an alternative that promises to deliver well-being in a sustainable way, without compromising nature and other human beings (Asamblea Constituyente de Ecuador, 2008; Monni & Pallottino, 2015). However, in practice, nature's rights have not always been prioritized over economic interests (Lalander, 2016). The debate about *Buen Vivir* and the rights given to nature has contributed to increasing socio-cultural awareness regarding environmental issues (Lalander, 2016; Rieckmann et al., 2011). Due to their enshrinement in the Ecuadorian constitution (Asamblea Constituyente de Ecuador, 2008), the guiding principles of *Buen Vivir* apply to all Ecuadorian citizens and not only to indigenous people.

In contrast to Ecuador, Germany does not acknowledge nature as a legal subject in Germany, although the conservation of the natural environment is considered in policy-making (BMU & BMZ, 2016; Küchler-Krischun & Walter, 2007). The Nature Awareness Study, which examines knowledge about and attitudes towards nature and its protection, is conducted at regular intervals in the general German population, providing some basic insights into national trends in the human-nature relationship. For several years running, results indicate that German citizens, on average, have positive attitudes towards nature and that nature conservation enjoys broad support among the population. (BMU & BFN, 2010, 2018, 2020). On the other hand, there is a relatively low familiarity with the term biodiversity, even though it is considered to be of great personal and social importance (BMU & BFN, 2010, 2018, 2020).

A striking finding from recent Nature Awareness Study cycles was that for the youngest group (18-29 years), nature held the lowest importance for them personally (BMU & BFN, 2020) and with respect to defining regional and global identity (BMU & BFN, 2018). They also considered protected areas to preserve nature for future generations less important compared to older age groups (BMU & BFN, 2020). This is in line with findings from an earlier version of the study, which indicated that this age group perceived their quality of life as less affected by biodiversity than other age groups (BMU & BFN, 2010). In addition, the youngest age group was found to be least supportive of the sustainable use of nature compared to other age groups (BMU & BFN, 2010). Based on results of the Nature Awareness Study over the past decade, it can be hypothesized that the younger generation is experiencing alienation from nature. This assumption is confirmed by the "Jugendreport Natur" (Youth Report on Nature), which has been recording young Germans' everyday relationships with nature from an environmental-sociological perspective at irregular intervals since 1997. Despite generally noting environmentally friendly attitudes, the report recorded a decline in interest in and experiences with nature (Brämer, 1999, 2004, 2010; Brämer et al., 2016), an observation the authors attribute to the increasing mechanization of everyday life as well as media demands and temptations.

Unfortunately, no such studies exist for the Ecuadorian general or youth population, which is why an evidence-based statement about differences in the human-nature relationship between the two cultures cannot be made. However, due to the culturally deeply rooted life philosophy of *Buen Vivir* as well as its political thematization, it can be hypothesized that the human-nature relationship is more pronounced among young Ecuadorians than among young Germans.

2.1.3 Knowledge about sustainable nutrition

As the sphere of the human-nature relationship, knowledge about sustainable nutrition (see Figure 2.2) is based on the competence model for environmental education of Roczen et al. (2014)**,** in which knowledge is considered a necessary but insufficient prerequisite for the development of PEB (Roczen et al., 2010). Following the model of environmental knowledge, which describes "knowledge and awareness about environmental problems and possible

solutions to those problems" (Zsóka, Szerényi, Széchy, & Kocsis, 2013, p. 127), in the context of this doctoral project, knowledge about sustainable nutrition is understood as knowledge about nutrition-related problems and actions that help solve those problems.

Frick (2003) distinguished three dimensions of environmental knowledge: (1) system knowledge, describing knowledge about the function and interrelationships within ecosystems and causal understanding of environmental problems, (2) action-related knowledge, referring to knowledge about actions to cope with environmental problems, and (3) effectiveness knowledge, describing knowledge about the efficacy of specific behaviors for environmental conservation and considering cost-benefit analysis and life cycle assessments.

In the context of this doctoral project, system knowledge about sustainable nutrition is understood as knowledge about basic definitions and nutrition-related relationships within the ecosystem. Action-related knowledge is akin to awareness of the sustainable nutrition recommendations defined by von Koerber et al. (2017). Effectiveness knowledge concerns an understanding of the measurable effects of nutrition-specific behaviors on ecology, economy, society, health, and culture. It also takes into account the magnitude of the effects due to the diet-specific behaviors.

The basis for including the knowledge dimensions in our theoretical framework is provided by studies that have examined the relationship between the three dimensions of environmental knowledge and PEB. The evidence suggests that system knowledge does not directly influence PEB but acts indirectly via effectiveness and action-related knowledge (Frick et al., 2004). While some studies have demonstrated that action-related and effectiveness knowledge directly affect PEB (Fremerey & Bogner, 2014; Frick et al., 2004), Roczen, Kaiser, Bogner, and Wilson (2014) found only action-related knowledge predicted PEB. Although no study has yet examined the relationship between these knowledge dimensions with respect to sustainable nutrition and nutrition-related behavior, the empirical data available gives reason to expect that effectiveness and action-related knowledge, but not system knowledge, will positively influence high school students' dietary behavior.

An overview of the complete theoretical framework of the learning prerequisites, which shows the expected relationships between the various psychological factors, knowledge about sustainable nutrition, and the students' dietary behavior, is shown in Figure 2.2.

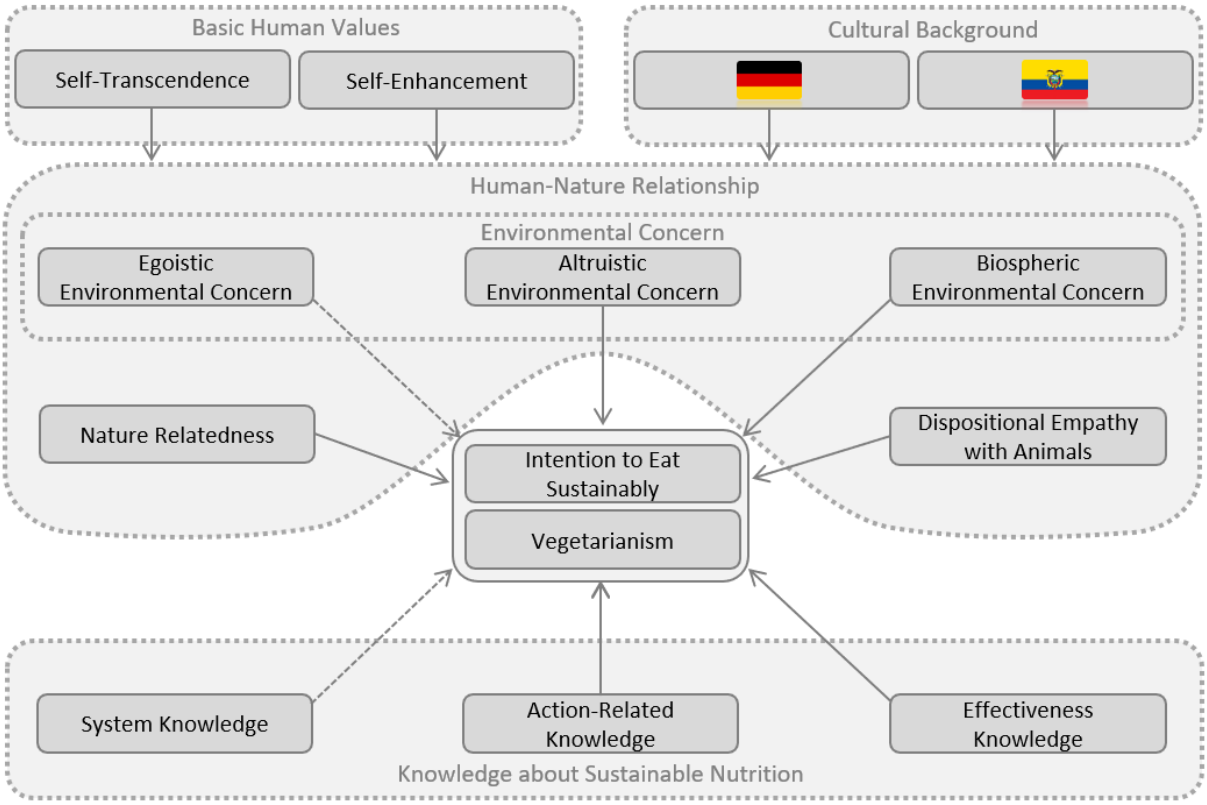


Figure 2.2 Overview of the theoretical framework for the psychological factors as learning prerequisites, including variables of the human-nature relationship, its potential determinants and knowledge about sustainable nutrition.
Note: Solid lines show the hypothesized relationships based on the literature. Dashed lines show relationships that are weak or not present, based on the literature. The gray shaded spheres represent the adaptation of the model to the context of sustainable nutrition.

2.2 High school students' conceptions of sustainable nutrition as a learning prerequisite for education for sustainable nutrition

This subchapter focuses on students' conceptions about the subject matter, and particularly the role these conceptions have as a learning prerequisite. It opens with the presentation of the model of educational reconstruction (section 2.2.1). This model provides the theoretical and methodological framework for research on teaching and learning, including research about students' conceptions about the subject matter. It then addresses constructivism in more depth, which provides the theoretical foundation for studying students' conceptions more broadly (see section 2.2.2).

2.2.1 The model of educational reconstruction

The model of educational reconstruction provides a theoretical and methodological framework for science education research and consists of three interrelated components (Figure 2.3), which refers to and systematically joins different sub-theories of subject learning and teaching (Kattmann, 2007).

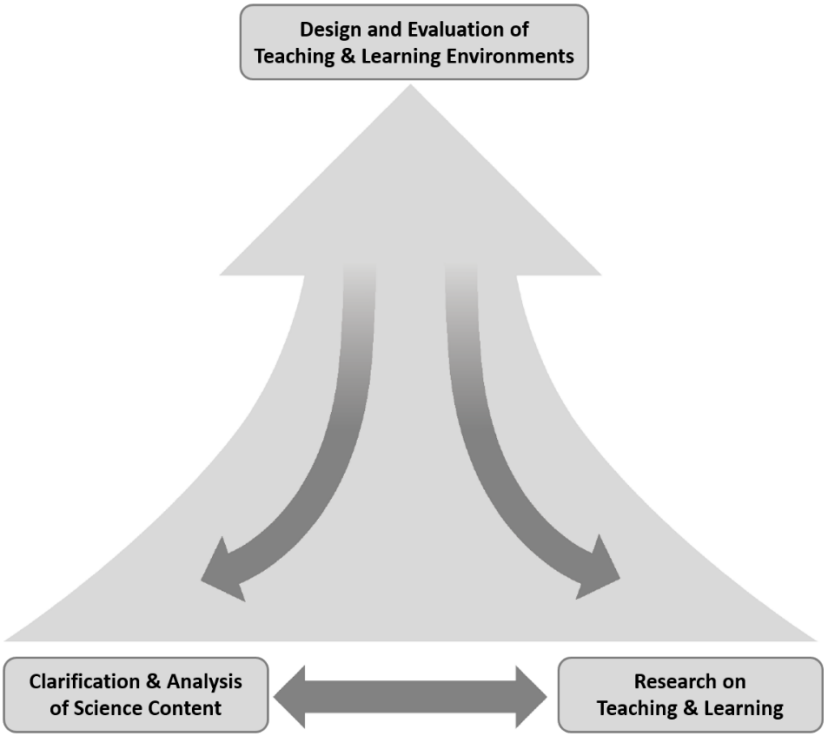


Figure 2.3 Model of educational reconstruction according to Duit et al. (2012). Figure modified from Hörnschemeyer (2020)[3].

The *clarification and analysis of science content* (see Figure 2.3) component involves analyzing the subject matter from a science educational perspective, including a critical analysis of textbooks and crucial publications on the topic. The *research on teaching and learning* component examines teachers' views and beliefs about science concepts and students' perspectives, including their conceptions of and attitudes toward the subject matter. The *design and evaluation of teaching and learning environments* component relates the outcomes of the *clarification and analysis of science content* with those of the *research on teaching and learning* to derive practical educational implications (e.g., for the development of educational materials, learning activities, or teaching guidelines; Duit et al., 2012; Kattmann et al., 1997; Kattmann, 2007, 2015).

As shown in Figure 2.3 the individual steps of the research process do not merely follow a linear pattern but are repeatedly fed back to one another so that the overall procedure is recursive. For example, teaching guidelines require renewed analysis after they have been developed, e.g., through real classroom studies *(research on teaching and learning*; Duit et al., 2012).

This dissertation project focuses on the *research on teaching and learning* components, particularly on investigating students' naïve and alternative conceptions. The term 'conceptions' is used in this thesis to describe cognitive constructs at different levels of complexity, such as associations, cognitions, and subjective theories (Kattmann et al., 1997). Naïve conceptions refer to students' conceptions about a subject matter before receiving

[3] Permission to use the illustration was obtained from the author.

information about it, for example, in school lessons. ‘Alternative conceptions’ characterize students’ conceptions that do not correspond to the scientific perspective on the subject matter. Each component in the model of educational reconstruction is based on distinct theoretical considerations. In what follows, the theories that underpin research on students’ conceptions are discussed.

2.2.2 Students’ conceptions as an important learning prerequisite – a constructivist view

Research on students’ conceptions is founded on a moderate constructivist perspective on the learning process, which has its origins in radical constructivism (von Glasersfeld, 1995). The epistemology of radical constructivism postulates that while an objective reality exists, its direct apprehension by humans is not possible (von Glasersfeld, 1995). Consequently, any form of human cognition or perception is based on subjective processes of observation, construction, and interpretation (Reinmann & Mandl, 2006; Terhart, 1999). Thus, the epistemology of radical constructivism represents an alternative to the cognitivist theory of learning, which does not consider these individual differences in the learning process. On the contrary, a cognitivist perspective assumes that knowledge is passed on from one person to another and then exists as a representation of the environment within the individual (Reinmann & Mandl, 2006; Tobinski & Fritz, 2014).

Moderate constructivism is a view on learning derived from the epistemological position of radical constructivism. While radical constructivism – as an epistemology – questions how cognition forms in people, moderate constructivism – as a learning theory – addresses how cognitions (knowledge), once formed, change individually (Riemeier, 2007). Over the past 30 years, moderate constructivism has established itself as the dominant paradigm for research on teaching and learning (Duit, 1995).

At the center of the moderate constructivist perspective are learners in an individual learning process, who actively (re)structure their knowledge (Piaget, 1974, 1983) based on individual experiences, and pre-existing conceptions of the subject matter (Posner et al., 1982). This active and individual construction process takes place in context-bound social situations and cannot be controlled from the outside but can be stimulated by a supportive learning environment with suitable learning options (Duit & Treagust, 2003; Kattmann, 2015; Piaget, 1983; Riemeier, 2007).

This process requires that the learners' naïve conceptions are identified, which is what *research on teaching and learning* intends to achieve. Because conceptions can become obstacles to learning if they conflict with scientific conceptions (i.e., alternative conceptions; Duit, 1995), this research has a special interest in identifying alternative conceptions.

3 Study design and research foci

This dissertation has three research foci, which were the subject of three different empirical studies (Figure 3.1).

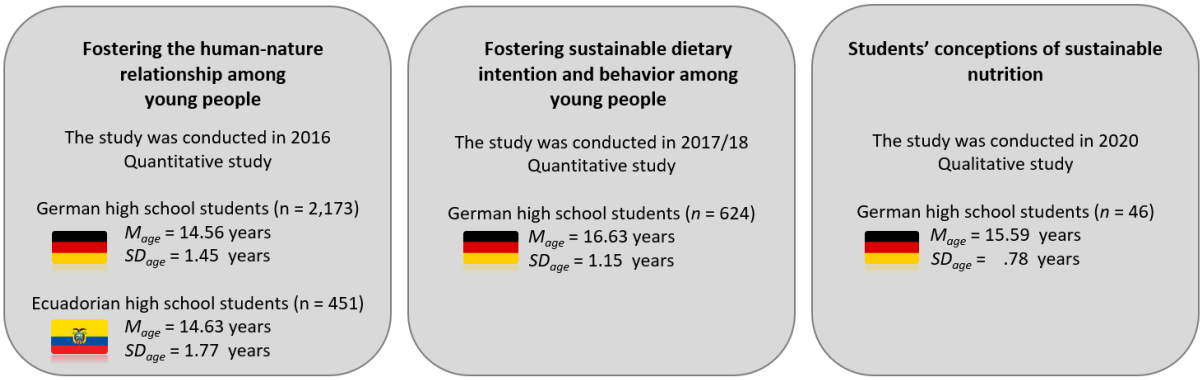


Figure 3.1 Overview of the research foci and the corresponding studies.

3.1 Fostering the human-nature relationship among young people

The human-nature relationship, especially nature relatedness and environmental concern, has been identified as a crucial psychological factor in determining PEB, such as a sustainable dietary behavior (Capaldi et al., 2014; Mayer & Frantz, 2004; Milfont et al., 2006; Otto & Pensini, 2017; Rosa et al., 2018; Schultz, 2001; Schultz et al., 2005; Whitburn et al., 2020). Therefore, education that promotes nature relatedness and environmental concern seems promising for encouraging sustainable dietary behavior among young people. However, the human-nature relationship depends on various factors, such as cultural background, gender, basic human values, and time spent in nature. For this reason, in the context of research focus I, the first study (see chapter 4.1) compared – for the first time – young people from Ecuador and Germany on their relationship to nature, represented by nature relatedness and environmental concern. Furthermore, it investigated the role that cultural background, gender, basic human values, and time spent in nature play in the development the development of nature relatedness and environmental concern. Specifically, the first study addressed the following research questions:

> **RQ1:** How do Ecuadorian and German young people differ in their nature relatedness and environmental concern?
>
> **RQ2:** How do young people's gender and nationality, their basic human values, and time spent in nature affect their nature relatedness and environmental concern?

To answer the research questions, in 2016, 2,173 high school students from Germany (M_{age} = 14.56 years, *SD* = 1.45; female: 55.1%) and 451 high school students from Ecuador (M_{age} = 14.63 years, *SD* = 1.77; female: 55.3%) were surveyed using a paper-and-pencil questionnaire (Appendix A1, Q1). Chapter 4.1 provides a detailed description of the theoretical background, the method, and the results of the first study.

3.2 Fostering sustainable dietary intention and behavior among young people

Research focus II aims to identify the factors that influence sustainable dietary intention and behavior in young people to support the development of effective didactic concepts for education on sustainable nutrition.

It builds on research focus I by examining whether the evidence that the human-nature relationship is associated to PEB (Capaldi et al., 2014; Mayer & Frantz, 2004; Milfont et al., 2006; Otto & Pensini, 2017; Rosa et al., 2018; Schultz, 2001; Schultz et al., 2005; Whitburn et al., 2020) could also apply to sustainable dietary intention and behavior in young people.

Therefore, the second study examined the predictive power of the human-nature relationship, which was conceptualized as nature relatedness, environmental concern, and dispositional empathy with animals, on the intention to eat sustainably and on vegetarianism. The latter represents one aspect of sustainable nutrition that serves as a concrete example of sustainable dietary behavior. Perceived consumer effectiveness, knowledge about sustainable nutrition, and gender were included as potential predictors of dietary intention and behavior. Perceived consumer effectiveness describes the extent to which consumers believe they can minimize environmental problems through their nutrition-related consumer behavior. Specifically, the second study addressed the following research question:

> **RQ1:** Which of the investigated factors (nature relatedness, environmental concern, dispositional empathy, perceived consumer effectiveness, knowledge about sustainable nutrition, and gender) significantly predict the intention to eat sustainably and vegetarianism in young people?

To answer the research question, in January and February 2020, 624 German high school students were surveyed (M_{age} = 16.63 years, *SD* = 1.15; female: 48.2%) using a paper-and-pencil questionnaire (Appendix A1, Q2). Chapter 4.2 provides a detailed description of the theoretical background, the method, and the results of the second study.

3.3 Students' conceptions of sustainable nutrition

As the theoretical framework of this dissertation shows, in addition to the psychological factors that contribute to sustainable nutrition behavior, students' conceptions about a subject matter are also an important prerequisite for learning. Since relatively little is known about what conceptions high school students have about the topic of sustainable nutrition, the third study investigated high school students' conceptions of sustainable nutrition. The third study addressed the following research questions:

> **RQ1**: What relevance do the students attribute to the different dimensions of sustainable nutrition (health, environment, economy, society, and culture)?
> **RQ2**: What alternative conceptions do students hold about sustainable nutrition?

To answer the research questions, between August 2017 – March 2018, a semi-structured interview guide was used (Appendix A2) to conduct individual interviews with 46 10th-grade high school students (M_{age} = 15.59 years, *SD* = .78; female: 47.8%). Chapter 4.3 provides a detailed description of the theoretical background, the method, and the results of the third study.

4 Empirical part

4.1 Nature relatedness and environmental concern of young people in Ecuador and Germany[4]

Abstract

Today's societies are confronted by a daily biodiversity loss, which will increase in the face of climate change and environmental pollution. Biodiversity loss is a particularly severe problem in so-called biodiversity hotspots. Ecuador is an example of a country that hosts two different biodiversity hotspots. Human behavior - in developing as well as in industrial countries such as Germany - must be considered as one of the most important direct and indirect drivers of this global trend and thus plays a crucial role in environmentalism and biodiversity conservation. Nature relatedness and environmental concern have been identified as important environmental psychological factors related to people's pro-environmental behavior. However, the human-nature relationship depends on a variety of other factors, such as values, gender, nationality, qualities of environmental concern and time spent in nature. This study compared young people from Ecuador and Germany with regard to their nature relatedness and environmental concern. Furthermore, the role of the aforementioned factors was investigated. In total, we surveyed 2,173 high school students from Germany (M_{age} = 14.56 years, *SD* = 1.45; female: 55.1%) and 451 high school students from Ecuador (M_{age} = 14.63 years, *SD* = 1.77; female: 55.3%). We found that young Ecuadorians were more related to nature than young people from Germany. Additionally, we found country-specific differences in the structure of environmental concern and in the role of gender in the explanation of biospheric environmental concern and nature relatedness. In both samples, the self-transcendence value cluster was a significant positive predictor for biospheric environmental concern and nature relatedness. Time spent in nature was a significant positive predictor for nature relatedness in both samples. The results are an empirical basis for the assumption of culture-specific differences in human-nature relationships.

Keywords: biodiversity; students; values; cross-cultural; environmental concern; gender; sustainable development; self-transcendence

[4] Dornhoff, M., Sothmann, J.-N., Fiebelkorn, F., & Menzel, S. (2019). Nature relatedness and environmental concern of young people in Ecuador and Germany. *Frontiers in Psychology*, *10:453*. https://doi.org/10.3389/fpsyg.2019.00453

Introduction

The rate of biodiversity loss, among other environmental problems, such as climate change and biogeochemical cycles, has already exceeded its safe planetary boundary (Rockström, Steffen, et al., 2009; Steffen et al., 2015). Biodiversity loss not only affects the functioning of ecosystems (Cardinale et al., 2012) but also the ecosystem services for humanity (Costanza et al., 1997; Millenium Ecosystem Assessment, 2005). Even though the negative consequences of environmental destruction are globally relevant, some ecoregions, especially biodiversity hotspots, are of particular importance in terms of biodiversity conservation. These biodiversity hotspots are characterized by an extraordinary plant and animal endemism as well as high levels of habitat loss (Mittermeier et al., 2011). By definition a hotspot must contain at least 1,500 endemic plant species (0.5% of the worlds` plant species) and should have lost at least 70% of its primary vegetation (Myers et al., 2000).

Ecuador is extremely rich with respect to biodiversity, as it is covered by two biodiversity hotspots, namely, the Tumbes-Chocó-Magdalena and Tropical Andes Hotspot (Mittermeier et al., 2011). For instance, Ecuador has the highest density of vertebrates species in the world (Myers et al., 2000). It hosts about 7.3% of the vertebrate species described worldwide and 7.6% of the vascular plant species (Ministerio del Ambiente del Ecuador, 2015). However, Ecuador is a so-called developing country in which a large part of the population suffers drastic socio-economic inequalities (Lopez-Cevallos & Chi, 2010). Therefore, socio-economic development is required, which is often considered to be associated with environmental degradation (Panayotou, 2016). For instance, Ecuador is still reporting a decrease in forest area (FAO, 2016) and an increased number of endangered species (Ministerio del Ambiente del Ecuador, 2015). The International Union for Conservation of Nature and Natural Resources (IUCN , 2017a) lists nine extinct and 518 critically endangered, endangered, or vulnerable animal species, whereas nine plant species are considered to be extinct, and 1,857 plant species are classified as critically endangered, endangered, or vulnerable (IUCN, 2017b).

However, the Ecuadorian government has developed new approaches for sustainable development with a focus on biodiversity conservation. For instance, Ecuador was the first country to incorporate the rights of nature and the indigenous concept of *Buen Vivir* in its constitution (Asamblea Constituyente de Ecuador, 2008). The basic idea of *Buen Vivir* is the good way of living in harmony with nature and other human beings (Lalander, 2016). However, Ecuadorian state policies are characterized by economic interests that are hindering the effective implementation of new biodiversity conservation measures (Lalander, 2016). Nevertheless, the debate about *Buen Vivir* and the rights of nature has contributed to a growing socio-cultural awareness regarding environmental issues (Lalander, 2016; Rieckmann et al., 2011). In addition, in industrialized countries such as Germany, efforts are being made to adapt some aspects of the basic concept of *Buen Vivir* (Acosta, 2015).

In a worldwide comparison, Germany, one of the most industrialized countries in the world, is counted as an area with relatively low biodiversity, on the basis of geological history development and geographic location. For instance, it hosts only 1.2% of the vertebral species described worldwide and 1.4% of the vascular plant species (BMU, 2014). Additionally, the Federal Ministry for the Environment Nature, Conservation and Nuclear Safety observed a statistically significant deterioration of species diversity (BMU, 2014). In Germany, four animal species are considered to be extinct and 101 critically endangered, endangered, or vulnerable (IUCN, 2017a). With regard to plant species richness, 36 species are considered to be critically endangered, endangered, or vulnerable (IUCN, 2017b). Thus, Germany and Ecuador are both affected by a progressive loss of species.

To reduce biodiversity loss, both countries have drafted a national biodiversity strategy with ambitious goals regarding biodiversity conservation (BMU, 2007; Ministerio del Ambiente del Ecuador, 2016). Furthermore, Germany cooperates internationally to support biodiversity on a global scale (BMU & BMZ, 2016). Both countries have acknowledged human behavior as core challenge in all efforts to protect biodiversity. Thus, in addition to political efforts to conserve biodiversity, human behavior, and thus, people's attitudes and values are becoming increasingly significant worldwide in preserving biodiversity (BMU, 2007; Nisbet & Zelenski, 2013). Besides the aforementioned personality traits that may be related to environmental behavior, it seems that people – and especially young people – have lost their inner connection with nature due to modern societal development that hinders a human-nature interaction (Brämer et al., 2016; Louv, 2008; Soga & Gaston, 2016). A disturbed human-nature relationship, however, has been considered one of the main reasons for people's harmful behavior towards the environment and for decreasing environmental concern (Nisbet & Zelenski, 2013). Given that young people are approaching the stage of taking responsibility for their own lives, including a critical reflection of their own environmental behavior, these results seem particularly alarming. Moreover, young people are in an important period of value formation (Wray-Lake et al., 2010). As they are still students, appropriate educational programs can help to promote the formation of important values fostering pro-environmental behavior (von Braun, 2017). Regarding the impact of environmental education, Otto and Pensini (2017) showed that the frequency of children's visits to nature-based environmental education institutions is positively related to pro-environmental behavior, mediated by an increased environmental knowledge and nature relatedness. Furthermore, they found nature relatedness to explain a high percentage and environmental knowledge a low percentage of the variance in pro-environmental behavior (Otto & Pensini, 2017).

Nature relatedness can be understood as a perceived cognitive, affective, and experiential connection to the natural world that is regarded to be "trait-like", because it is relatively stable over time and across situations but not completely fixed (Brügger et al., 2011; Mayer & Frantz, 2004; Nisbet et al., 2009; Nisbet & Zelenski, 2013; Schultz, 2002). The cognitive component of nature relatedness can be considered as the extent to which people include nature within their cognitive representation of self, which in turn is regarded as the

fundamental aspect of human-nature relations by some authors (Schultz, 2002). Other authors place the affective connection, the sense of feeling connected, at the center of the human-nature relationship (Mayer & Frantz, 2004). The experiential connection is often neglected but is an important aspect in some concepts of nature relatedness (Nisbet et al., 2009). It represents an individual's physical familiarity with the natural world and the level of perceived comfort with being in nature. Since we refer to the nature relatedness construct of Nisbet et al. (2009) all three aspects of individual connection with the natural world are regarded as equally important.

Nature relatedness can be explained theoretically by the biophilia hypothesis (Wilson, 1984) that assumes an innate tendency of humans to approach and contact other living and natural things. The biophilia hypothesis postulates that it is inherent in human beings to learn from and value the natural environment (Kellert & Wilson, 1993).

Additionally, studies have shown that having frequent nature contact promotes nature relatedness and may lead to increased environmental concern(Mayer et al., 2009; Nisbet & Zelenski, 2013) and that nature-related people spending more time outdoors in a natural environment (Nisbet et al., 2009; Raymond et al., 2010). Moreover, Kals, Schumacher and Montada (1999) found the frequency of time spent in nature to be a powerful predictor for emotional affinity toward nature.

In addition to nature relatedness, environmental concern plays an important role in explaining environmental behavior. As part of their 'value basis of environmental concern' theory, Stern and Dietz (1994) suggest that environmental concern can be based on egoistic, social-altruistic, and biospheric value orientations and on beliefs about the consequences of environmental changes for valued objects. Based on this, Schultz (2001) could show a three factorial structure of environmental concern. These three factors are egoistic concern, altruistic concern, and biospheric concern about the environment, depending on whether individuals care about themselves, other people, or all living things. Thus, he explained that one person's environmental concern and behavior are not necessarily based on their nature relatedness but may have egoistic or altruistic motives (Schultz, 2002). Yet a positive relation to pro-environmental behavior could only be demonstrated for biospheric concern about the environment (Schultz, 2001). Stern, Dietz, and Kalof (1993) showed that women have stronger beliefs about the harmful consequences of bad environmental conditions for self, others, and the biosphere and that pro-environmental behavior is predicted by these beliefs. These gender differences are attributed to socialization processes (Baron-Cohen & Wheelwright, 2004; Beutel & Marini, 1995; Gilligan, 1982; Jolliffe & Farrington, 2006) that are regarded as culture-specific (Davidson & Freudenburg, 1996).

Value orientations determine the actions of people, their beliefs, and attitudes in general as well as towards nature (Schultz et al., 2004; Schwartz, 1994). In order to explain value-based environmental behavior in cross-cultural studies, the Schwartz theory of basic human values (1992, 1994) has proven to be particularly appropriate since certain values could be identified in more than 30 nations. The basic human Schwartz-values of the self-

transcendence value cluster have proven to be a powerful predictor for a connection to nature (Sothmann & Menzel, 2017). The self-transcendence value cluster represents prosocial norms oriented towards the welfare of close others in everyday interaction humans (benevolence) and all people and nature including all living beings (universalism; Schwartz, 1992). Furthermore, it correlated positively with biospheric and altruistic concern but negatively with egoistic concern about the environment (Schultz, 2001; Schultz et al., 2005). The basic human values of the self-enhancement value cluster showed a positive relation with egoistic environmental concern but a negative relation with biospheric and altruistic concern (Schultz, 2001; Schultz et al., 2005). It represents values orientated towards success, the demonstration of competence (achievement), social status and prestige (power), pleasure and enjoyment of life (hedonism) (Schwartz, 1992).

Up to now, there has been no comparison of young people from Latin America and those from Europe with regard to their nature relatedness and environmental concern and the factors that predict them. Therefore, the present study aims at providing insight into the relatively unexplored topic of intercultural differences of young people's human-nature relationship.

The present study

When considering biodiversity and its loss globally, we assume that Ecuadorian young people, who live in a biodiversity hotspot, and German young people, who grow up in one of the most industrialized countries in the world, show differences in their human-nature relationship. Our assumption is reinforced by studies that show that Ecuadorian college students score higher on environmental concern than US and European college students (Schultz, 2001). Regarding an international comparison of nature relatedness, there is insufficient empirical evidence to develop a literature-based hypothesis. However, due to the higher biodiversity in Ecuador and the fact, that the Ecuadorian people triggered current political debate on the rights of nature, we assume that Ecuadorian people in general as well as young people are higher in their nature relatedness than German young people. Additionally, we are interested in the factors that are related to nature relatedness and environmental concern. Based on the aforementioned studies, we expect self-transcendence, time spent in nature, and having a female gender to positively predict nature relatedness and biospheric environmental concern in both samples. A cross-cultural investigation into the relations between young people's nature relatedness, environmental concern, and the basic human values of the self-transcendence value cluster should provide important information that could be used to design adequate environmental education and outreach projects in both countries.

Thus, the present study aimed at comparing Ecuadorian and German young people's nature relatedness and environmental concern and at elucidating the factors that are related to them.

Two research questions and subsequent hypotheses were addressed:

Q1: How do Ecuadorian and German young people differ in their nature relatedness and environmental concern?
H1: Ecuadorian young people have higher nature relatedness and environmental concern.
Q2: How do young people's gender and nationality, their basic human values, and time spent in nature affect their nature relatedness and environmental concern?
H2: Self-transcendence, time spent in nature, and having a female gender positively predict nature relatedness and biospheric environmental concern.
H3: Self-transcendence positively predicts altruistic concern and negatively egoistic concern.
H4: Self-enhancement positively predicts egoistic environmental concern.

Material and methods

Participants and procedure

The sample was divided into two subsamples. The first sample consisted of 2,173 anonymously surveyed high school students from ten Northwest Germany secondary schools in and around the cities of Osnabrück and Hannover (M_{age} = 14.56 years, *SD* = 1.45; female: 55.1%). Five schools were located on the outskirts of the city, close to forest areas or agricultural land. In contrast, five schools were located in the center of the city, without direct access to forest areas or agricultural land. The second sample consisted of 451 anonymously surveyed high school students from four private secondary schools located in Southern Ecuador in and around the city of Cuenca (M_{age} = 14.63 years, *SD* = 1.77; female: 55.3%). While one school was located on the outskirts of the city, close to forest areas and agricultural land, three schools were located in the center of the city, far from forest areas or agricultural land.

The variables addressed in this article were embedded in a paper-and-pencil questionnaire. The survey contained 66 items and was conducted during regular school hours. The students had the length of one school lesson (45 minutes) to complete the questionnaire. The time limit was not exceeded in any case. Some students finished the questionnaire 15 minutes before the end of the time limit. Without measuring the average time precisely, we can conclude from our classroom observations that the Ecuadorian students needed more time to complete the questionnaire than the German students. The differences between the two samples in the time taken to complete the questionnaire can be explained by the differences in reading literacy between Latin American and German students. The assumption that the German sample achieved a higher level of reading skills than the Ecuadorian sample is based on large-scale assessments in education (OECD, 2016). Of course, this is only one possible explanation. It may be the case that Ecuadorian students paid closer attention to the questions than the German students did.

Anonymity was guaranteed, and participation was voluntary. Ethical approval for the study was obtained in July 2016 from the responsible State Board of Education in Germany - Niedersächsische Landesschulbehörde (NLSchB), which is the body responsible for providing ethics approvals for studies carried out in schools. The participating German schools were informed about the research conducted and provided their written consent. All participants had the chance to decline to participate and to withdraw from the research at any time. Since we surveyed Ecuadorian students from private schools, we asked the respective headmasters, in advance, for permission to carry out the questionnaire study. In all schools, the questionnaire was reviewed by the school psychologist, who did not raise any objections to the study. Permission from the headmasters was granted for all schools.

In both countries, the parents of the students were informed about the study by a letter, in which the voluntary participation and anonymity of the study was pointed out. The possibility to contact us was given by the attached contact data. According to the APA's Ethical Principles of Psychologists and Code of Conduct (American Psychological Association, 2016) psychologists may dispense with informed consent where research would not reasonably be assumed to create distress or harm. As our investigation was conducted by an anonymous questionnaire in an educational setting and in the presence of the respective teacher, an informed consent was not necessary (American Psychological Association, 2016). Moreover, the responsible State Board of Education in Germany only requires written consent in the case of surveys involving the processing of personal data. However, this was not the case in the present study. Furthermore, since the students were not asked about their parents or family circumstances, racial and ethnic origin, political opinions, religious beliefs, health, or sex life, no informed consent of the legal guardian is required (Niedersächsische Landesschulbehörde, 2015). The consent procedures followed were also approved by the State Board of Education in Germany - Niedersächsische Landesschulbehörde (NLSchB).

Materials

We measured the amount of time spent in nature as a basic socio-demographic sample characteristic and used established psychometric scales to assess altruistic, egoistic, and biospheric concern about the environment as well as nature relatedness and value orientations.

Time spent in nature was measured by one item asking how much time the participants generally spend in nature. They answered on a 5-point Likert scale ranging from 1 (*very little*) to 5 (*very much*). We deliberately refrained from providing a definition of nature and an exact indication of time, as several studies have already shown that humans can have very different concepts of nature. For example, an artificial park can be viewed as nature for a person from the city, whereas a cultural landscape with farmlands can represent nature for a person from the countryside (BMU (Federal Ministry for the Environment Nature Conservation and Nuclear Safety) & BFN (Federal Agency for Nature Conservation), 2010; Thompson et al., 1990). Thus, we preferred to assess students' subjective perception of

nature. In addition, some people may have easier access to nature than others, which might influence their perception of the time they spent in nature. For instance, for a person who lives and works in an urban environment, 20 minutes per day in a park may be a lot of valuable time in nature, whereas for a person from the countryside, 20 minutes in a forest may not be considered very much time. We intended to address these potential differences between the subjective conception of nature and time by asking in this way. Nevertheless, this single item is a relatively soft indicator of time spent in nature, which should be taken into account when interpreting the results.

The Environmental Concern Scale developed by Schultz (2001) is an established instrument for measuring concern about the environmental problems rooted in human behavior. Following the original scale as suggested by Schultz (2001), twelve items were used to ask participants whether their environmental concern is caused by egoistic, altruistic, or biospheric motives. Participants rated each of the items from 1 (*not important*) to 5 (*important*) on a 5-point Likert scale. The scale starts with the following statement:

> 'People around the world are generally concerned about environmental problems because of the consequences that result from harming nature. However, people differ in the consequences that concern them the most. How important are the consequences of environmental problems for ...?'

Each dimension of environmental concern was measured by four items: egoistic concern by (1) me, (2) my lifestyle, (3) my health, and (4) my future; altruistic concern by (1) people in my community, (2) all people, (3) children, and (4) future generations; and biospheric concern by (1) plants, (2) marine life, (3) birds, and (4) mammals. We created the German version of the scale by translation and back-translation. For the Ecuadorian sample, we mainly used the Spanish version by Schultz (2001). In both the German and Spanish versions, we replaced the original biospheric concern item (4) *animals* with *mammals* to illustrate the difference to (3) *birds*. After consultation with native speakers familiar in local dialects, we replaced the original Spanish altruistic concern item (4) *mis paisanos* by *mis compatriotas*, because the latter is more commonly used in the region. Exploratory factor analyses showed that the three environmental concern dimensions loaded on their theoretically separate factors with high reliabilities for both samples (Table 4.1).

The self-transcendence and the self-enhancement values were measured by eight and nine items from the Portrait Values Questionnaire (Schmidt et al., 2007), which is composed of verbal portraits defining a person's goals, expectations, or desires that implicitly indicate the importance of a value. Respondents were asked to rate the similarity of the described person to themselves on a 5-point Likert scale ranging from 1 (*not like me at all*) to 5 (*very much like me*). For the Ecuadorian sample, we used an approved Spanish version of the scale (García Castro, 2014). A cross-cultural construct validity for the Portrait Values Questionnaire could be confirmed in various studies (Schwartz & Sagiv, 1995; Spini, 2003).

There are numerous suitable measures of subjective connectedness with the natural environment. For instance, the Disposition to Connect with Nature Scale (Brügger et al., 2011) is an intellectually simple instrument consisting of 40 items that relies only on simple

self-reflection and is therefore well suited to assess the nature relatedness of school students (Brügger & Otto, 2017). In order to avoid respondent fatigue, we decided to measure nature relatedness via the much shorter 6-item version of the Nature Relatedness Scale (NR-6; Nisbet & Zelenski, 2013). Participants were asked to what extent they agreed with statements like 'I feel very connected to all living things and the earth' on a 5-point Likert scale ranging from 1 (*I disagree*) to 5 (*I agree*). The German as well as the Spanish version of the scale were created by translation and back-translation and checked by native speakers familiar with local dialects and the scale.

Even though the scales used in this study were originally designed for adults, the Portrait Values Questionnaire has already been validated with young people. For instance, Menzel and Bögeholz (2010) validated the Portrait Values Questionnaire by surveying an international sample of 15 to 19-year-old Chilean and German school students. It is regarded as a relatively intellectually less demanding instrument for measuring human values (Schmidt et al., 2007). There are no known studies using the environmental concern scale and the NR-6 on a comparably young sample. In addition, the current study found good reliability for both scales.

Analyses

First, we conducted exploratory factor analyses in order to empirically test the scales used for the two samples on dimensionality. According to the theoretical basis, the tested were regarded as interdependent, which is why we performed oblimin rotation. Additionally, we conducted a confirmatory factor analysis in order to verify the factor structure of the environmental concern scale. We then checked our scales for normality with a Kolmogorov-Smirnov-test and computed reliability with Cronbach's alpha.

With regard to the Portrait Values Questionnaire, we decided to exclude two items of the hedonism value type, which were to be assigned theoretically to the value dimension of self-enhancement, because in the German sample, the items SEHE1 and SEHE3 loaded on the second (self-transcendence) factor. In the Ecuadorian sample, only SEHE3 did so (see Table 4.2). An explanation for this can be found in the dynamic structure of value types presented by Schwartz (1992). He points out that despite the focus of hedonism on self, it is not characterized by the same competitive motivation that is expressed by achievement and power values. Moreover, hedonism is apparently characterized by the motivation for arousal and challenge, which is not represented in achievement and power since they show a frequent proximity to the conservation value dimension (Schwartz, 1992).

Confirmatory factor analysis verified the three-factor structure of environmental concern (see Supplementary Material in the Appendix A3). All scales showed acceptable, good to very good reliabilities for both samples (Table 4.1). To answer our research questions, we included a total of 27 items from the aforementioned scales in our analyses.

Table 4.1 Reliabilities, results of the Kolmogorov-Smirnov test, and sources of the scales used in the current study.

Scale	Germany			Ecuador			Items
	α	*n*	K-S	α	*n*	K-S	
ST[1]	0.72	2,048	0.09***	0.72	432	0.13***	8
SE[1]	0.77	2,065	0.06***	0.72	432	0.06***	7
NR-6[2]	0.80	2,001	0.06***	0.83	426	0.10***	6
EC[3]	0.86	2,064	0.07***	0.85	371	0.14***	12
Egoistic EC	0.77	2,107	0.10***	0.79	425	0.20***	4
Altruistic EC	0.78	2,100	0.13***	0.72	388	0.17***	4
Biospheric EC	0.92	2,115	0.14***	0.91	434	0.26***	4

*Note: ST, self-transcendence; SE, self-enhancement; EC, environmental concern; [1]Source:García Castro (2014) for the Spanish version, Schmidt et al.(2007) for the German version; [2]Source: Nisbet and Zelenski (2013) for the English version; [3]Source: Schultz (2001) for the Spanish and English version, ***= p ≤ 0.001.*

Although some variables did not follow a normal distribution, we calculated independent group t-tests to compare the German and the Ecuadorian samples. However, we interpreted the bootstrap with 95% bias corrected and accelerated confidence intervals as recommended by Field (2018) in the case of non-normal distributed variables. Since it is a cross-cultural study, a response bias cannot be ruled out (Hofstede, 1980; Schwartz, 2009; Smith, 2004), which is why we also carried out standardized mean value comparisons, using the method of group mean centering (Fischer, 2004). For creating scores that controlled for differences in response tendency, we produced group-mean centered egoistic, altruistic, and biospheric environmental concern scale scores by subtracting the group mean of all twelve of the environmental concern items (EC-mean$_{Gernany}$ = 4.01; EC-mean$_{Ecuador}$ = 4.42) from each of the three scale scores (see also Schultz et al., 2004). Furthermore, we computed the grand mean of all the items of the value clusters self-transcendence and self-enhancement (we only asked for these two value clusters). Afterwards, we subtracted the total of all 14 items (PVQ-mean$_{Gernany}$ = 3.44; PVQ-mean$_{Ecuador}$ = 3.62) from the scale score of self-transcendence and self-enhancement (see also Schwartz, 2009). The mean-corrected scores are presented in the lower part of Table 4.3. The effect sizes of group differences were calculated by Cohen's *d*, using the two means (raw mean scores and centered mean scores), standard deviations, and the sample sizes of both groups (Hedges & Olkin, 1985).

In order to answer the second research question, we conducted a robust multiple regression, because some scales followed a non-normal distribution. After that, we compared the resulting *b*-values, the standard errors, and the *t*-statistics with the non-robust versions. The robust estimates revealed basically the same results; hence we report the non-robust versions, as recommended by Field (2018). Since we were interested in the effect of young people's socio-demographic factors and values on their nature relatedness and environmental concern, we calculated regression analyses for the independent variables nature relatedness as well as egoistic, altruistic, and biospheric environmental concern for both samples.

Table 4.2 Factor loadings based on an exploratory factor analysis with oblimin rotation for 17 items from the Portrait Values Questionnaire (PVQ; $N_{Germany}$ = 1,965; $N_{Ecuador}$ = 411).

Items for the collected value types	Germany		Ecuador	
	SE	ST	SE	ST
SEPO1: It is important to him/her[1] to be rich. He/She wants to have a lot of money and expensive things.	**0.57**	-0.25	**0.52**	-0.12
SEPO2: It is important to him/her to be in charge and tell others what to do. He/She wants people to do what he/she says.	**0.68**	-0.26	**0.60**	-0.24
SEPO3: He/She always wants to be the one who makes the decisions. He/She likes to be the leader.	**0.71**	-0.19	**0.67**	0.03
SEAC1: It is very important to him/her to show his/her abilities. He/She wants people to admire what he/she does.	**0.64**	0.04	**0.57**	0.13
SEAC2: Being very successful is important to him/her. He/She likes to impress other people.	**0.69**	0.00	**0.67**	0.08
SEAC3: Getting ahead in life is important to him/her. He/She strives to do better than others.	**0.70**	-0.07	**0.60**	0.07
SEHE1: He/She seeks every chance he/she can to have fun. It is important to him/her to do things that give him/her pleasure.	0.24	**0.52**	**0.40**	0.35
SEHE2: Enjoying life's pleasures is important to him/her. He/She likes to 'spoil' himself/herself.	**0.47**	0.30	**0.57**	0.38
SEHE3: He/She really wants to enjoy life. Having a good time is very important to him/her.	0.31	**0.47**	0.29	**0.49**
STUN1: He/She thinks it is important that every person in the world be treated equally. He/She believes everyone should have equal opportunities in life.	-0.15	**0.54**	-0.01	**0.54**
STUN2: It is important to him/her to listen to people who are different from him/her. Even when he/she disagrees with them, he/she still wants to understand them.	-0.12	**0.55**	-0.08	**0.46**
STUN3: He/She strongly believes that people should care for nature. Looking after the environment is important to him/her.	-0.06	**0.46**	0.13	**0.59**
STUN4: It is important to him/her to adapt to nature and to fit into it. He/She believes that people should not change nature.	-0.05	**0.40**	0.08	**0.50**
STBE1: It's very important to him/her to help the people around him/her. He/She wants to care for other people.	-0.13	**0.66**	0.03	**0.66**
STBE2: It is important to him/her to be loyal to his friends. He/She wants to devote himself to people close to him.	0.03	**0.66**	0.07	**0.51**
STBE3: It is important to him/her to respond to the needs of others. He/She tries to support those he knows.	-0.05	**0.71**	0.08	**0.70**
STBE4: Forgiving people who might have wronged him/her is important to him/her. He/She tries to see what is good in them and not to hold a grudge.	-0.20	**0.42**	-0.20	**0.44**
Factor correlations between SE and SE	-0.05		0.08	

[1]In the German version, we used "the person" instead of "he/she" and "him/her"; Factor loadings ≥ 0.4 are printed in bold; items shaded in grey will not be included in further analyses; SE, self-enhancement; ST, self-transcendence, PO, power; AC, achievement; HE, hedonism; UN, universalism; BE, Benevolence.

Results

Q1: How do Ecuadorian and German young people differ in their nature relatedness and environmental concern?

The results of the independent group *t*-tests are reported in Table 4.3. Since a centering was not possible for nature relatedness and time spent in nature, uncentered scores are reported for these variables. For environmental concern, self-transcendence and self-

enhancement, only the centered scores are provided (see Supplementary Material for presentation of uncentered scores; Appendix A3).

Table 4.3 Comparison between the mean scores of the German and Ecuadorian samples.

Based on raw mean scores									
Variables	**Germany**			**Ecuador**			**t-test**	**95% BCaCI**	**Effect size *d***
	M	***SE***	***SD***	***M***	***SE***	***SD***			
Nature relatedness	2.66	0.02	0.78	3.69	0.04	0.83	-24.54***	[-1.12, -0.95]	1.32
Time spent in nature	2.91	0.02	0.88	2.82	0.04	0.88	1.95*	[0,00, 1.18]	0.10
Based on centered mean scores									
Egoistic EC	-0.14	0.02	0.74	0.02	0.03	0.65	-3.53***	[-0.20, -0.05]	0.17
Altruistic EC	0.11	0.02	0.73	-0.13	0.04	0.71	6.15***	[0.17, 0.32]	0.33
Biospheric EC	0.00	0.02	0.91	0.08	0.04	0.72	-2.01*	[-1.61, -0.01]	0.09
ST	0.39	0.01	0.55	0.47	0.03	0.62	-2.55**	[-0.15, -0.02]	0.14
SE	-0.44	0.02	0.69	-0.57	0.04	0.74	3.42**	[0.05, 0.21]	0.19

*EC, environmental concern; ST, self-transcendence; SE, self-enhancement; Confidence intervals based on 1000 bootstrap samples, *= p ≤ 0.05, **= p ≤ 0.01, ***= p ≤ 0.001.*

The results of the independent group *t*-tests are reported in Table 4.3. Since a centering was not possible for nature relatedness and time spent in nature, uncentered scores are reported for these variables. For environmental concern, self-transcendence and self-enhancement, only the centered scores are provided (see Supplementary Material for presentation of uncentered scores; Appendix A3).

Regarding nature relatedness, the *t*-test revealed differences with large effect sizes between German and Ecuadorian young people, with Ecuadorians scoring higher than Germans.

The comparison between the centered mean scores showed only altruistic environmental concern as differing significantly between the two groups, with a small effect size. In this case, German young people scored higher than Ecuadorians. Additionally, the centered mean score comparison provided insight into the structure of environmental concern for our two samples. Whereas we found a relative preference for altruistic (M = 0.11) over biospheric (M = 0.00) and egoistic concern (M = -0.14) in the German sample, the Ecuadorian sample was most concerned about the consequences of environmental problems for biospheric reasons (M = 0.08), followed by egoistic (M = 0.02) and altruistic reasons (M = -0.13).

Q2: How do young people's gender and nationality, their basic human values, and time spent in nature affect their nature relatedness and environmental concern?

Multiple regressions were conducted in order to determine how the sample's gender, their values, and time spent in nature affected their nature relatedness and environmental concern. To investigate the differences between both samples in explaining nature relatedness and environmental concern, we carried out separate multiple regressions for our two groups (Table 4.4).

Table 4.4 Results of regression analyses predicting nature relatedness as well as egoistic, altruistic and biospheric environmental concern for the German and the Ecuadorian sample.

	German sample							
	NR		**Egoistic EC**		**Altruistic EC**		**Biospheric EC**	
	β	**t**	***β***	**t**	***β***	**t**	***β***	**t**
ST	0.37	17.91***	0.26	11.24***	0.42	18.98***	0.40	18.17***
SE	-0.01	-0.62	0.14	6.33***	0.01	0.53	0.01	0.43
Time spent in nature	0.34	16.79***	0.08	3.41***	0.02	0.97	0.06	2.90*
Female	0.12	5.73***	-0.02	-0.65	-0.01	-0.49	0.00	0.13
$Adj.R^2$	0.30***		0.09***		0.18***		0.18***	
n	1,820		1,910		1,904		1,912	
	Ecuadorian sample							
ST	0.32	7.15***	0.17	3.45**	0.31	5.94***	0.25	5.04***
SE	-0.03	-0.58	0.19	3.74***	-0.01	-0.18	-0.03	-0.53
Time spent in nature	0.31	6.90***	0.08	1.55	-0.02	-0.41	0.14	2.93**
Female	-0.11	-2.42*	-0.01	-0.15	0.01	0.14	-0.13	-2.56*
$Adj.R^2$	0.24***		0.07***		0.08***		0.11***	
n	390		387		356		395	

ST, self-transcendence; SE, self-enhancement; NR, nature relatedness; EC, environmental concern,= p ≤ 0.05, **= p ≤ 0.01, ***= p ≤ 0.001.*

In both samples, self-transcendence and time spent in nature showed a positive effect on nature relatedness. Whereas female gender in the German sample predicted the nature relatedness positively, the reverse was true in the Ecuadorian sample. Neither in the German sample nor in the Ecuadorian sample did self-enhancement have an effect on nature relatedness. The regression explained 30% of nature relatedness' variance in the German sample and 24% in the Ecuadorian sample.

Furthermore, multiple regressions accounted for 9% of egoistic concerns' variance in the German sample and 7% in the Ecuadorian sample. In both samples, self-transcendence and self-enhancement showed a positive effect on egoistic concern. In both samples, only self-transcendence predicted altruistic concern. The regression on altruistic concern explained 18% of its variance in the German sample and 8% in the Ecuadorian sample.

In both samples, self-transcendence and time spent in nature had a positive effect on biospheric concern. While there was no relation between female gender and biospheric concern in the German sample, female gender showed a negative effect on biospheric concern in the Ecuadorian sample. The regression on biospheric concern explained 18% of the variance in the German sample and 11% in the Ecuadorian sample.

Discussion

Q1: How do Ecuadorian and German young people differ in their nature relatedness and environmental concern?

H1: Ecuadorian young people have higher nature relatedness and environmental concern.
With our first research question, we intended to compare young people's nature relatedness and environmental concern between the two samples from Ecuador and Germany.

In a comparison of means across different cultures, a response bias cannot be ruled out, because people from different cultures differ in their response behavior (Smith, 2004) and socially desirable responding influences the self-reported priorities (Schwartz et al., 1997). For this reason, we consider the standardized mean scores (Table 4.3) to be more meaningful and to better represent the priorities of their values and environmental concern than the non-standardized values. Thus, regarding environmental concern, we decided to report only the comparison of the centered mean scores. The discussion of the differences in nature relatedness refers to the raw scores.

A deeper look into the structure of environmental concern revealed clear patterns in each sample. The prioritization of altruistic concern in the structure of environmental concern, which was the case in the German sample, was frequently found, for example, in nine of eleven adult samples from the United States and different Latin American countries surveyed by Schultz (2001). Only El Salvador and Columbia were most concerned about the consequences of environmental problems for biospheric reasons. However, a German sample was not part of the study mentioned above.

We suspect that living in the biodiversity hotspot Tropical Andes influences Ecuadorian young people's environmental concern, thus presenting a possible explanation for the Ecuadorian young people's structure of environmental concern. A biodiversity hotspot is characterized not only by its high species density but also by its high degree of threat. The biodiversity in such a place is therefore particularly worth protecting and people living there could be more aware of nature's intrinsic value, which could explain the higher biospheric concern of Ecuadorian young people.

Regarding egoistic and altruistic environmental concern, the occurrence and consequences of environmental disasters, which differ extremely in Ecuador and Germany, have to be considered. Ecuadorians live in a biodiversity hotspot and news like the destruction of tropical rainforests for the exploration of oil or the cultivation of crops destined for export to Europe is not uncommon. Many human-made environmental problems have either a direct or indirect consequence on their personal lives, whether through land loss, water pollution, or the loss of traditional food and medicinal plants. For instance, during oil exploitations in the Ecuadorian Amazon by an American multinational energy corporation between 1964 and 1992, millions of gallons of toxic substances were spilled into the Amazon. The contamination covered an area of 1,700 square miles and caused damage not only to flora

and fauna, but also to human life (Cely, 2014; Lambert, 2017). In addition, the resulting long-running lawsuit received considerable media attention worldwide, this extended the environmental disaster; and its consequences are still present in the Ecuadorian population today (Krauss, 2014; Reuters, 2017). In contrast, young German people are virtually unaffected by such environmental disasters but are made aware of them and their consequences for people in other parts of the world almost daily by the media. Thus, we postulate that for Ecuadorian young people, the negative consequences of environmental problems for oneself are easier to imagine than for German young people. Due to these circumstances, the prioritization of egoistic motives for environmental concern in the Ecuadorian sample and altruistic motives in the German sample seems plausible.

While environmental concern has already been well researched across samples of different nationalities, there is a lack of cross-national empirical research regarding nature relatedness or equivalent constructs. Since nature relatedness is related to environmental concern, especially to biospheric concerns (Nisbet & Zelenski, 2013), the higher nature relatedness found in the Ecuadorian sample fits well with our result of the relative preference for biospheric over altruistic and egoistic environmental concerns in this sample. Nevertheless, the question arises as to how the different results come about in nature relatedness and the structure of the environmental concern. This question can be answered from two different directions. First, living in the biodiversity hotspot Tropical Andes may encourage Ecuadorian young people's nature relatedness. Furthermore, the indigenous concept of *Buen Vivir,* which is not only deeply rooted in the culture of the indigenous people but also being politically instrumentalized (Lalander, 2016), may have an effect on the socialization process in Ecuador that could increase their nature relatedness. For example, the concept of *Buen Vivir* assumes a central position in the constitution, in which the construction of "a new form of citizen coexistence in diversity and harmony with nature, to achieve good living (*Buen Vivir*)" (Asamblea Constituyente de Ecuador, 2008, p. 15) is announced. As a result, the indigenous guiding principles of *Buen Vivir* apply to all Ecuadorian citizens and not only to those of an indigenous background.

Second, the debate about *Buen Vivir* and the associated social awareness regarding environmental issues (Lalander, 2016; Rieckmann et al., 2011) may increase the pressure to respond in a socially desirable way (Schwartz et al., 1997; Smith, 2004). Both explanatory approaches probably apply to a certain extent. For instance, the items of the NR-6 "I always think about how my actions affect the environment" and "My connection to nature and the environment is a part of my spirituality" (Nisbet & Zelenski, 2013) are in many respects consistent with the concept of *Buen Vivir,* which is based on the idea of living in harmony with nature to achieve good living (*Buen Vivir)* and of interdependence of society and nature (Asamblea Constituyente de Ecuador, 2008; Vanhulst & Beling, 2014).

To summarize the results of the first research question, the current study showed that Ecuadorian students related more to nature than German students and were most

concerned about the consequences of environmental problems for biospheric reasons, whereas German students were most concerned for altruistic reasons.

Q2: How do young people's gender and nationality, their basic human values, and time spent in nature affect their nature relatedness and environmental concern?

H2: Self-transcendence, time spent in nature, and having a female gender positively predict nature relatedness and biospheric environmental concern.

Based on diverse results in the literature, in our second hypothesis, we assumed that self-transcendence (Sothmann & Menzel, 2017), time spent in nature (Mayer et al., 2009; Nisbet & Zelenski, 2013), and having a female gender (Stern et al., 1993; Tam, 2013b) would predict nature relatedness. Although the regressions found that time spent in nature is a positive predictor for nature relatedness (Table 4.4), we must consider the ex post facto design of our study, which is why we cannot make a definitive statement about the direction of the relationship between the two variables. Indeed, it is also reasonable to assume that a sense of nature relatedness motivates people to seek out nature. Nonetheless, we hypothesized a positive effect of time spent in nature on nature relatedness on the basis of experimental studies that showed the positive effect of exposure to nature on college students' nature connectedness (Mayer et al., 2009). However, it may be the case that there is a bidirectional relationship between these two variables, such as that having a desire to connect with nature leads to spending more time in nature, which in turn positively affects connectedness with nature and vice versa (see alsoMacKerron & Mourato, 2013; Mayer et al., 2009; Nisbet, Zelenski, & Murphy, 2011).

In accordance with available literature (Schultz, 2001), self-transcendence was the most powerful predictor for biospheric concern in both samples (Table 4.4). Among other things, self-transcendence represents a pro-environmental value orientation orientated towards the welfare of all living things and nature (universalism; Schwartz, 1992), which explains its positive effect on biospheric environmental concern and nature relatedness.

The positive effect of female gender on nature relatedness found in the German sample can be explained by Tam (2013), who found in an adult Chinese sample that female individuals had more dispositional empathy with nature, which was related to connection to nature. In contrast, in the Ecuadorian sample, female gender had a negative effect on nature relatedness, running contrary to our supposition and pointing to cultural differences regarding the relation between gender and nature relatedness.

The second part of our hypothesis dealt with biospheric environmental concern. As in the case of nature relatedness as dependent variable, self-transcendence and time spent in nature seemed to predict biospheric concern in both samples. However, the different sample sizes must be taken into account. It is very likely that time spent in nature in the German sample was significant only because of the very large sample size (N = 1,912). Such an effect would most likely not occur with a sample size comparable to the Ecuadorian

sample. This also applies to the regression of time spent in nature on egoistic concern (Table 4.4).

Although it might seem surprising that female gender had a negative effect on biospheric environmental concern in the Ecuadorian sample, while there was no relation found in the German sample between these variables, Zelezny et al. (2000) came to comparable conclusions, examining gender differences in environmental attitudes and behaviors across 14 countries. They showed that only in three (Colombia, Ecuador, and El Salvador) out of the 14 countries did males have higher environmental attitudes than females. They also found that only in two of the 14 countries did males report higher ecocentric environmental attitudes than females (Dominican Republic and Ecuador). In addition to Ecuador, the mentioned study examined ten other Latin American countries, suggesting that Ecuador is an exception regarding gender differences in the human-nature relationship. Therefore, the findings of Zelezny et al. (2000) in an adult Ecuadorian sample could be replicated by our study for Ecuadorian young people, even if these differences cannot be explained easily.

Gender differences in environmental concern and nature relatedness can be explained by approaches based on gender roles and socialization, according to which behavior is a product of the socialization process, characterized by gender expectations in terms of cultural norms. Females are generally socialized to have a stronger “ethic of care” (Gilligan, 1982, p. 73), to be more compassionate, and to be more involved in caregiving activities than males (Beutel & Marini, 1995). Therefore, females are expected to be more empathic than males (Hoffman, 2008), which has been empirically proven (Baron-Cohen & Wheelwright, 2004; Jolliffe & Farrington, 2006). Based on these findings, Tam (2013) proposed that women have stronger dispositional empathy with nature than men do and could confirm his assumption in a study with Chinese adults. Based on this, gender differences in predicting nature relatedness and biospheric environmental concern could be an expression of culture-specific socialization, and it supports the hypothesis of Davidson and Freudenburg (1996) that gender differences in environmental concern are not universal.

As previously mentioned, we consider the indigenous concept of *Buen Vivir,* which is deeply rooted in the culture of the indigenous people, to be central in the explanation of nature relatedness and environmental concern. On a conceptual level, the variable of nature relatedness and the basic idea of *Buen vivir* have many overlapping points and similarities (Nisbet et al., 2009). We propose that a life concept of living in harmony with nature that applies to everyone, male or female, influences the process of socialization. The current debate about *Buen Vivir* and the associated social awareness regarding environmental issues (Lalander, 2016; Rieckmann et al., 2011) may reinforce this effect. In addition, Rafael Correa, who was the President of Ecuador from 2007 to 2017 and promoted life in harmony with nature, may have been a role model for many Ecuadorian boys.

In summary, with regard to our second hypothesis we found that self-transcendence predicted students’ biosperic environmental concern in Germany and Ecuador. In addition,

in the Ecuadorian sample, time spent in nature had a positive effect on biosperic concern, whereas female gender had a negative effect. No relation could be found in this respect in the German sample. In both samples, nature relatedness was predicted positively by self-transcendence and time spent in nature. Surprisingly, female gender predicted nature relatedness negatively in the Ecuadorian sample and positively in the German sample.

H3: Self-transcendence positively predicts altruistic concern and negatively egoistic concern.

With respect to our third hypothesis, self-transcendence was the only predictor for altruistic environmental concern, thus, our results are consistent with those in the literature (Schultz, 2001). As self-transcendence triggers prosocial norms oriented towards the welfare of humans (particularly through the value of benevolence) (Schwartz, 1992), its predictive power for altruistic environmental concern is plausible.

Surprisingly, we found self-transcendence to be a positive predictor for egoistic concern, even though Schultz (2001) and Schultz et al. (2005) found a negative relation between self-transcendence and egoistic environmental concern. However, the mentioned studies were conducted with adult samples, thus results are only applicable for adults. Sothmann and Menzel (2016) found that especially young people were shown to profit from nature as a resource for their own well-being and that this connection decreases with increasing age. Self-transcendence, especially the universalism value type, emphasizes the importance of caring for and adapting to nature, which represents the idea of the nature connection of including nature within the cognitive representation of self (Schultz, 2002). Accordingly, nature connected people are expected to relate the damage to their environment to themselves.

Therefore, it seems true that young people who are high in self-transcendence are concerned about environmental problems because of the biosphere and also because they are afraid of the destruction of the source for their own well-being and relate the damage to their environment to themselves.

However, we have to consider the low percentage of variance explained for egoistic concern by self-transcendence in Germany and Ecuador, which leads us to suspect that other variables besides self-transcendence and self-enhancement are more important in the explanation of egoistic environmental concern.

H4: Self-enhancement positively predicts egoistic environmental concern.

The results support our assumption that self-enhancement predicted egoistic environmental concern in both samples (Schultz, 2001; Schultz et al., 2005), because self-enhancement predicted egoistic environmental concern in both samples (Table 4.4). Self-enhancement reflects goals and ideals that are linked with tangible rewards for self (e.g., success, social power, enjoyment, and pleasure). We propose that people who are orientated towards self-enhancement values do not include other people or other living things within their

representation of self (Schultz, 2001). Thus, our results replicated those of earlier studies conducted with adult samples from different countries (Schultz, 2001; Schultz et al., 2005).

Conclusions and Limitations

The aim of the present study was to compare Ecuadorian and German young people's nature relatedness and environmental concern and to investigate its predicting factors. The following conclusions can be drawn from the results described in this article:

(1) Ecuadorian young people were found to be more related to nature than young people in Germany. Living in a biodiversity hotspot and culture-specific socialization are seen as reasons for the differences. However, a social desirability response bias cannot be ruled out, which is why we recommend the application of a scale to measure social desirability for further studies. (2) German and Ecuadorian young people differed in their structure of environmental concern. Living in a biodiversity hotspot, which includes the contact with biodiversity particularly worthy of protection, might be one explanation for the high biospheric environmental concern in the Ecuadorian sample. Differences between Ecuador and Germany regarding biodiversity loss and its immediately noticeable consequences served as an explanation for the high altruistic concern of German students and the high egoistic concern about the environmental problems of Ecuadorian students. (3) Gender differences between Ecuadorian and German young people in the explanation of nature relatedness and biospheric concern were found. These differences were interpreted as an expression of a culture-specific socialization. (4) Contrary to previous studies conducted with adult samples (Schultz et al., 2005), in our samples of young people, their self-transcendence had a positive effect on egoistic concern. We assume that young people will be better able than adults to combine the intrinsic value of nature with selfish goals, such using its positive effect on their well-being. (5) As in other studies conducted with adults, time spent in nature and self-transcendence also had positive effects for high school students' nature relatedness and biospheric environmental concern.

Unlike a variety of previous studies conducted with adults, our results refer to the human-nature relationship of young people. The outcomes indicate that differences exist in the human-nature relationship between German young people, who live in an industrial country, and Ecuadorian young people, who live in a biodiversity hotspot. Nevertheless, the chosen variables could only explain a small proportion of the variance for the three dimensions of environmental concern, and thus our results should be validated with replication studies using a scale to measure social desirability. We assume that the students from Ecuadorian private schools are neither representative in terms of socio-ecological status, nor do they reflect cultural diversity of the country. Therefore, a sampling bias cannot be ruled out.

We assume that Ecuadorian students from private schools are more likely than those from public schools to have their basic material needs met. As the formation of environmental concern might be understood as a consequence of increasing post-materialism, private school students may differ from public school students in terms of their environmental concern (Inglehart, 1995; Maslow, 1954; Stern et al., 1999). On the basis of government

expenditure per secondary school student for the year 2014, however, it can be seen that German students receive considerably more financial support from the state (11,180 US$) than do Ecuadorian secondary school students(338 US$; UIS, 2018; World Bank National Accounts data & OECD National Accounts data, 2018). For this reason, we assume that the comparison of German public school students with Ecuadorian private school students is more appropriate than with Ecuadorian public school students. Nevertheless, future studies should survey both private and public school students in order to assess for a possible sampling bias.

Nature relatedness and environmental concern, especially biospheric concern, are important prerequisites for pro-environmental behavior. In the face of a daily biodiversity loss, which is particularly prevalent in biodiversity hotspots, it is imperative to identify factors that contribute to the promotion of nature relatedness and biospheric environmental concern among young people. Our study clearly showed that young people living in Ecuador, a country that hosts two relevant biodiversity hotspots, were most concerned about the consequences of environmental problems for biospheric reasons. They also feel more related to nature than young people from an industrialized country such as Germany. In both samples self-transcendence was the strongest predictor for nature relatedness as well as for biospheric environmental concern. Hence it represents a particularly strong leverage point to stimulate pro-environmental behavior. Self-transcendence values could be fostered in both family life and teaching by addressing and rewarding aspects such as justice and solidarity instead of placing the focus on performance-oriented aspects.

The study indicated a clear positive effect of time spent in nature on biospheric concern only in the Ecuadorian sample. Living in a biodiversity hotspot and directly experiencing complex biotopes constitute a plausible reason for Ecuadorian young people's high biospheric environmental concern and nature relatedness. As a consequence, also in countries with a relatively low biodiversity such as Germany, visiting and experiencing diverse biotopes, in or outside the country, could contribute to the promotion of both variables.

Finally, the effects of time spent in nature on nature relatedness emphasize the importance of giving young people opportunities to learn in and from nature, whether they are living in a biodiversity hotspot or an industrialized country. This can happen by means of family activities, leisure activities, or out-of-school environmental education. In the field of education, the results may encourage teachers to leave the classroom more often with their students and conduct environmental education directly in or close to nature in order to increase young people's pro-environmental behavior.

4.2 Fostering sustainable diets among German high school students: the potential of perceived consumer effectiveness, the human-nature relationship, and knowledge[5]

Abstract

The current food system is a causal factor in multiple global problems such as climate change and biodiversity loss. Negative impacts can be drastically reduced by adopting a more sustainable diet, especially by reducing or renouncing meat. Education for sustainable development plays a key role in fostering sustainable dietary behavior among young people. The development of effective educational concepts requires identifying the factors that influence sustainable dietary intention and behavior. For this purpose, we collected data on environmental psychological factors, sustainable dietary intention and actual dietary behavior in a sample of 624 high school students from four secondary schools in Germany (M_{age} = 16.63 years; *SD* = 1.15; female: 48.2%; male: 49%; gender-diverse: 2.8%; vegetarians: 14.1%). Our study revealed that perceived consumer effectiveness, biospheric environmental concern, and knowledge about sustainable nutrition were positive predictors for both the intention to eat sustainably and vegetarianism. Nature relatedness explained the intention to eat sustainably but not vegetarianism, while dispositional empathy with animals only predicted vegetarianism. Egoistic and altruistic environmental concern and gender showed no effect on the intention to eat sustainably or on vegetarianism. We discuss our findings in the context of starting points for developing educational concepts in the area of sustainable nutrition.

Keywords: Sustainable food consumption; Education for Sustainable Development Goals; Pupils; Nature relatedness; Environmental concern

[5] Dornhoff, M., Bischof, J., & Fiebelkorn, F. (2021). Fostering sustainable diets among German high school students: the potential of perceived consumer effectiveness, the human-nature relationship, and knowledge. *Food Quality and Preference* (manuscript submitted).

Introduction

The world population will grow from about 7.8 billion people currently to an expected 10 billion people in 2050 (United Nations, 2019). As a result, we face the challenge of feeding a considerably expanding global population in an economically efficient, socially, and environmentally sustainable manner and in a way that promotes human health. Our food system is already failing to meet these demands today. At the same time, global food distribution shows a paradoxical trend: the number of overweight people has tripled to over 1.9 billion since 1975 (WHO, 2020b), while 820 million people are currently suffering from hunger (FAO et al., 2019). From an ecological perspective, the global food system represents the world's largest greenhouse gas emitting sector (IPCC, 2019) and is the primary driver of biodiversity loss and ecosystem degradation (Campbell et al., 2017; IPBES, 2019). In this context, livestock farming is particularly environmentally harmful and inefficient. Calculations of the contribution of livestock to anthropogenic greenhouse gas emissions vary between 14.5% (Gerber et al., 2013) and 51% (Goodland & Anhang, 2009). Furthermore, livestock farming occupies two-thirds of the total agricultural land (FAO, 2009; Steinfeld et al., 2006), while it produces only 18% of the world's calories and 37% of the world's proteins (Ritchie & Roser, 2019). Moreover, in parallel with population growth, global meat consumption is expected to rise from 42 kg/capita/year (carcass weight; OECD & FAO, 2020) to 49 kg/capita/year (Alexandratos and Bruinsma, 2012).

Vegetarian or vegan dietary shifts alone could significantly reduce greenhouse gas emissions from the food sector (Aleksandrowicz et al., 2016; Chai et al., 2019; Rosi et al., 2017; Scarborough et al., 2014; Segovia-Siapco & Sabaté, 2019). Although renouncing meat consumption is one of the most efficient means to achieve a sustainable food system, holistic sustainable diets should not be restricted to vegetarianism. Von Koerber, Bader, and Leitzmann (2017) developed a comprehensive definition of sustainable nutrition. Implementing the concept to everyday life, von Koerber et al. (2017) recommend the preferential consumption of (1) plant-based foods, (2) organic foods, (3) minimally processed foods, (4) regional and seasonal products, (5) fair trade food products, and finally, (6) adopting resource-saving housekeeping practices. According to von Koerber et al. (2017), a diet following these recommendations has positive ecological, economic, social, cultural, and health effects. The concept of sustainable nutrition of von Koerber et al. (2017) therefore corresponds to the FAO definition of sustainable diets (Barbara Burlingame et al., 2012) but offers more concrete recommendations for everyday life.

There is no doubt that a food system transformation is urgently needed in light of the evident shortcomings of the current food system. In addition to technical innovations and political actions, a consistent change in eating habits towards a vegetarian and a holistic sustainable diet is essential. Within educational politics, the implementation of sustainable dietary patterns is also viewed as a critical action point toward achieving several Sustainable Development Goals (SDGs) in the context of Agenda 2030 (e.g., SDG 2 'Zero hunger' or SDG 12 'Responsible consumption and production'; FAO, 2017; United Nations General Assembly, 2015). Education, and explicitly education for Sustainable Development Goals (ESD-G), plays

a crucial role in empowering young people to take “responsible actions for environmental integrity, economic viability and a just society for present and future generations” (Rieckmann, 2017, p. 7). Young people are of particular importance in this context, as they represent a key future consumer group and occupy a unique position as agents of change for ESD-G by influencing their peers, families, and local communities (Damerell et al., 2013; von Braun, 2017).

Although teaching materials and didactic concepts to foster sustainable consumption and dietary behavior exist (Bryant & Dillard, 2020; Fiebelkorn & Kuckuck, 2020; United Nations Environment Programme, 2010), they are not based on an a-priori analysis of relevant psychological prerequisites. Therefore, to design an ESD-G that encourages students to adopt a sustainable diet, it is essential to identify the psychological factors that foster the intention to adopt sustainable eating behavior and vegetarianism.

For this purpose, we developed separate models to explain the intention to eat sustainably and to adopt vegetarianism in high school students. We included a comprehensive set of explanatory variables that previous research has identified as predictive of pro-environmental behavior (PEB; Coelho et al., 2017; Joshi and Rahman, 2019; Kaiser and Frick, 2002; Mackay and Schmitt, 2019; Otto and Pensini, 2017; Rosa et al., 2018), sustainable dietary behavior (Weber et al., 2020; Weber & Fiebelkorn, 2019), following a vegetarian diet (Modlinska et al., 2020), or buying organic products (Irianto, 2015; Rimal et al., 2005; Sangkumchaliang & Huang, 2012). The study’s main aims were to support the development of educational concepts and policy interventions tailored to students’ psychological prerequisites for adopting sustainable dietary behavior and provide valuable insights to advance models for predicting sustainable eating behavior.

Theoretical background and current state of research on determinants of pro-environmental and sustainable eating behavior

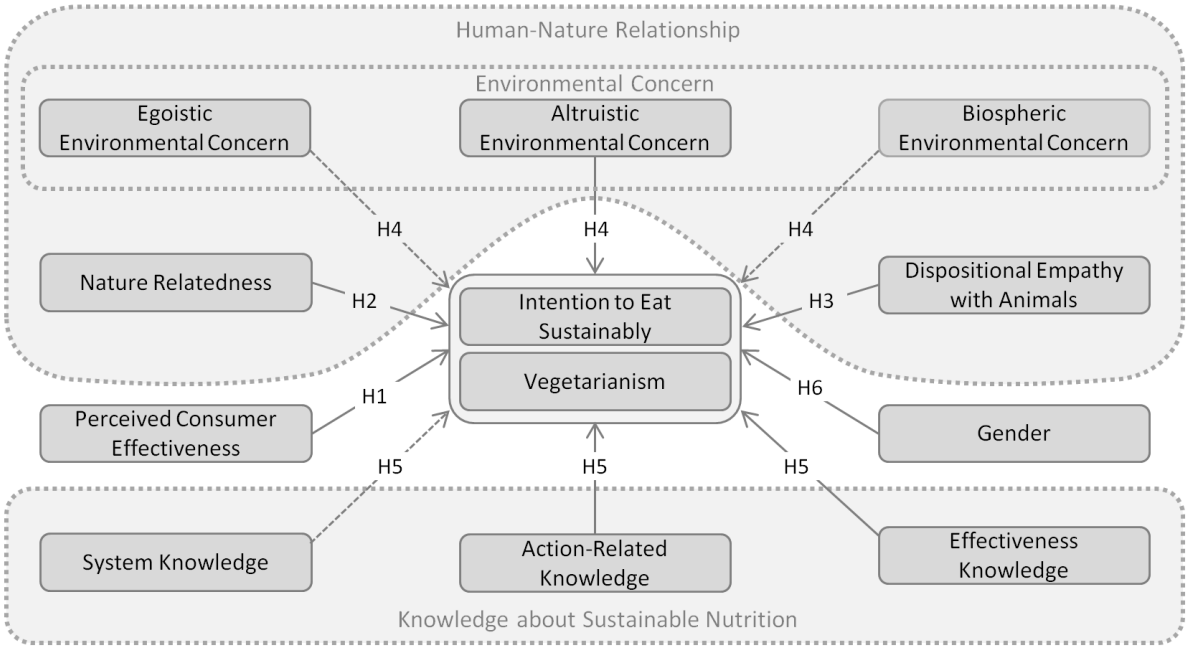


Figure 4.1 Hypothesized effects of potential explanatory variables on the intention to eat sustainably and the adoption of vegetarianism. Solid lines show the assumed relationships based on the literature. Dashed lines show relationships, that are unexpected based on the literature, but are examined to test our hypotheses.

Intention to eat sustainably and vegetarianism as pro-environmental behavior

As we highlighted in the introduction, a sustainable diet is associated with positive ecological, economic, social, cultural, and health effects, thus representing broadly sustainable rather than solely pro-environmental behavior (von Koerber et al., 2017). However, from an environmental psychological perspective, the positive ecological effects qualify adopting a sustainable diet as a form of PEB. All else being equal, the omission of meat from one's diet has beneficial environmental effects, and as such, we also consider vegetarianism as a form of PEB. The following theoretical considerations rest on these basic assumptions.

Perceived consumer effectiveness (PCE)

In general, PCE describes the extent to which consumers believe they can attain valued and desired outcomes (Hanss & Doran, 2020). In our study, PCE represents a domain-specific construct, referring to nutrition-related consumer behavior, executed to achieve a specific outcome, namely, to minimize environmental problems. Numerous studies have identified PCE as a direct (Coelho et al., 2017; Joshi & Rahman, 2019; Kim & Choi, 2005; Lee et al., 2014; Roberts, 1996) or indirect (Kang et al., 2013; Vermeir & Verbeke, 2006) predictor of pro-environmental consumer behavior. In the context of nutritional choices, research suggests that willingness to consume less meat relates to the perceived effectiveness of a low meat diet in mitigating climate change (de Boer et al., 2016). Therefore, we hypothesize

that increased PCE leads to more pronounced intention toward and actual adoption of sustainable eating behavior.

H1: PCE positively predicts high school students' intention to eat sustainably and the adoption of vegetarianism.

Human-nature relationship

The relationship of an individual to their natural environment is a crucial element in explaining PEB. In the context of our study, the human-nature relationship is conceptualized as nature relatedness, dispositional empathy with animals, and environmental concern. We chose these variables because they explain PEB (Capaldi et al., 2014; Mackay & Schmitt, 2019; Mayer & Frantz, 2004; Milfont et al., 2006; Otto & Pensini, 2017; Rosa et al., 2018; Schultz, 2001; Schultz et al., 2004, 2005; Whitburn et al., 2020) or sustainable dietary behavior (Kern & Fiebelkorn, 2020; Rothgerber & Mican, 2014; Weber et al., 2020; Weber & Fiebelkorn, 2019; Zickfeld et al., 2018).

Nature relatedness

Nature relatedness is based on the assumption that humans have a natural urge to be close to all living things (Kellert & Wilson, 1993; Wilson, 1984) and describes the affective, cognitive, and experiential connection of humans to the natural world. It is a relatively stable disposition, both temporally and situationally, yet is not entirely fixed (Mayer & Frantz, 2004; Nisbet et al., 2009). According to Schultz (2002), people who feel closely related to nature have a schema of the self that overlaps largely with their cognitive representation of nature. For these people, environmental destruction is related to their self-concept (Mayer & Frantz, 2004), which motivates them to behave in a pro-environmental way, e.g., eating sustainably or following a vegetarian diet.

Various studies have already shown that nature relatedness is associated with PEB and a greater willingness to protect the environment (Capaldi et al., 2014; Mackay & Schmitt, 2019; Mayer & Frantz, 2004; Otto & Pensini, 2017; Rosa et al., 2018; Whitburn et al., 2020). However, few studies have investigated the effect of nature relatedness on the intention to eat sustainably (Weber et al., 2020; Weber & Fiebelkorn, 2019). Weber et al. (2020) and Weber and Fiebelkorn (2019) found that nature relatedness among German student biology teachers predicted their intention to eat sustainably. To the best of our knowledge, no study to date has investigated this relationship in high school students. Nevertheless, based on the results of studies on adults, we formulate the following hypothesis.

H2: Nature relatedness positively predicts high school students' intention to eat sustainably the adoption of vegetarianism.

Dispositional empathy with animals

In line with Writz (2017), we consider empathy as the ability to understand and share another living being's emotions. Batson (1987) established the empathy-altruism hypothesis,

which states that people act unselfishly when they feel empathy toward others in a situation. Multiple studies support this hypothesis (Batson, 2014; Batson et al., 2002).

People are not only capable of feeling empathy towards other people but also toward (farm) animals, plants, and nature in general (Kern & Fiebelkorn, 2020; Tam, 2013b). Dispositional empathy with nature is defined as the "dispositional tendency to understand and share in emotional experiences of the natural world" (Tam, 2013, p. 92) and consists of an affective (empathic concern) and a cognitive component (perspective taking; Tam, 2013). In five different studies, Tam (2013) found that dispositional empathy with nature predicted conservation behavior. Berenguer (2007) showed that empathy for a natural object promoted the willingness to act in a way that protects the environment.

In this study, we focus on dispositional empathy with animals. We based this decision on methodological considerations (see Material and methods) and the unique role it seems to play in meat consumption. Multiple studies have already shown that empathy with animals is negatively associated with meat consumption (Kern & Fiebelkorn, 2020; Rothgerber & Mican, 2014; Zickfeld et al., 2018). A substantial proportion of vegetarians' dietary choice is motivated by the avoidance of animal suffering (Humane League Labs, 2014; Janssen et al., 2016; Ruby, 2012). Due to the proven positive effects of dispositional empathy with nature on PEB and the negative relationship between empathy with animals and meat consumption, we formulate the following hypothesis.

H3: Empathy with animals positively predicts high school students' intention to eat sustainably the adoption of vegetarianism.

Environmental concern

According to Stern and Dietz (1994), environmental concern is based on egoistic, social-altruistic, and biospheric value orientations and on beliefs about the consequences of environmental change on valued objects. Schultz (2001) demonstrated a three-factor structure of environmental concern, which reflects the individuals' concerns about the effect of environmental destruction on themselves (egoistic environmental concern), on other people (altruistic environmental concern), and on all living things (biospheric environmental concern).

Several studies have demonstrated the effect of general environmental concern on pro-environmental intentions and behaviors (Kilbourne & Pickett, 2008), 'green' purchasing behavior (Kim & Choi, 2005), and the intention for organic food consumption (Çabuk et al., 2014). However, studies on the relationship between the three environmental concern dimensions (Schultz, 2001) and PEB have shown less consistent results. Many studies found that only biospheric environmental concern had a positive effect on PEB (Milfont et al., 2006; Schultz, 2001) or correlated with it (Schultz et al., 2004, 2005). Weber et al. (2020) exclusively identified altruistic environmental concern as a predictor for the intention to eat sustainably in university students. They hypothesized that the intention to eat sustainably was socially motivated in their sample of student biology teachers intended to eat

sustainably, especially for social reasons. Based on Weber et al.'s (2020) observations and on the assumption that vegetarianism is at least partly a sustainable diet, we formulate the following hypothesis:

H4: Altruistic environmental concern, but not egoistic or biospheric concern, positively predicts high school students' intention to eat sustainably and the adoption of vegetarianism.

Knowledge about sustainable nutrition

In general, knowledge is the entirety of information stored in the human brain (or in another data carrier; Frick, 2003). Environmental knowledge, then, describes "knowledge and awareness about environmental problems and possible solutions to those problems" (Zsóka, Szerényi, Széchy, & Kocsis, 2013, p. 127) and this forms the basis for defining sustainable nutrition knowledge in our study. Environmental knowledge is an important component of ESD-G (Rieckmann, 2017) and a necessary but not sufficient prerequisite for PEB development (Roczen et al., 2010). Empirically, the effect of environmental knowledge on PEB is disputed. While some studies have demonstrated a weak direct effect of environmental knowledge on PEB (Casaló et al., 2019; Díaz-Siefer et al., 2015; Heo & Muralidharan, 2019; Kaiser & Frick, 2002; Otto & Pensini, 2017), other studies suggest this effect is mediated by environmental or general attitudes (Gkargkavouzi et al., 2019; Liu et al., 2020; Paço & Lavrador, 2017; Uddin & Khan, 2018; Van Loo et al., 2013).

Research is increasingly differentiating the general concept of environmental knowledge into different dimensions. Frick (2003) summarized the most relevant aspects as (1) *System knowledge*, referring to knowledge about the function and interrelationships within ecosystems and causal understanding of environmental problems, (2) *action-related knowledge*, describing knowledge about actions to cope with environmental problems, and (3) *effectiveness knowledge, referring* to knowledge about the efficacy of specific behaviors for environmental conservation. The latter includes cost-benefit considerations and knowledge about life cycle assessments (Frick, 2003; Frick et al., 2004).

It is evident that all three knowledge dimensions are interlinked and mutually dependent (Fremerey & Bogner, 2014). System knowledge appears not to have a direct influence on PEB. Instead, this dimension acts indirectly via effectiveness and action-related knowledge (Frick et al., 2004). Frick et al. (2004) and Fremerey and Bogner (2014) demonstrated a direct positive effect of action-related and effectiveness knowledge on PEB. Roczen, Kaiser, Bogner, and Wilson (2014), in turn, only found action-related knowledge to predict PEB. We formulate the following hypothesis based on the empirical data on environmental knowledge reported by Frick et al. (2004) and Fremerey and Bogner (2014):

H5: Effectiveness and action-related knowledge, but not system knowledge, positively predict high school students' intention to eat sustainably and adopt vegetarianism.

Gender

Previous studies investigating gender differences in environmental behavior have suggested that women are more likely to engage in PEB than men (Davidson & Freudenburg, 1996), and this trend appears to hold cross-culturally (Zelezny et al., 2000). In terms of dietary behavior, men consume more meat than women and have a more positive attitude toward meat consumption. In Western societies, women are twice as likely as men to be vegan or vegetarian (Modlinska et al., 2020). Furthermore, most studies have shown that women hold more positive attitudes and stronger purchasing intentions toward organic products (Irianto, 2015; Rimal et al., 2005). Women also buy more organic products than men (Sangkumchaliang and Huang, 2012). However, Tsakiridou et al. (2008) found no gender differences in the attitude and intention to consume organic food. Based on the frequently observed relationship between gender and PEB and dietary behavior, we formulate the following hypothesis:

H6: Female gender positively predicts high school students' intention to eat sustainably and the adoption of vegetarianism.

Material and methods

Data collection and sample description

We surveyed 624 high school students (M_{age} = 16.63 years, *SD* = 1.15; range: 15-20 years; female: 48.2%; male: 49%; gender-diverse: 2.8%; vegetarians: 14.1%) in January and February 2020. We recruited students from three secondary schools in Lower Saxony and one school in Schleswig-Holstein in the Northwest of Germany. All schools were located in an urban environment. The participants completed a paper-and-pencil questionnaire during regular school hours in the presence of a teacher. The time to complete the questionnaire ranged between 15 and 30 minutes. The data were collected by the first and second author of this article, who briefly introduced themselves and the study project. Participation was voluntary, and data collection was anonymous. Approval for the study was obtained in December 2019 from the State Board of Education in Lower Saxony, Germany—Niedersächsische Landesschulbehörde (NLSchB), which is the body responsible for providing approvals for studies conducted in schools. The headmasters of the participating schools were informed beforehand about the study and provided written consent. We also provided the participants' parents or legal guardians with an information letter and obtained prior written informed consent.

Questionnaire and variables

The questionnaire was presented to the students in German. The original German-language scales were translated into English only for the purpose of this publication. Table 4.5 shows the descriptive statistics (number of items, mean, *SD,* Cronbach's alpha). All items and the results of the factor analyses are shown in the Appendix A3 (Table A.1). The original questionnaire can be obtained from the first author on request.

The questionnaire was divided into five blocks: (1) socio-demographic characteristics (age, gender) and dietary habits (vegetarian/vegan or omnivore), (2) intention to eat sustainably, (3) assessment of participants' human-nature relationship, (4) PCE, and (5) knowledge about sustainable nutrition. We finalized the questionnaire following a pilot test on a smaller sample and a subsequent focus group with seven 10th grade high school students. We describe the modifications to the questionnaire in the following paragraphs.

Socio-demographic characteristics and dietary habits

We asked participants to indicate their age and gender. Regarding gender, we included the option "*diverse*" for those who did not identify as male or female"0 = *male*" or "1 = *female*" gender. Due to the low number of participants identifying as gender-diverse, we excluded this third group from the analyses on gender differences. We used a simple "1 = *yes* ="/ "0 = *no*" response format to assess participants' dietary habits, asking them to indicate whether they followed a vegetarian or vegan diet. We summarized both vegetarianism and veganism under the variable vegetarianism.

Intention to eat sustainably

We extended the original 7-item version of the scale for assessing the intention to eat sustainably by Weber et al. (2020), which was developed based on the seven recommendations for sustainable nutrition by von Koerber et al. (2017), to a 14-item version. Although the original scale showed good reliability (α = .78), it is a new measuring instrument and has only been tested in student biology teachers. We aimed to improve the scale's reliability and limit the possibility of confirmation bias by presenting both positively and negatively connoted items. For each item, we added a reverse-coded item (e.g., "*Next month, I intend to consume preferably vegetable food*" and "*Next month, I intend to consume preferably animal source foods such as meat, eggs, and dairy products*"). We used a 5-point Likert scale ranging from "1 = *strongly disagree*" to "5 = *strongly agree*".

Perceived consumer effectiveness (PCE)

We based this scale on Antil's (1984) PCE scale, which consists of four items that capture consumers' subjective assessment of their ability to overcome environmental problems through their consumer behavior. The original PCE scale was translated into German using the back-translation method. We subsequently modified the scale to assess relevant consumer behavior by concretizing unspecific statements (e.g., "*When I buy products […]"*) to describe nutrition-specific behavior (e.g., "*When I buy food products […]"*). Moreover, we converted negative formulations (e.g., "*It is worthless […]"*) to positive ones (e.g., "*It is worthwhile […]";* see Appendix A3, Table A.1) to facilitate understanding. Participants were asked to indicate on a 5-point Likert scale ranging from "1 = *strongly disagree*" to "5 = *strongly agree*" to what extent they agreed with statements such as "*When I buy food products, I try to consider how they affect the environment*".

Human-nature relationship

Nature relatedness

To avoid overburdening participants and keep the questionnaire length manageable, we decided to measure nature relatedness with the abbreviated 6-item version of the nature relatedness scale (NR-6; Nisbet & Zelenski, 2013). We used the German version of the scale (Dornhoff et al., 2019). Participants were asked to indicate on a 5-point Likert scale ranging from "1 = *strongly disagree*" to "5 = *strongly agree*" to what extent they agreed with statements such as "*I feel very connected to all living things and the earth*". One of the original six items ("*My connection to nature and the environment is a part of my spirituality*") was removed because pilot testing indicated comprehension difficulties.

Dispositional empathy with animals

To measure dispositional empathy with animals, we modified the German version of the dispositional empathy with nature scale (DENS) developed by Temmen and Fiebelkorn (2020; original English-language scale by Tam, 2013). The DENS consists of ten items, of which six assess perspective-taking ability (the cognitive component), and four assess empathic concern (the affective component). Despite the subdivision into these two theoretical factors, principal axis factoring analyses of five studies conducted by Tam (2013) revealed and replicated a single factor structure for the English version. Temmen and Fiebelkorn (2020) confirmed the single factor structure in the German version of the scale. Due to the high level of abstraction and content repetitions, we shortened the scale to 5 items based on our pilot testing. The original scale includes double-barreled statements such as "*I can very easily put myself in the place of the suffering animals and plants*", which refers to both plants and animals and is therefore ambiguously formulated (Döring & Bortz, 2016). For this reason, and because we suspect, based on theoretical considerations, that dispositional empathy with animals is influential in adopting a sustainable diet, our version of the scale only refers to suffering animals. Participants were asked to indicate on a 5-point Likert scale ranging from "1 = *strongly disagree*" to "5 = *strongly agree*" to what extent they agreed with statements such as "*I can very easily put myself in the place of suffering animals*". Moreover, the original scale is preceded by a short introductory text, in which destruction of the environment by humans and the resulting consequences for animals and plants is described in detail. We chose not to include this introductory text, as our pilot test revealed it had undue influence on participants' response tendencies. All items of the modified scale are included in the Appendix A3 (Table A.1).

Environmental concern

We measured environmental concern with the three-dimensional construct developed by Schultz (2001). We used the German version of the scale developed by Dornhoff et al. (2019). In total, 12 items were used to assess whether participants' environmental concern is caused by egoistic (4 items), altruistic (4 items), or biospheric (4 items) motives. Participants rated each item on a 5-point Likert scale from "1 = *not important"* to "5 = *important".* Items covering the three environmental concern factors were formulated

similarly, e.g., "*I am concerned about environmental problems because of the consequences for my health"* (egoistic), "*[…] for all people*" (altruistic), and *"[…] for plants*" (biospheric).

Knowledge about sustainable nutrition

We developed a novel test to measure sustainable nutrition knowledge. The test included 23 items based on the seven recommendations for sustainable nutrition developed by von Koerber et al. (2017) and representing the three dimensions of Kaiser and Frick (2002): (1) system knowledge (9 items), (2) action-related knowledge (9 items), and (3) effectiveness knowledge (5 items). For example, the multiple-choice question "*A vegetarian diet can save 0.45 tons of CO_2 per year. In contrast, how much CO_2 does a vegan diet save? (1) About 0.5 tons, (2) About 2 tons, (3) About 10 tons",* referred to the first recommendation for sustainable nutrition, "preference for plant-based foods" (von Koerber et al., 2017), and is an example of effectiveness knowledge.

The knowledge test was presented over two consecutive question blocks in the questionnaire. The first block contained single-choice questions in which one of three response options was correct. The second block consisted of multiple-choice questions in which the respondents had to decide how many of the five response options were correct (pick any out of n; Jonkisz et al., 2012). In addition to the two question blocks, we included one ranking question in which participants had to order different foods according to their CO_2 emissions.

The questions were taken from existing knowledge tests and educational materials, modified and updated for this study. Source references for each question can be found in the Appendix A3 (Table A.2). As part of our pilot testing approach, we presented a larger pool of possible test items to seven 10th grade high school students and assessed the items for practical suitability. Items that the high school students considered too difficult or incomprehensible were reformulated or eliminated from the test. Item assignment to the various knowledge dimensions was checked by members of the working group of biology education of Osnabrück University. The results of this process are presented in the Appendix A3 (Table A.2).

Data analyses

First, we conducted principal component analyses to test the scales for their postulated dimensionality (see Appendix A3, Table A.1). We based extraction of the components on Kaiser's criterion, which recommends retaining components with eigenvalues > 1, and on inspection of the scree plots (Field, 2018). The subsequent reliability analyses showed acceptable reliability values for all scales (see Table 4.5).

We carried out a difficulty analysis of the knowledge test items to achieve an optimal measure with a suitable difficulty level. We calculated the difficulty index P_i for each item and in line with Kelava and Moosbrugger (2012), eliminated items that were too easy (P_i > 80) or too difficult (P_i < 20). The complete knowledge test with source references and difficulty indices for all items and a detailed explanation of the difficulty index calculation

can be found in the Appendix A3 (Table A.2). Seven of the 23 items were excluded from further analyses. Therefore, system knowledge was captured by eight items, action-related knowledge by five items, and effectiveness knowledge by three items. Due to the relatively low number of items for the action-related and effectiveness knowledge dimension, we decided against a separate consideration of the individual knowledge dimensions. Instead, we aggregated them into a general knowledge measure about sustainable nutrition. Consequently, we were unable to test H5.

Due to the higher average difficulty index of the multiple-choice questions (Table A.2) we weighted them with two points and the single-choice questions with only one point. In the multiple-choice questions, the participants could achieve one point if at least three of the five statements were correctly answered. In total, 26 points could be achieved in the knowledge test. The analyses are based on the percentage of points achieved in the knowledge test.

To test our hypotheses (see Figure 4.1), we conducted a multiple linear regression with intention to eat sustainably as the dependent variable (Table 4.6). We also conducted a multiple logistic regression with vegetarianism as the binary dependent variable (1 = vegetarianism, 0 = non-vegetarianism; Table 4.7). As a prerequisite for the regressions, we conducted a collinearity analysis. Based on inspection of the correlation matrix, the variance inflation factor (VIF), and the tolerances (Table 4.5), we ruled out multicollinearity.

Table 4.5 Spearman correlations (*n* = 508) and descriptive statistics of all variables.

Variable	1	2	3	4	5	6	7	8	9	10
1. Intention	1	.35***	.58***	.48***	.38***	.18**	.32***	.45***	.24***	-.02
2. Veg		1	.32***	.24***	.30***	.08	.13**	.28***	.15***	.04
3. PCE			1	.44***	.39***	.29***	.47***	.47***	.23***	.06
4. NR				1	.45***	.15***	.21***	.39***	.21***	-.01
5. DEA					1	.21***	.32***	.51***	.01	-.02
6. EC_EGO						1	.59***	.38***	.11*	-.01
7. EC_ALT							1	.59***	.04	.01
8. EC_BIO								1	.08	-.06
9. Knowledge									1	.01
10. Gender										1
Number of items	14	1	4	5	5	4	4	4	23 (16)	1
Mean	3.25	0.14	3.97	2.77	3.21	4.12	4.17	4.17	62.97	.50
SD	.56	.35	.75	.81	.99	.84	.80	.82	12.98	.50
Cronbach's α	.81	-	.80	.78	.87	.89	.84	.91	-	-
Tolerance	-	-	.54	.64	.61	.65	.46	.48	.90	-
VIF	-	-	1.84	1.55	1.63	1.53	2.19	2.09	1.11	-

*Note: Veg = vegetarianism, PCE = perceived consumer effectiveness, NR = nature relatedness, DEA = dispositional empathy with animals, EC_EGO = egoistic environmental concern, EC_ALT = altruistic environmental concern, EC_BIO = biospheric environmental concern. The reduced sample size for this analysis is a result of accumulated missing values due to the listwise exclusion of cases. * = p < .05, ** = p < .01, *** = p < .001.*

Results

To investigate the role of the human-nature relationship (nature relatedness, dispositional empathy with animals, and environmental concern), PCE, knowledge about sustainable nutrition, and gender in explaining the intention to eat sustainably, we conducted a multiple linear regression (Table 4.6). The full model explained 40% of the variance of the intention to eat sustainably. We identified PCE as the strongest positive predictor (β = .38, $p < .001$), followed by nature relatedness (β = .20, $p < .001$), biospheric environmental concern (β = .15, $p < .01$), and knowledge about sustainable nutrition (β = .11, $p < .01$). Dispositional empathy with animals, egoistic and altruistic environmental concern, and gender showed no effect.

Table 4.6 Results from the multiple linear regression predicting the intention to eat sustainably (n = 515).

Variables	B	SE B	β
PCE	.28	.03	.38***
NR	.14	.03	.20***
DEA	.03	.02	.06
EC_EGO	-.03	.03	-.05
EC_ALT	-.01	.03	-.02
EC_BIO	.10	.03	.15**
Knowledge	.01	.00	.11**
Gender	-.03	.04	-.03

*Note: Adj. R^2 = .40; p ≤ .001. PCE = perceived consumer effectiveness, NR = nature relatedness, DEA = dispositional empathy with animals, EC_EGO = egoistic environmental concern, EC_ALT = altruistic environmental concern, EC_BIO = biospheric environmental concern. The reduced sample size for this analysis is a result of accumulated missing values due to the listwise exclusion of cases. **= p < .01, ***= p < .001.*

To investigate the role of the same predictors in explaining vegetarianism, we conducted a multiple logistic regression (Table 4.7). The full model explained 31% of the variance. We identified PCE as the strongest positive predictor (B = .1.14, $p < .001$, odds ratio = 3.14). If the PCE increases by one point (on the 5-point Likert scale), the relative probability that a person will follow a vegetarian diet increases by 214% (3.14 - 1 = 2.14). The second strongest predictor was biospheric environmental concern (B = .82, $p < .05$, odds ratio = 2.27), followed by dispositional empathy with animals (B = .73, $p < .001$, odds ratio = 2.08) and knowledge about sustainable nutrition (B = .04, $p < .05$, odds ratio = 1.04). Nature relatedness, egoistic and altruistic environmental concern, and gender showed no effect.

Table 4.7 Results from the logistic regression predicting a vegetarian diet (n = 537; $n_{vegetarians}$ = 71; $n_{non\text{-}vegetarians}$ = 466).

			95% CI for Odds Ratio		
Variables	**B**	**SE B**	**Lower**	**Odds Ratio**	**Upper**
PCE	1.14***	.34	1.60	3.14	6.13
NR	.06	.21	.69	1.06	1.62
DEA	.73***	.20	1.42	2.08	3.05
EC_EGO	-.07	.23	.60	0.94	1.46
EC_ALT	-.52	.28	.35	0.60	1.02
EC_BIO	.82*	.32	1.20	2.27	4.38
Knowledge	.04*	.01	1.01	1.04	1.07
Gender	.21	.29	.69	1.23	2.17

*Note: Nagelkerke R^2 = .31. Model $\chi 2$ = 99.47, df = 8, $p \leq 0.001$. PCE = perceived consumer effectiveness, NR = nature relatedness, DEA = dispositional empathy with animals, EC_EGO = egoistic environmental concern, EC_ALT = altruistic environmental concern, EC_BIO = biospheric environmental concern. The reduced sample size for this analysis is the result of accumulated missing values due to the listwise exclusion of cases. * = $p < 0.05$, *** = $p < 0.001$*

Discussion

On average, the young people surveyed in this study reported a moderate intention to eat sustainably, which is in accordance with prior findings for student biology teachers (Weber et al., 2020). The proportion of vegetarians in our sample was 14.1%, which is three times higher than in the adult German population (4.3%; Mensink et al., 2016). This observation might indicate that present-day teenagers are more likely to follow a vegetarian diet than adults (Mensink et al., 2016).

Perceived consumer effectiveness (PCE)

Participants' reported PCE exceeded the center point of the scale on average, which indicates that young people are well aware of their effectiveness as consumers on the solution of environmental problems. We identified PCE as the most important explanatory variable for both the intention to eat sustainably and vegetarianism, thus confirming our H1. This result is in line with existing studies that demonstrate an effect of PCE on pro-environmental behavioral intentions, self-reported PEB (Coelho et al., 2017; de Boer et al., 2016; Joshi & Rahman, 2019; Kabadayı et al., 2015; Kim & Choi, 2005; Lee et al., 2014), and the willingness to consume less meat (de Boer et al., 2016). According to Kim and Choi (2005), to act sustainably, an individual should understand how their discrete choices, for example, their food choices, can contribute to solving environmental problems. Providing appropriate information and examples that illustrate the direct effect of food choices on the environment (Coelho et al., 2017; Kabadayı et al., 2015) can support this understanding. We explore the implications of these findings in the context of educational practice in the educational implications.

Human-nature relationship

Nature relatedness

Participants' reported nature relatedness was slightly below the center point of the scale on average, a finding consistent with the data for German young people from previous studies (Dornhoff et al., 2019). As was the case in studies with student biology teachers (Weber et al., 2020; Weber & Fiebelkorn, 2019), we found a positive effect of nature relatedness on the intention to eat sustainably. This finding is also consistent with studies that showed a positive correlation between nature relatedness and PEB (Capaldi et al., 2014; Mayer & Frantz, 2004; Otto & Pensini, 2017; Rosa et al., 2018; Whitburn et al., 2020). Schultz (2002) describes nature relatedness as the inclusion of nature in the cognitive representation of the self. Consequently, we might assume that nature-related young people tend to associate environmental destruction with themselves and thus are more inclined to engage in behavior that protects the environment, such as sustainable eating behavior. Although it was the second strongest factor determining the intention to eat sustainably (after PCE), nature relatedness was not a significant predictor for vegetarianism. Therefore, we can partially confirm our H2, that is, only for the intention to eat sustainably but not for vegetarianism. A possible reason why nature relatedness failed to explain vegetarianism could lie in the motivations that underpin the adoption of a vegetarian diet. The most frequently mentioned reason for vegetarianism is avoiding animal suffering (Humane League Labs, 2014; Janssen et al., 2016; Ruby, 2012). Environmental motivations come in third place after health motives (Janssen et al., 2016; Ruby, 2012). Although the well-being of nature is important to vegetarians and a connection between vegetarianism and nature relatedness could be shown in our study, it is plausible that nature relatedness is less relevant in explaining vegetarianism when other variables, such as dispositional empathy with animals, is taken into consideration.

Dispositional empathy with animals

Consistent with the results of many other studies (Kern & Fiebelkorn, 2020; Rothgerber & Mican, 2014; Zickfeld et al., 2018), dispositional empathy with animals was the second strongest predictor of vegetarianism. However, it was not a significant predictor for the general intention to eat sustainably. Therefore, we can partially confirm our H3, that is, only for vegetarianism but not for the intention to eat sustainably. Although von Koerber et al.'s (2017) first recommendation for a sustainable diet (preference for plant-based foods) is similar to vegetarianism, most of their recommendations highlight sustainable behavior that aims to protect the environment, rather than behavior motivated by animal ethics. Therefore, it is conceivable that dispositional empathy with animals has limited explanatory power for the intention to eat sustainably, especially when considering more relevant variables such as nature relatedness.

Environmental concern

Remarkably, all three dimensions of environmental concern exceeded the scale center on average, which leads us to conclude that young people in Germany are very concerned about environmental problems, whether due to the consequences for the biosphere, other people, or themselves. A study comparing the environmental concerns of Ecuadorian and German high school students obtained similar results (Dornhoff et al., 2019, see Appendix A3 for Supplementary Table 2). However, German young people's egoistic concern, in particular, increased between two survey time points. We suspect that the Fridays for Future movement, which started after Dornhoff et al.'s (2019) data was collected, has contributed to a rising trend among young people to relate the consequences of environmental problems to themselves.

Moreover, our results showed that only environmental concern based on biospheric reasons had a positive effect on the intention to eat sustainably and on vegetarianism. While this data falsifies our H4, the results are in line with previous studies demonstrating that biospheric environmental concern correlates positively with PEB (Schultz et al., 2004, 2005) or predicts it (Schultz, 2001) across different cultural settings (Milfont et al., 2006). Our results contradict those of Weber et al. (2020), whose study results informed our H4. Weber et al. (2020) identified altruistic environmental concern as the only dimension predicting the intention to eat sustainably in a sample of student biology teachers. The authors explained their findings by referring to participants' "intention to eat sustainably for reasons based on the social dimension of sustainable nutrition" (Weber et al., 2020, p. 12). As an example of social injustices in the food system, Weber et al. (2020) highlight the unsustainable eating habits of Western cultures, which are partly responsible for the food insecurity of more than 820 million people around the world suffering hunger. We note that the crucial difference between ours and Weber et al.'s (2020) study is the sample. Weber et al. (2020) surveyed student biology teachers while we focused on high school students. Another survey of high school students found that students' conceptions about sustainable nutrition were primarily dominated by the health and ecological dimension, while the social dimension was hardly present (Dornhoff et al., 2020). Consequently, we speculate that student biology teachers might be more aware of the connection between social aspects and sustainable nutrition than high school students are.

Considering the results of Weber et al. (2020) and Dornhoff et al. (2020), we conclude that for young people with a less holistic conception of sustainable nutrition, biospheric environmental concern is a crucial predictor of the intention to eat sustainably and to adopt vegetarianism. For people with a more elaborate conception of sustainable nutrition, such as student biology teachers, altruistic environmental concern might gain importance in predicting the intention to eat sustainably.

Knowledge

For methodological reasons (see Material and methods), we decided against the division of knowledge about sustainable nutrition into the three knowledge dimensions (system, action-related, and effectiveness knowledge), which is why we could not test our H5. Nevertheless, we were able to demonstrate a positive effect of general knowledge about sustainable nutrition on the intention to eat sustainably and on vegetarianism, although it only weakly explained both dependent variables. These results are consistent with previous studies that consider knowledge to be a necessary but not sufficient prerequisite for the development of PEB (Casaló et al., 2019; Díaz-Siefer et al., 2015; Frick et al., 2004; Otto & Pensini, 2017).

The relatively small effect of knowledge on the two dependent variables in our study is consistent with other studies that identified similarly small contributions of knowledge to PEB (Frick et al., 2004; Otto & Pensini, 2017). However, its overall influence should not be underestimated, as knowledge also could have indirect effects on PEB (Kaiser & Fuhrer, 2003). Other studies have shown that attitudes mediate the effect of knowledge on green purchasing behavior (Uddin & Khan, 2018; Van Loo et al., 2013) and PEB (Liu et al., 2020). A promising avenue for future research would be to investigate the indirect influence of knowledge mediated by other variables such as attitudes.

Gender

We were unable to substantiate any effect of gender on the intention to eat sustainably or on vegetarianism, thus falsifying our H6. The result contradicts previous findings that women have a more positive attitude toward organic products, have a stronger purchasing intention, and are more likely to actually buy organic products than men (Irianto, 2015; Rimal et al., 2005; Sangkumchaliang & Huang, 2012). On the other hand, our results complement those of Tsakiridou, Boutsouki, Zotos, and Mattas (2008), who found no gender differences in the attitude and intention to consume organic food.

Nevertheless, it is surprising that we found no effect of gender on vegetarianism since existing empirical data demonstrate that women consume less meat than men and are more likely to follow a vegetarian diet (Modlinska et al., 2020). Moreover, in their systematic review of gender differences in attitudes to vegans and vegetarians, Modlinska et al. (2020) showed that adolescent girls receive more encouragement from their families to follow a vegetarian diet than boys. However, the studies cited by Modlinska et al. (2020) are at least a decade old (Caine-Bish and Scheule, 2009; Diehl, 1999; Reynolds et al., 1999). Our results suggest the possibility that contemporary vegetarianism no longer represents gender-specific behavior among urban adolescents.

Educational implications

Fostering perceived consumer effectiveness (PCE)

To foster PCE among students, they must be given the opportunity to experience effectiveness in the context of their daily dietary behavior. They should recognize that their efforts contribute to protecting the environment and managing global problems (Coelho et

al., 2017; Kabadayı et al., 2015). In the context of ESD-G, some existing learning approaches and methods are already suitable for fostering PCE (Rieckmann, 2017; United Nations Environment Programme, 2010). Rieckmann (2017) suggests calculating and reflecting on one's ecological footprint and evaluating different products with life cycle analyses. This approach allows the direct effects of specific behaviors to become concrete and comprehensible. This method seems justifiable as both adults (Macdiarmid et al., 2016) and high school students (Dornhoff et al., 2020) may not be aware of the environmental impact of their dietary behavior. Practical teaching magazines already offer didactic concepts for the educational practice, evaluating different foods according to their ecological footprint and other sustainability criteria (Fiebelkorn & Kuckuck, 2020). For example, data-based decision making can be used to compare the sustainability of different meat types (Fiebelkorn et al., 2020; Fiebelkorn & Kuckuck, 2019).

Fostering nature relatedness, biospheric environmental concern

Young people who spend a lot of time in nature are more nature-related and have greater biospheric environmental concern than those who spend less time in nature (Dornhoff et al., 2019). To foster nature relatedness and biospheric environmental concern, we recommend facilitating direct contact with nature, e.g., with extracurricular excursions or nature-based environmental education. Barrable and Booth (2020) have derived design recommendations based on a review of 14 studies that evaluated different nature relatedness interventions in a natural environment. The authors point out that longer interventions seem to have a greater impact on nature relatedness than shorter ones and highlight the importance of fostering nature relatedness through positive emotions. Moreover, interventions with younger children (before age 11) are more likely to have a long-term effect than with older children (Barrable & Booth, 2020; Liefländer et al., 2013). Otto and Pensini (2017) demonstrated that nature-based environmental education is well suited to combine knowledge transformation, which we also identified as a contributing factor in this study, with strengthening nature relatedness. However, time spent in nature does not merely predict nature relatedness but also biospheric environmental concern (Dornhoff et al., 2019). Therefore, we postulate that nature-based environmental education would have positively influence biospheric environmental concern in young people. However, there is still a need for further research on the effects of nature-based environmental education on biospheric environmental concern.

To link biospheric environmental concern with nutrition-related behavior, it is important to raise students' awareness of the effect of their dietary choices on the environment. Considering recent findings that some students are not aware of the environmental impact of dietary patterns (Dornhoff et al., 2020), this implication seems urgent. It is equally essential to illustrate the positive effects of implementing a sustainable diet from an ecological perspective, to prevent young people from conceding defeat. The recommendations of von Koerber et al. (2017) for a sustainable diet are exceedingly well-suited for this purpose. Initial concepts for educational realization, which adopt the idea of

sustainable nutrition and suggest concrete action points, are already available (Fiebelkorn & Kuckuck, 2020).

Fostering dispositional empathy with animals

One well-researched method to foster empathy is to adopt an animal's perspective through imagination (Berenguer, 2007; Schultz, 2000; Sevillano et al., 2007), which can be achieved through storytelling and role-playing (Young et al., 2018). Moreover, educational programs for ESD-G should aim to convey a realistic picture of meat production by creating the association between meat and its animal origins. Meat marketing uses product processing and communication strategies to systematically dismantle this association and diminish empathy (Kunst & Hohle, 2016). Therefore, using language that describes animals, especially farm animals, as subjects with individual personalities, authentic feelings, and biographies rather than food products, could re-establish this connection and foster dispositional empathy with animals. The selection of appropriate textbooks and the teacher's conscious use of language are both crucial as existing socialization processes tend to objectify farm animals and subjectify pets (Stewart and Cole, 2009).

Limitations of the Study

Although our study revealed influential factors explaining German young peoples' sustainable dietary behavioral intention and vegetarianism, the proportion of explained variance (40% for the intention to eat sustainably and 31% for vegetarianism) indicates that other relevant factors were omitted from our model. Future research should integrate the predictors we identified into established behavioral models, such as the theory of planned behavior (Ajzen, 1991). This would also allow the consideration of possible mediation effects. As Weber et al. (2020) have demonstrated in a sample of student biology teachers that attitudes, subjective norms, and perceived behavioral control mediate the effect of nature relatedness and environmental concern on the intention to eat sustainably, the possibility of mediation effects requires further investigation in other samples.

Furthermore, behavioral intention does not necessarily translate into actual behavior (intention-behavior gap; Sheeran & Webb, 2016), as various barriers can prevent the realization of behavior. However, since most of the independent variables (except for nature relatedness) also significantly predicted vegetarianism, which represents a dietary behavior, it can be assumed that the identified predictors indeed influence the adoption of a sustainable diet. However, we recommend that future studies conduct a more holistic assessment of sustainable dietary behavior, as vegetarianism only covers one aspect of sustainable nutrition and adopting a meat-free diet may be easier to realize than other elements of a holistic, sustainable diet since, for example, products with eco or fair trade labels involve greater financial expenditure.

Another limitation is that our sample was not representative of the general population of high school students in Germany. We only surveyed students in the tenth, eleventh and twelfth grades in the northwest of Germany. Nevertheless, our study has relevant implications since the surveyed age group represents a key future consumer group and can

contribute substantially to the sustainable transformation of our food system. In addition, this age group is still integrated into the school system and receptive to educational interventions that foster sustainable eating behavior.

The vegetarian subsample consisted of only 86 participants (39 male, 45 female, 2 gender-diverse), limiting our ability to draw firm conclusions about vegetarianism as an outcome variable. Based on the literature on the role of gender in vegetarianism, we cannot exclude the possibility of a gender effect if a larger group of vegetarians had been surveyed. Future studies that intend to investigate vegetarianism should include a larger group of vegetarian participants to refute or replicate our results.

Finally, the knowledge test requires improvements to enable separate assessment of the three knowledge dimensions. We recommend expanding the item pool with action-related and effectiveness knowledge items since these knowledge dimensions were captured by a relatively small number of items in our finalized knowledge test. Furthermore, single-choice questions with one correct out of three possible answers have a relatively high guess probability. To mitigate this problem, we added an "*I don't know*" response option.

Conclusion

Sustainable dietary behavior can contribute to transforming the food system and overcoming global problems such as climate change and biodiversity loss. Didactic approaches aim to foster sustainable dietary behavior directly (Bryant & Dillard, 2020; Fiebelkorn & Kuckuck, 2020; United Nations Environment Programme, 2010). Our study has demonstrated another feasible strategy that involves fostering psychological factors that, at first glance, may not appear to be connected to sustainable nutrition.

Our study offers the first empirical evidence that young people's intention to eat sustainably is predicted by PCE, nature relatedness, biospheric environmental concern, and knowledge about sustainable nutrition. PCE, dispositional empathy with animals, biospheric environmental concern, and knowledge about sustainable nutrition could be identified as positive predictors for vegetarianism. Since knowledge had weak explanatory power, we recommend that the design of educational interventions focus on strengthening PCE and the human-nature relationship primarily. The variables that explained the intention to eat sustainably and vegetarianism have previously been linked to other environmentally friendly and sustainable behaviors. Fostering the identified factors holds promise for enhancing sustainable and pro-environmental behaviors beyond the field of nutrition.

4.3 Students' conceptions of sustainable nutrition[6]

Abstract

In Education for Sustainable Development, the topic of sustainable nutrition offers an excellent learning topic as it combines the five dimensions of health, environment, economy, society, and culture, unlike most topics with a regional-global scope. The identification of existing students' conceptions of this topic is important for the development of effective teaching and learning arrangements. This study aimed to understand students' conceptions of sustainable nutrition and the relevance that students attribute to the five dimensions. For this purpose, we conducted semi-structured individual interviews with 10th-grade students at secondary schools in Germany (n = 46; female = 47.8%; M_{Age} = 15.59, SD = 0.78). We found that the health dimension prevailed in students' conceptions of sustainable nutrition; however, the more dimensions the students considered, the less importance was attached to the health dimension. The ecological dimension, in turn, became more prominent as the students' conceptions became more elaborate. Many students neglected the social, economic, and especially the cultural dimensions. Furthermore, alternative conceptions of the terminology of sustainable nutrition, which did not correspond to the scientific concept, were identified. Students had difficulties linking the ecological, social, economic, and cultural dimensions to sustainable nutrition due to a predominant egocentric perspective on nutrition, which primarily entails focusing on one's own body.

Keywords: sustainable diet; pupils; preconceptions; understanding; qualitative interview study; Education for Sustainable Development

[6]Dornhoff, M., Hörnschemeyer, A., & Fiebelkorn, F. (2020). Students' conceptions of sustainable nutrition. *Sustainability*, *12*(13), 5242. https://doi.org/10.3390/su12135242

Introduction

The current global food system is the largest greenhouse gas emitting sector in the world (IPCC, 2019). Furthermore, it is mainly responsible for biodiversity loss and the degradation of ecosystems (Campbell et al., 2017; IPBES, 2019) and is considered the largest sector-specific source of water pollution (Barbara Burlingame et al., 2012). While 820 million people are currently suffering from hunger (FAO et al., 2019), the number of overweight people has almost tripled to over 1.9 billion since 1975 (WHO, 2020b). Similarly, the rising prevalence of diet-related diseases in industrialized countries is an expression of the inherent shortcomings of the current food and agricultural sector (Clark et al., 2018). Without a transformation toward healthy diets from sustainable food systems, the international community will be unable to meet the Sustainable Development Goals (SDGs) set by the United Nations General Assembly (2015) and the Paris Climate Agreement (Rockström et al., 2020; Willett et al., 2019).

Changes in individual nutritional behavior are an essential prerequisite for such a transformation; therefore, education that empowers learners in the context of nutrition "to take informed decisions and responsible actions for environmental integrity, economic viability, and a just society for present and future generations" is needed (Rieckmann, 2017, p. 7). In view of its importance for achieving the SDGs, our own diet and the processes related to our food system are perfectly suited to ESD. As future consumers and decision makers, students can actively contribute to the sustainable development of the nutrition system, e.g., by shaping their individual nutritional habits in a sustainable way and exerting a positive influence on their personal and social environment. In this context, schools fulfill an important educational task, as appropriate education "empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability, and a just society, for present and future generations, while respecting cultural diversity" (UNESCO, 2014, p. 12).

Following a constructivist perspective, we understand students to be actively structuring their knowledge(Piaget, 1974, 1983). Based on their individual experiences, students already hold conceptions of teaching content before they are confronted with it in the classroom. We use the term "conceptions" to summarize cognitive constructs of different levels of complexity, such as associations, cognitions, and subjective theories (Kattmann et al., 1997). Students construct new knowledge structures based on pre-existing conceptions (Posner et al., 1982). They use already existing conceptions in order to explain new problems or phenomena (assimilation) and extend or adapt their conceptions when these are not adequate to explain new problems (accommodation; Piaget, 1983a; Posner et al., 1982). We base our research on this learning theory, because behaviorism only examines what is observable (interaction between environmental influences and behavior) and does not take into account the inner processes of information processing. Cognitivism, in turn, takes this inner process into account but fails to consider individual differences in the learning process and assumes that knowledge is passed on from one person to another and then exists as a representation of the environment in the individual (Reinmann & Mandl, 2006; Tobinski &

Fritz, 2014). This is contrasted with a constructivist view according to which learning represents an active, self-defined, and individual construction process that takes place in context-bound social situations and cannot be controlled from the outside but can be stimulated by a supportive learning environment with suitable learning options(Piaget, 1983; Riemeier, 2007). It forms the basis for research on students' conceptions in didactics of natural sciences.

A better understanding of students' conceptions helps teachers systematically address them in science teaching (Duit & Treagust, 2003; Kattmann, 2015); thus, the identification of students' existing conceptions is essential for the development of appropriate and effective teaching and learning arrangements on sustainable nutrition, and its consideration is critical for the students' learning success (Duit & Treagust, 2003; Kattmann, 2015). In our study, we were especially interested in students' naïve and alternative conceptions of sustainable nutrition. "Naïve conceptions" represent students' conceptions of sustainable nutrition before they receive information on this topic from us. "Alternative conceptions" represent students' conceptions that do not correspond to the scientific definition of a sustainable diet according to von Koerber et al. (2017; see also, Results, research question two (RQ2): What alternative conceptions do students hold about sustainable nutrition?).

To the best of the authors' knowledge, only a few studies on students' conceptions of sustainable nutrition have been published. Most of these studies relate to their general conceptions of nutrition or agriculture, but none were clearly based on a definition of sustainable nutrition; therefore, the primary aim of this study is to explore students' conceptions of sustainable nutrition in order to compare them with scientific conceptions and derive implications for teaching practice.

Definition of sustainable nutrition

There are various definitions of sustainable nutrition (Barbara Burlingame et al., 2012; Gussow, 1999; Gussow & Clancy, 1986; von Koerber et al., 2017; Willett et al., 2019). Internationally, reference is often made to the definition published by the Food and Agriculture Organization of the United Nations (FAO) (Burlingame et al., 2012, p. 294), which defines sustainable diets as follows:

> "Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources."

Our study is based on the concept of sustainable nutrition posited by von Koerber et al. (2017), which is particularly prevalent in German-speaking countries and therefore suitable for use in German schools. This representation takes into account the five dimensions: (1) health, (2) environment, (3) economy, (4) society, and (5) culture. In addition, it contains seven recommendations for action in everyday life, which includes how people can feed themselves as sustainably as possible by incorporating (1) plant-based foods, (2) organic

foods, (3) regional and seasonal products, (4) minimally processed foods, (5) Fair Trade products, (6) resource-saving housekeeping, and (7) an enjoyable eating culture.

There are many similarities between the two definitions of sustainable diets posited by the FAO (Barbara Burlingame et al., 2012) and von Koerber et al. (2017), especially with regard to the different dimensions of sustainable nutrition. The concept of sustainable nutrition by von Koerber et al. (2017) was used as a basis for data collection and evaluation in this study. The advantage of this definition lies in its clearer structure resulting from unambiguously defined dimensions and the concrete recommendations for implementing sustainable nutrition in everyday life. Conversely, the definition described by the FAO (Barbara Burlingame et al., 2012) is less accessible to students due to its complex structure. In addition, it does not give clear instructions on how to sustainably feed oneself in everyday life. Because a detailed description of sustainable nutrition according to von Koerber et al. is beyond the scope of this article, we recommend using the original literature to review the concept (von Koerber et al., 2012, 2017).

Sustainable nutrition as a teaching topic in education for sustainable development

Through the 2030 Agenda, the United Nations formulated 17 SDGs for shaping a sustainable future, which will guide political action until 2030. In the field of education, the SDGs aim to "ensure that all learners acquire the knowledge and skills needed to promote sustainable development" (Target 4.7 of SDG 4 – 'Quality Education'; (United Nations General Assembly, 2015). The transition to sustainable nutrition is considered key for achieving many SDGs (e.g., SDG 2 'Zero Hunger' or SDG 12 'Responsible consumption and production'). Due to its high relevance for achieving the SDGs, sustainable nutrition is perfectly suited for an ESD, and because this topic combines ecological, economic, social, and health aspects to a greater degree than most other topics with a regional-global scope, it was declared by the German Commission for UNESCO as the 2012 topic of the year of the UN Decade of Education for Sustainable Development (DUK, 2012).

In Germany, each of the 16 federal states has its own school curricula, but they are very similar. We only refer to the school curricula of the three school types (Hauptschule, Realschule, and Gymnasium; see *Data Collection and Sampling*) in Lower Saxony, where the study was conducted. German school curricula are competence-oriented, which is why there are few recommendations for concrete teaching topics, and teachers have a high level of freedom to choose adequate content. ESD is an integral part of school curricula and can be taught through varying content, which can be chosen at the teachers' discretion. Nevertheless, there are a few recommendations in the sifted school curricula for teaching nutritional topics and ESD.

Despite the topic of nutrition being perfectly suited for ESD, in Germany, school curricula for natural sciences only recommend it in combination with health aspects in the context of one's diet (Lower Saxony Ministry of Education, 2015a), or it is missing completely (Lower Saxony Ministry of Education, 2015b, 2015c). Conversely, ESD is associated with issues of environmental conservation or sustainable energy (Lower Saxony Ministry of Education,

2015a, 2015b, 2015c). A similar trend can be observed in the most commonly used biology textbooks (Adamitzki et al., 2020; Baack & Steinert, 2015; Bergau et al., 2015, 2018; Beyer et al., 2016). Both textbooks and school curricula indicate that, despite its potential, as indicated by Burlingame et al. (2012) and von Koerber et al. (2017), the topic of nutrition is not yet perceived as a suitable topic for ESD in the German teaching practice.

Students' conceptions of (sustainable) nutrition and agriculture – current state of research

In recent studies, both high school students (Gralher, 2015) and adult consumers (Macdiarmid et al., 2016) perceived nutrition mainly from a self-centered perspective and hardly noticed the environmental impact of their own nutrition. Consequently, they either did not recognize the influence of their own dietary behavior on the global food system or considered it to be very small (Gralher, 2015; Macdiarmid et al., 2016). Hamann (2004), who examined primary school children's conceptions of agriculture in Germany, concluded that they had only diffuse and superficial ideas about the environmental impact of agriculture and took little account of ecological and economic aspects. A meta-study of 190 studies derived similar results, concluding that young people (aged 3–19 years) have very limited knowledge and understanding of agriculture and food production (Dillon et al., 2005).

Regarding nutritional-physiological aspects, de Freitas Zompero et al. (2019) found that Brazilian elementary and high school students lack coherent conceptions of nutrients and are unable to distinguish nutrients from food; however, a study on Australian high school students revealed they understand the importance of different macronutrients in the body but are unable to distinguish their functions (Mann & Treagust, 2010). Furthermore, Rasnake et al. (2005) identified a tendency for young people to be dose insensitive (e.g., something harmful in large amounts should be avoided in small amounts) and categorical thinkers (e.g., foods are either good or bad). With respect to the relationship between body and nutrition, it has been shown that many young people are dissatisfied with their body, in the sense that they think they are overweight (Currie et al., 2012), and that female adolescents in particular adopt eating behaviors in which they forego certain foods or entire meals as a means of achieving their desired figure (Aragon et al., 2017; Bartsch, 2008; Fredrickson et al., 2015).

Concerning nutrition as a sustainability issue, Gralher (2015) showed that high school students primarily focused on health aspects of nutrition and mostly ignored ecological, social, and economic aspects. The focus on health is also evident in the German population, where 89% of people believe that eating should be healthy (BMEL, 2017), which some surveys found to be more important than taste (Techniker Krankenkasse, 2017). In contrast, university students were found to have an ecological perception of sustainable nutrition (Bartsch, 2015; Hertrampf & Bender, 2016). The latter finding was also noted in numerous studies of other sustainability contexts in which the participants took account of ecological aspects but paid little attention to economic and social aspects (Berglund & Gericke, 2016; Fiebelkorn & Menzel, 2013; Lockley & Jarrath, 2013; Menzel & Bögeholz, 2006; T. Richter & Schumacher, 2011). Moreover, in general, high school students seem to have difficulties in

taking into account more than two dimensions in sustainability contexts (Gausmann et al., 2010).

Aim of the study and research questions

Based on the current state of research, the present study aimed to explore students' conceptions of sustainable nutrition. We were particularly interested in the extent to which their conceptions are consistent with the scientific conception of a sustainable diet according to von Koerber et al. (2017). In more detail, the following research questions were addressed:

RQ1: What relevance do the students attribute to the five dimensions of sustainable nutrition?
RQ2: What alternative conceptions do students hold about sustainable nutrition?

Materials and methods

Data collection and sampling

To answer our research questions, we conducted semi-structured individual interviews with 46 10th-grade students from August 2017 to March 2018. The school system in Germany covers primary (grades 1–4) and secondary (grades 5–13) education. The lower secondary education (grades 5–10) follows a tripartite structure in which three different school types are included. The *Hauptschule* offers students a "basic general education," the *Realschule* offers a "more extensive general education," and the *Gymnasium* offers an "intensified general education" (Eckhard & BMBF, 2019, pp. 121-122). The Hauptschule is completed after nine school years and can be extended by one year to achieve a better degree. The Realschule is completed after ten years, and the Gymnasium, after 13 years. In order to capture the diverse ideas of students from all three school types, we considered all three in our sample selection ($n_{Gymnasium}$ = 16, *female* = 8, M_{age} = 15.1, *SD* = .44; $n_{Realschule}$ = 15, *female* = 7, M_{age} = 15.6, *SD* = 0.63; $n_{Hauptschule}$ = 15, *female* = 6, M_{age} = 16.1, *SD* = 0.83; for detailed information on the respective subsamples and on individual participants, see Appendix A3 for Supplementary Material, Table S1). We decided to choose the 10th-grade because we assumed, based on a screening of the respective curricula, that students of all school types should already have received at least some ESD-relevant content in science education (Lower Saxony Ministry of Education, 2015b, 2015a, 2015c). Since we conducted a qualitative study with a relatively small sample, it was at no time our intention to compare the students from the three school types.

For each school type, our sample comprised students from three or four different schools in northwest Germany in and around the city of Osnabrück. The acquisition of participants at the respective schools was conducted with the help of a supervising teacher, who was informed in advance by the first author regarding the contents and process of the study. The teacher gave a short introduction to the study and, if possible, selected two male and two female students from the volunteers. Apart from the gender ratio, they had no selection criteria. Accordingly, they selected the students who were the first to volunteer for

participation. Since our goal was to explore naïve conceptions, the students were only informed that the study was about their conceptions of nutrition and not explicitly about sustainable nutrition. Due to deviations from the interview guide used during two of the interviews, the authors decided to exclude those two from the sample. Since the students who volunteered first were selected, it can be assumed that some of the participants had a particularly high interest in the topic of nutrition. This assumption is supported by the fact that six participants stated that they follow a vegetarian diet (13%; see Appendix A3 for Supplementary Material, Table S1), which is considerably higher than the proportion in the German population (4.3%; 18–79 years; Mensink, Barbosa, & Brettschneider, 2016).

Anonymity was guaranteed and participation was voluntary. Approval for the study was obtained in August 2017 from the responsible State Board of Education in Lower Saxony, Germany —Niedersächsische Landesschulbehörde (NLSchB), which is the body responsible for providing approvals for studies conducted in schools. The headmasters of the participating schools were informed beforehand about the study and provided written consent. In addition, the parents of the students were informed about the study by an information letter in which the voluntary participation and anonymity of the participants were explained. The possibility to contact us was given by the attached contact data. Both the parents and students gave their informed written consent for participation in the study. During the interviews, all participants could decline to participate and withdraw from the study at any time.

The interview procedure

Within the respective schools, individual interviews were conducted in a quiet room by one of three interviewers who were familiar with the subject matter and had received prior instructions in the interview procedure and interview management. All interviewers conducted two or three test interviews with students in the age group to become familiar with the interview procedure and content of the interview guide. The test interviews were not included in the final sample.

The interviews were conducted in German, and the statements were translated into English for the purpose of this paper. The duration of the interviews was between 40 and 113 min (M = 64.11 min; SD = 15.36 min). The large differences in interview duration were caused by the varying response behaviors of the students. Some students needed more time to formulate their thoughts, while others presented their thoughts in detail. The length of the interview does not have any bearing on the quality of the statements made.

Interviews were conducted with the help of a semi-structured interview guide that had previously been tested and adapted through pre-tests (the complete interview guide can be obtained from the first author upon request). The interview guide served as an orientation for the interviewers and was used to develop discussions while allowing participants to express their thoughts in a flexible way. Due to the limited space in this paper, we present the phases of the interview in a shortened form, considering all steps of the interview relevant to the research questions (see Table 4.8).

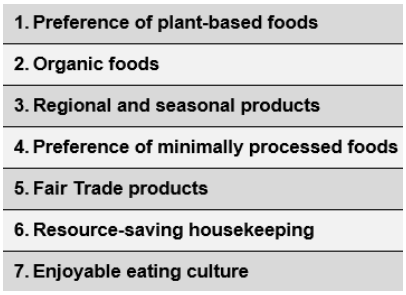
The interview guide was divided into four thematic phases: naïve conceptions of sustainable nutrition (Phase 1), the conceptions of the dimensions of (Phase 2) and recommendations for (Phase 3) sustainable nutrition, and the assumed connections between the dimensions and recommendations (Phase 4; see Table 4.8). For research question one (RQ1), only Phase 1 was considered. For research question two (RQ2), all interview phases were considered. The various interventions in the different phases aimed to create opportunities for talking and revealing alternative conceptions of sustainable nutrition. The statements that revealed alternative conceptions were determined in the course of the phases presented.

In the free association task used in Phase 1, we asked participants to note ten terms that they associated with a sustainable diet. They then explained why they wrote down these terms. Our analysis was based on the students' explanations regarding the terms and not on the terms themselves. The banana with the brand logo used in Phase 2 (see Table 4.8) represents the most famous brand for bananas in Germany. By the brand logo, we emphasized that it is neither a Fair Trade nor an organic product, whereby we wanted to encourage the students to talk about the different dimensions of sustainable nutrition.

Table 4.8 Excerpt from the interview guide with the questions that were used in the analysis. The original interviews were conducted in German.

Content and questions	Materials used in the interview
Phase 1 – Naïve conceptions of sustainable nutrition	
Students were given a list with the heading 'ten terms on sustainable nutrition' for entering ten terms (see right column). 1. What do you associate with sustainable nutrition? Please write down ten words on this sheet of paper that are coming to your mind. After the task, the students explained to the interviewer what they meant by each term, which was noted on the list. 2. Please try to describe in your own words what you understand by sustainable nutrition 3. Imagine giving a friend recommendations on how to eat more sustainably. Do you have any ideas what you could tell him/her?	**10 terms on sustainable nutrition** 1. Organic 2. Vegan 3. Genetic manipulation 4. Farm 5. Factory farming 6. Self-sufficiency 7. Vegetable garden 8. Home-baked 9. Whole grain spelt 10. Grain field (Data taken from GM9 – Felix)
Phase 2 – Dimensions of sustainable nutrition	
The students were given a schematic illustration of sustainable nutrition (see right column). 1. Can you explain to me what you understand by these five terms? In case they had any comprehension problems, the students were given a short explanation of the dimensions. 2. How would you relate these dimensions to sustainable nutrition? 3. Would you like to change something in the figure? The students were presented a banana with a clearly visible trademark sticker of a multinational company (Chiquita Brands International; see right column). 4. Do you have any ideas on how to relate this banana with the different dimensions of sustainable nutrition?	 Schematic illustration to illustrate the five dimensions of sustainable nutrition (modified from von Koerber et al. (2017).  Banana used to relate the dimensions of sustainable nutrition to a concrete food item.

Table 4.8 continued

Phase 3 – Recommendations for sustainable nutrition	
Students were presented with a list of the seven recommendations for implementing sustainable nutrition in everyday life (see right column). 1. Please explain what you think is meant by these recommendations. If the students misunderstood some recommendations, we gave them a short explanation.	 Seven recommendations for sustainable nutrition (modified from von Koerber et al. (2017).
Phase 4 – Relationships between the dimensions and recommendations	
1. Could you try to link the recommendations with the terms in this figure? (see the excerpt of the table in the right column) The table listed the five dimensions in the top row and the seven recommendations in the left column.	 Excerpt of the table used in the interview to support the students connecting the recommendations with the dimensions of sustainable nutrition.

Data processing and analysis

The interviews were digitally recorded with an Olympus WS-550M Voice Recorder and transcribed according to the transcription rules set by Dresing and Pehl (2015). We analyzed the interviews using the Qualitative Data Analysis (QDA) software MAXQDA 2018 (VERBI, 2018) based on the ideas of qualitative content analysis (Mayring, 2014). In order to answer the two research questions, we modified and adapted the analysis process. To answer RQ1, we classified the students' statements into five deductive categories; "health," "ecological," "economic," "social," and "cultural," according to the five dimensions of sustainable nutrition (von Koerber et al., 2017; Figure 4.2). As these were deductive categories, they were defined before the interview material was analyzed. The definitions were documented in a coding guideline, which described in detail what kind of statements should be assigned to the respective categories. For better comprehensibility, anchor examples from the interview material were added at the beginning of the coding process for the respective categories. Based on the number of statements assigned to the different dimensions, we were able to determine how many students considered how many and which dimensions and to what extent in Phase 1 of the interview.

To capture the alternative conceptions in the context of RQ2, we retained the structure of our initial code system and extended it by inductive subcategories based on the participants' statements. Furthermore, we added one inductive category including subcategories (terminology of sustainable nutrition; Figure 4.2). Because the category system was

inductive, we developed the coding guide during the analysis and continuously adapted it to newly coded statements. The final coding guide corresponds to Table 4.9 in the results for RQ2. In contrast to RQ1, in this research question, we considered the entire interview and only coded statements that did not correspond to the essential foundations of the scientific definition of a sustainable diet according to von Koerber et al. (2017).

Some of the students' statements were coded into several categories if they applied to more than one category. This was the case for both research questions. For the coding procedure, two raters were used who were familiar with the topic. Each rated half of the interviews using the same coding guide and met several times to discuss the coding. To validate our analysis of RQ1, we conducted an inter-rater reliability test and used Brennan and Prediger's Kappa in MAXQDA to assess the level of agreement between the two raters (Brennan & Prediger, 1981; Kuckartz & Rädiker, 2019). Taking into account the expected number of coded segments in the interviews, the diversity of cases, and our available resources (people available who were willing and able to do a second round of coding), we chose to randomly select 15% of all statements for the calculation of Brennan and Prediger's Kappa (Kuckartz & Rädiker, 2019). The two raters each coded 15% of the interviews they had not coded before. The resulting Brennan and Prediger's Kappa revealed an "almost perfect" (Landis & Koch, 1977, p. 165) agreement ($\kappa = 0.89$). Because the frequency distributions of the statements were not relevant for RQ2, and the categories were mainly inductive, the validity of our analysis on this research question was ensured by consensual validation. For this purpose, a consensus on the interpretations was reached among the researchers involved in the project as well as by argumentative validation with one layperson who was not involved in the project (Bortz & Döring, 2006). We conducted Chi-square tests with SPSS (IBM, version 26) to check for a random distribution of the statements to the different categories (health, ecological, social, economic, cultural) and for a random distribution of the categories to the subsamples (considering one, two, three, four, or five dimensions).

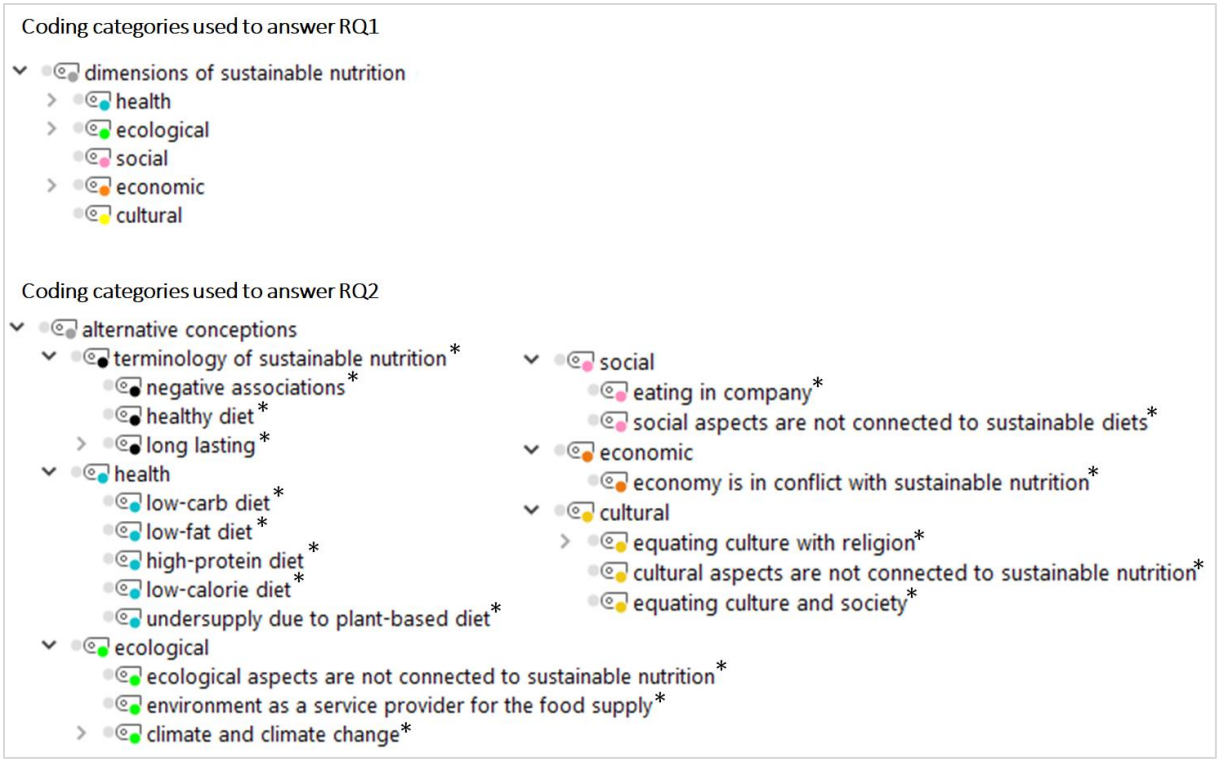


Figure 4.2 Overview of the coding categories used to analyze the interview material. Categories were further differentiated based on statements by the participants. * Inductive codes.

Results

RQ1: What relevance do the students attribute to the different dimensions of sustainable nutrition?

Based on the association task in interview Phase 1 (see Table 4.8), we assigned 159 statements to the health dimension, 77 to the ecological dimension, 37 to the social dimension, 23 to the economic dimension, and 7 to the cultural dimension (see Figure 4.3). A complete list of students' associations with sustainable nutrition can be found in the Supplementary Material (see Appendix A3 for Table S2–S6). With the help of a Chi-square test, we checked the probability that the distribution of the statements to the different categories could have occurred randomly (Kuckartz & Rädiker, 2019). We rejected the null hypothesis of a random distribution ($\chi 2 = 249.56$, $p < 0.001$; see Appendix A3 for Supplementary Material, Figure S1). The health dimension of sustainable nutrition, followed by the ecological dimension, had the highest relevance in the students' conceptions. The social and economic dimensions had relatively low relevance, while the cultural dimension was hardly considered.

Furthermore, we divided the sample into five different subsamples depending on how many dimensions the students considered in their conception of sustainable nutrition (see Figure 2). The health dimension dominated in almost all subsamples except the one that considered five dimensions. Especially in the subsample that considered only one dimension, the health dimension was the most frequently mentioned. Next, the ecological dimension was the

second most mentioned and was present in all subsamples. Furthermore, the relevance of the ecological dimension increased with the number of dimensions considered.

The social and economic dimensions were rare but present in all subsamples that considered two dimensions or more, whereas the cultural dimension was only mentioned by students who considered all five dimensions. For detailed information on how the conceptions of the subsamples are composed on an individual level, see Figure 4.4. In addition, using a Chi-square test, we checked the probability that the distribution of the different categories on the subsamples (considering one, two, three, four, or five dimensions) could have occurred randomly. We rejected the null hypothesis of a random distribution ($\chi 2 = 101.29$, $p < .001$; see Appendix A3 for Supplementary Material, Figure S2).

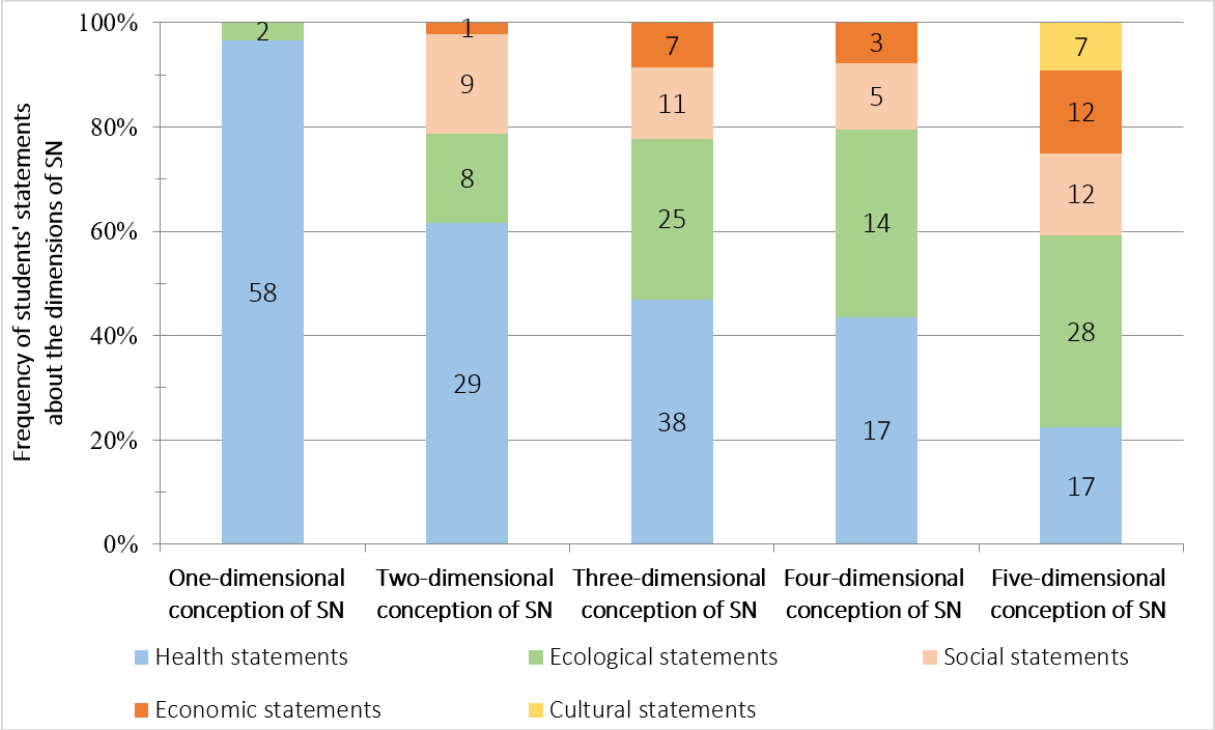


Figure 4.3 Frequency of (y-axis) and number of students' statements (in the bars) about sustainable nutrition, ranked according to whether they included one, two, three, four, or five dimensions in their conceptions. In total, the analysis included 303 coded statements from 46 students ($n_{\text{one dimensional conception}} = 21$; $n_{\text{two dimensional conception}} = 9$; $n_{\text{three dimensional conception}} = 9$; $n_{\text{four dimensional conception}} = 3$; $n_{\text{five dimensional conception}} = 4$). SN, sustainable nutrition.

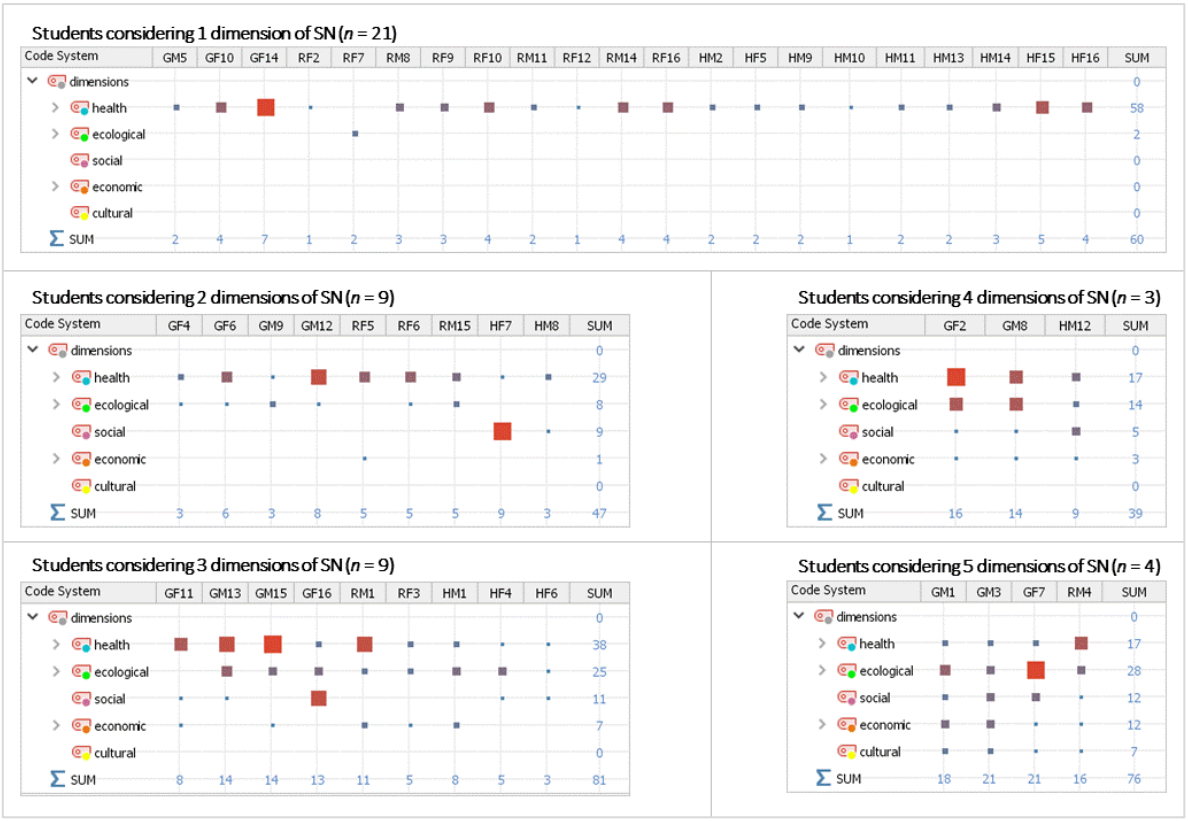


Figure 4.4 Students' conceptions of sustainable nutrition on an individual level, ranked according to whether they included one, two, three, four, or five dimensions in their conceptions. The size of the squares indicates the number of statements within a category; the larger the square, the higher the number of statements. SN, sustainable nutrition; G, Gymnasium; R, Realschule; H, Hauptschule; F, female; M, male.

RQ2: What alternative conceptions do students hold about sustainable nutrition?

We structured students' alternative conceptions regarding the terminology of sustainable nutrition (Table 4.9) and the five dimensions of sustainable nutrition (Table 4.10).

Table 4.9 Students' alternative conceptions regarding the terminology of sustainable nutrition.

Conceptions	Definitions	Examples	Students holding this conception
Negative associations	Sustainable nutrition is understood as something negative.	GM12 – Tim: "Sustainable" just sounds negative. So, in terms of nutrition, it might mean that it is simply not the ideal food.	GM12, RM8, RF9, RM11, RF12, RF16, HF5, HF6, HM10, HM11, HM13, HM14, HF16 (*13 students*)
Healthy diet	Sustainable nutrition is understood exclusively as a healthy diet.	RF2 – Saskia: I imagine sustainable nutrition to mean eating things for a healthy body.	GF4, GM5, GM12, GF14, GM15, RM1, RF2, RF6, RF10, HF5, HM11, HF15, HF16 (*13 students*)
Lasting into the future	Sustainable nutrition is understood exclusively in the sense of long-lasting: long-lasting satiation, health or shelf life of foods.	RM8 – Malte: Things you get full off longer or which are very nutritious, which have a lot of carbohydrates. RM14 – Thomas: If you eat sustainably over a longer period of time, then you may also have a longer life expectancy and a good spirit. HM2 – Jona: For me, milk would be sustainable because you can keep the milk in the refrigerator for two or three days.	GM1, GM5, GM8, GF11, GM12, GM13, GF14, GM15, RF7, RM8, RF10, RM14, HM2, HF4, HM8, HM14, HF15, HF16 (*19 students*)

G, Gymnasium; R, Realschule; H, Hauptschule; F, female; M, male.

Table 4.10 Students' alternative conceptions regarding the five dimensions of sustainable nutrition.

Conceptions	Definitions	Examples	Students holding this conception
Health dimension			
Low-carb diet	Sustainable nutrition is understood as a low-carb diet or implies the avoidance of products high in carbohydrates.	HM10 – Burhan: In terms of carbohydrates, I would say that sustainable nutrition implies that you should try to buy as few carbohydrates as possible.	GF14, RF6, RM8, RF9, HM8, HM9, HM10, HF16 (*8 students*)
Low-fat diet	Sustainable nutrition is understood as a low-fat diet or implies the avoidance of fatty products.	HM9 – Lutian: Sustainable nutrition might mean a diet "low in fat," not adding a lot of fat where it doesn't have to be.	GM1, GF4, GF6, GM12, GF14, RM1, RF6, RM8, RF9, RF10, RM11, RF16, HF5, HF6, HM8, HM9, HM10, HM11, HM14, HF15, HF16 (*21 students*)
High-protein diet	Sustainable nutrition is understood as a high-protein diet or implies preferring products high in protein.	RF9 – Elif: When I think of sustainable nutrition, I think of a diet "high in protein," when a diet is based on many proteins.	GF14, RF6, RF9, RM11, HF6, HF8, HM14, HF16 (*8 students*)
Low-calorie diet	Sustainable nutrition is understood as a low-calorie diet or implies the avoidance of products high in calories.	HF5 – Ela: For a sustainable diet, I would recommend buying fruits, vegetables, and potatoes, because they have relatively few calories […].	RF6, HF5, HM10, HF16 (*4 students*)
Undersupply due to a plant-based diet	An undersupply (especially of macronutrients) through a plant-based diet is feared since animal foods are considered to have a monopoly on certain nutrients.	GF10 – Julia: Regarding the preference for plant-based foods, I wouldn't say that it would lead to sustainable nutrition. Well, it's clear to me that animals die for producing meat. But in some way, I need milk. Milk is also an important part of our diet. So, you need the calcium that is in it […] but I personally would not be a vegan, they do not use any animal food.	GF10, RF6, RF7, HM8, HM10, HF16 (*6 students*)

Table 4.10 continued

Conceptions	Definitions	Examples	Students holding this conception
Ecological dimension			
Ecological aspects are not connected to sustainable nutrition	No connection can be made between the environment and sustainable nutrition.	RF6 – Caroline: I would leave out the environmental dimension, because for me, personally, it has very little to do with nutrition.	GM5, RF6, RF7, RF12, HF5, HM10, HM13 (*7 students*)
Environment as a service provider for the food supply	The relationship between sustainable nutrition and the environment is only understood in the sense that food comes from the environment.	HM10 – Burhan: I can't imagine the connection between sustainable nutrition and the environment. Well, actually, I do, because vegetables are actually the environment. Well, it comes from the earth, the vegetables. And that's why I think that the environment plays a very important role in sustainable nutrition.	GF4, GM5, GF6, RF5, RF7, RM11, HF4, HF5, HM10, HM12, HF15 (*11 students*)
Climate and climate change	Statements about climate or climate change that show that the phenomenon of climate change has not been properly understood. Technically incorrect statements about the consequences of CO_2 emissions.	GM3 – Lukas: CO_2 emissions are generally problematic for the environment. All this goes back into the cycle and then it becomes more and more difficult to cultivate food sustainably, if the whole soil is then contaminated, or the air, or the rain. Then the actual system will be damaged.	GM3, GM9, GF11, GM13, GM15, RF3, RM4, RF5, RF6, RF7, RM14, RM15, HM1, HF4, HF6, HF7, HM9, HM10, HM11, HM12, HM13, HM14, HF15, HF16 (*24 students*)
Social dimension			
Social aspects are not connected to sustainable nutrition	No connection can be made between society and sustainable nutrition.	GF16 – Laura: In terms of the dimension society, I don't know exactly how this is related to sustainable nutrition.	GF2, GM5, GM12, GF14, GM15, GF16, RM11, HF5, HM9, HM10, HM14, HF15 (*12 students*)

Table 4.10 continued

Conceptions	Definitions	Examples	Students holding this conception
Economic dimension			
Economy is in conflict with sustainable nutrition	The economic dimension is not considered compatible with the other dimensions of sustainable nutrition.	GM8 – Noah: And the economy is for me rather the driving force against sustainable nutrition, because the economy in general has the urge to make a lot of money with little effort and regardless of the consequences and therefore I think that the economy really doesn't match well with sustainable nutrition.	GF4, GM5, GM8, RM1, RM4, RF6, RF7, RM15, HF6 (*9 students*)
Cultural dimension			
Equating culture with religion	Culture is being reduced to religion.	RF12 – Leonie: When I link culture to sustainable nutrition, I would think about religion, for example that Muslims are not allowed to eat pork.	RF6, RF12, HF6, HF7, HM9, HM10, HM13 (*7 students*)
Cultural aspects are not connected to sustainable nutrition	No connection can be made between culture and sustainable nutrition.	RF5 – Emilia: Regarding culture [...] I couldn't understand at all what this has to do with nutrition.	GM5, GF6, GF7, GM9, GM12, GF14, GM15, RF5, RF10, HM9, HM11, HM14, HF15 (*13 students*)
Equating culture with society	The cultural and social dimension cannot be separated.	GF4 – Anna: In relation to culture or society 'preference for plant-based foods' refers to the fact that some people prefer to eat plant foods, for example, eating vegan or vegetarian.	GM1, GM3, GF4, GM5, GF6, GF7, GM8, GF11, GM12, GF14, GF16, RM1, RF3, RM4, RF7, RM8, RF9, RM14, HM1, HF4, HF6, HM8, HM14, HF15 (*24 students*)

G, Gymnasium; R, Realschule; H, Hauptschule; F, female; M, male.

Discussion

RQ1: What relevance do the students attribute to the different dimensions of sustainable nutrition?

The fact that many students – 20 out of 46—solely considered the health dimension in their naïve conceptions can be explained by the great relevance attributed to the health aspect, which has already been demonstrated in other studies on students' and laypeople's conceptions of and attitudes toward nutrition issues (BMEL, 2017; Gralher, 2015; Techniker Krankenkasse, 2017). The reason for this could be that, in German schools, a nutritional-physiological teaching approach is primarily used in biology lessons to help students become familiar with the topic of nutrition (Adamitzki et al., 2020; Baack & Steinert, 2015; Bergau et al., 2015, 2018; Beyer et al., 2016; Lower Saxony Ministry of Education, 2015b, 2015c, 2015a). This could have led to an automated association of nutrition topics in the school context with the health aspect.

Our results suggest that the health dimension is particularly present in students' naïve conceptions. In the context of nutrition in adolescence, the health aspect, or rather the figure ideal, is of particular importance (Bartsch, 2008). The enormous social pressure to optimize their bodies that young people are exposed to, which is often associated with eating behavior (Bartsch, 2008), may explain the focus of our sample on the health dimension. Moreover, the health dimension, in contrast to the other dimensions, has an immediate relation to the student's own body and thus affects their everyday life to a great extent. It seems easier for students to approach the topic of sustainable nutrition from an egocentric perspective rather than to adopt the perspective of other people (altruistic perspective) or the environment (biospheric perspective). We suggest that the link between nutrition and health aspects is the most intuitive one and therefore the easiest to create. This assumption is supported by the fact that the relevance of the health dimension decreases with an increasing number of the dimensions of sustainable nutrition considered by our participants. This means that the less elaborate the naïve conception of sustainable nutrition is in terms of the total number of dimensions considered, the more prominent the health dimension is.

Nevertheless, references to the ecological dimension frequently made by students should not be neglected. Although students' focus on ecological aspects has already been identified in other studies on sustainability topics (Lockley & Jarrath, 2013; Menzel & Bögeholz, 2006), it was previously observed that it has no relevance in students' conceptions of nutrition in general (Gralher, 2015). Now, the results are completely different when the naïve conceptions of sustainable nutrition are investigated. The results of RQ1 showed that a total of 21 students considered both the health and ecological dimensions (see Figure 4.4, Students considering 2, 3, 4, or 5 dimensions).

The often co-occurring consideration of both dimensions can be explained by the specific question of "sustainable" nutrition, which did not take place in previous studies on nutrition (e.g. Gralher, 2015), as it combines the focus on ecological aspects in sustainability topics

with the focus on health aspects in nutrition topics. However, the preference for the two dimensions cannot be attributed exclusively to the combination of the two topics. Health and the environment are generally two important topics for young people in Germany. For example, the 17th Shell Youth Study showed that 80% of over 2500 young people (aged 12–25 years) surveyed considered it important to live health-conscious lives and 66% to act with respect for the environment (Gensicke, 2015).

The ecological dimension was the second most coded, but unlike the health dimension, it became more prominent when two or more dimensions were considered. Studies conducted on student teachers in home economics classes showed that this sample group focused on the ecological dimension (Hertrampf & Bender, 2016). Since we assume that prospective home economics teachers have more elaborate conceptions of sustainable nutrition than many students, it confirms our assumption that consideration of the ecological dimension increases with increasing expertise.

The economic and social dimensions were rare in students' naïve conceptions but present in all subsamples that considered two dimensions or more, whereas the cultural dimension was only mentioned by students who considered all five dimensions (Figure 4.3). Although less pronounced, the presence of those dimensions (social, economic, cultural) in the students' conceptions is striking, as it is not commonplace in their conceptions of sustainability issues (Gausmann et al., 2010).

RQ2: What alternative conceptions do students hold about sustainable nutrition?

Terminology of sustainable nutrition

We noticed that some students had problems with the terminology of sustainable nutrition. This is particularly evident in statements such as those of GM12 – Tim (Table 4.9). In addition, particularly students with no prior experience with the term understood it as something negative; they associated it with a bad, unhealthy, or wrong diet. Their conceptions are therefore contrary to the scientific conceptions.

This contrasts with the results of a large-scale online survey of university students on the topics of "sustainable development" and "sustainability," in which no negative associations and only a positive understanding of the terms were found (Kagawa, 2007); however, the study was conducted in an English-speaking country, and ours, in a German-speaking country. In our study, the negative evaluation of the term "sustainable nutrition" can be traced back to the German adjective "nachhaltig/sustainable," to which the students intuitively had negative associations. We assume as a possible cause of the negative connotation the similarity to other German words like "nachteilig/disadvantageous" or "nachlässig/careless," which are phonetically similar but semantically different (*nachlässig [careless]*, n.d.; *nachteilig [disadvantageous]*, n.d.). In German, the prefix "nach" often gives words a negative meaning; therefore, the reason underlying the negative interpretation of sustainable nutrition could be an unconscious overgeneralization of this phenomenon.

In addition to the negative understanding of the term “sustainable nutrition”, there were also positive understandings of it in the context of a healthy diet (Table 4.9; *Healthy diet*). This is likely due to the great relevance attributed to the health aspect and the predominant practice of teaching nutrition topics under the health aspect (explained in the discussion on RQ1). Although this alternative conception of a healthy diet does not entirely contradict the scientific conception of sustainable nutrition, it does not cover it completely and only illuminates a part of it.

Even more frequently, the students expressed the view that sustainable nutrition means *lasting into the future* (Table 4.9). This alternative conception suggests that there are parallels with the definition for sustainable development of the World Commission on Environment and Development (WCED, 1987): development that “meets the needs of the present without compromising the ability of future generations to meet their own needs.” However, it is evident that the students’ understanding of “anhaltend/long lasting” does not include future generations, which were considered by only 12 students (GF7, GM8, GF11, GM12, GM13, GM15, GF16, RM1, RM4, RM15, HM1, HF6) but often focuses on their own life span. Their conceptions regarding *lasting into the future* can be divided into long-lasting satiation, health, or the shelf life of foods (Table 4.9; *Lasting into the future*). The conception *lasting into the future* can also be traced back to the German adjective “nachhaltig/sustainable”. The students seemed to interpret the prefix “nach/after” in the sense of continuation or extension (*nach [after]*, n.d.).

Taken together, the large number of participants with alternative conceptions indicates that problems of understanding the term “sustainable nutrition” do not occur sporadically among students but are widespread; however, further quantitative studies are needed to verify the findings on the basis of larger samples.

Health dimension

Regarding the health dimension, we found that students had strong beliefs about the recommended intake of macronutrients that contradict nutritional recommendations. The students frequently pointed out that only small amounts of carbohydrates and fats, but large amounts of protein, should be consumed (Table 4.10; *Low-carb diet*; *Low-fat diet*; *High-protein diet*); however, leading nutrition societies recommend covering approximately 50% of total energy intake with carbohydrates, 30% with fat, and only a small part with proteins (for normal body weight, 9% to 11%; DGE, ÖGE, & SGE, 2017). We see the students’ alternative conceptions of carbohydrate intake replicated in the actual nutritional behavior of the German population that fell below the recommended carbohydrate intake (Hauner et al., 2012).

Our results regarding students’ alternative conceptions of dietary fat intake are consistent with Rasnake et al. (2005), who identified a tendency for young people to be dose insensitive (e.g., something harmful in large amounts should be avoided in small amounts) and categorical thinkers (e.g., foods are either good or bad). Moreover, Heseker, Dankers, & Hirsch (2018) examined 238 textbooks of various subjects that included nutritional topics for

general education schools in Germany and found that those textbooks gave lower fat intake recommendations than recommended by official nutrition societies (Günther et al., 2015). Furthermore, the study found that textbooks do not mention the aspect of fat quality, especially in relation to vegetable fats. Considering that the fat intake of the German population is generally higher than recommended (Günther et al., 2015) and that the students' recommendations to consume only small amounts of fatty products comply with the dietary guidelines of various countries (DGE, 2020; HHS, the students' assessment is partly correct.

With regard to protein intake, it is evident that students' recommendations to consume large amounts of protein conflict with official recommendations of nutrition societies, which refer to a protein intake of 0.8 g/kg body weight (for normal body weight, 9% to 11% of total energy intake; DGE et al., 2017). However, it has been shown that even textbooks for general education schools erroneously give excessive protein intake recommendations (Heseker et al., 2018). Because textbooks are still the preferred teaching medium for teachers (Fuchs, 2014), we assume that their use in class may contribute to a fear of undersupply regarding protein intake.

We suspect that students' conceptions concerning macronutrients (carbohydrates, fats, and proteins) and the emphasis on low-calorie diets (Table 4.10; *Low-calorie diet*) can be attributed to the most popular weight loss diets (low-carb and low-fat diets; Freedman, King, & Kennedy, 2001), which are designed for weight reduction rather than a balanced, long-term healthy diet. The reasons for this are traced to the slimness ideal supported by society and the media (Gonçalves & Martínez, 2014) alongside the associated social pressure that affects both sexes (Bartsch, 2008). According to the data for Germany in the Health Behavior in School-aged Children (HBSC) Survey of the WHO, 53% of girls and 36% of boys at the age of 15 think they are too fat (Currie et al., 2012).

The importance of the desired body ideal in adolescents for the formation of conceptions of sustainable nutrition should therefore not be underestimated, as it is dietary behavior in particular that is one way to achieve a body ideal (Aragon et al., 2017; Fredrickson et al., 2015). The results show that dietary recommendations for weight reduction are perceived by students as a healthy diet; therefore, the task of nutrition education must be to provide information about the actual conditions of the supply of energy-providing nutrients.

The alternative conception *undersupply due to a plant-based diet* (Table 4.10) is particularly relevant, as it affects all other dimensions of sustainable nutrition in a special way (e.g., greenhouse gas emissions due to livestock breeding (ecological), food shortage due to land usage for livestock breeding (social), higher input costs for the production of animal food products than for plant food products (economic), and high meat consumption has become normal over the last 60 years (cultural; von Koerber et al., 2017)). For some students, a plant-based diet is contrary to a healthy diet. We conclude from the students' statements that this evaluation is based on the assumption that animal food products are the only source of some macro- and micronutrients. Heseker et al. (2018) found that 238 textbooks

of various subjects, including nutritional topics, often overstated the negative consequences of a vegan diet and unjustifiably identified the consumption of animal products such as milk as the only way to prevent deficiency symptoms. Such misrepresentations in textbooks could be responsible for the students' alternative conceptions in this respect.

The students' fear of undersupply due to a plant-based diet seems unjustified as food societies in many countries are in favor of appropriately planned vegetarian diets, including vegan diets for all stages of the life cycle, even while recognizing the need to supplement certain nutrients (Melina et al., 2016; Phillips, 2005). Conversely, the German Nutrition Society does not recommend a vegan diet for certain groups of people (e.g., pregnant women, lactating women, infants, children, or adolescents), but assumes "that a plant-based diet (with or without low levels of meat) is associated [with] a reduced risk of nutrition-related diseases in comparison with the currently conventional German diet" (M. Richter et al., 2016, p. 93).

Ecological dimension

We found some students to have problems recognizing the environmental impact of food consumption and production. In some cases, students were entirely unable to deduce a connection between food and the environment, arguing that the ecological dimension should be omitted from the concept of sustainable nutrition because it "has very little to do with nutrition" (RF6 – Caroline; Table 4.10; *Ecological aspects are not connected to sustainable nutrition*).

Apart from this complete negation of the ecological aspects of sustainable nutrition, other students only succeeded in establishing a unidirectional connection between the environment and sustainable nutrition by recognizing ecosystem services, such as the provision of food (Millenium Ecosystem Assessment, 2005), but not taking into account the environmental impacts of dietary behavior or the intensive agriculture associated with it (IPCC, 2019; Willett et al., 2019; Table 4.10; *Environment as a service provider for the food supply*).

Moreover, several indications could be identified that point to a lack of understanding of the importance of greenhouse gases for climate change. This lack of understanding led to little or no recognition of the links between nutrition and ecological aspects, particularly climate change. For example, we observed that although the transportation of food was associated at a superficial level with environmental consequences such as "pollutants in the air" (RF3 – Lara), no connection could be established directly with CO_2 emissions, the greenhouse effect, or climate change (RF3, HF4, HM11). In addition, some students identified CO_2 emissions as problematic but could not explain why or erroneously linked emissions to phenomena other than climate change, such as soil acidification and acid rain (GM3, GM15, RF6, RF7).

Our results complement the results of previous research on students' conceptions of climate change (Niebert & Gropengießer, 2014). Previous studies found that climate change was

attributed to more or less incorrect mechanisms, some of which did not involve greenhouse gases at all (for a summary of previously identified students' conceptions of the greenhouse effect, see (Niebert & Gropengießer, 2014)).

Social dimension

A total of 12 students expressed that they could not connect the social dimension with sustainable nutrition (Table 4.10; *Social aspects are not connected to sustainable nutrition*). It is striking that all students who had this problem did not succeed in adopting the perspective of employees in the food sector, especially in developing countries, but only argued from an egocentric perspective as consumers. GM12–Tim, for example, spoke about the power of the consumer, noting that "society is already responsible for what is happening, for example, prices and so on," but did not manage to direct this perspective toward workers in the value chain of food products. It is thus evident that some students have shortcomings in their ability to take on the perspective of workers in the value chain of food products; however, the ability to change perspectives was defined as one key competency for sustainable development (Rieckmann, 2012).

Economic dimension

Regarding the economic dimension of sustainable nutrition, we found that some students perceived the economy as a kind of "driving force against sustainable nutrition" (GM8 – Noah; Table 4.10; *Economy is in conflict with sustainable nutrition*). Such an alternative conception negates the possibility of achieving "sustainable development in its three dimensions—economic, social, and environmental—in a balanced and integrated manner" (United Nations General Assembly, 2015, p. 3) as sought by the United Nations.

This alternative conception not only occurs from a macroeconomic perspective ("the economy"; GM8 – Noah), but also at the level of the individual microeconomic situation of students and their families ("organic products are just more expensive and when they are more expensive, then you just buy them less often"; RM1 – Tobias). Similar results were obtained by Krüger and Strüver (2018), who found by conducting qualitative interviews with adult consumers that a part of the sample believed that the economy is opposed to healthy and sustainable food practices and that sustainable consumption is a privilege of the affluent population.

Such a conception carries the risk of feeling powerless in the face of the unsustainable practices of the food system and undermines the students' perceived effectiveness in their role as food consumers. Similarly, Gralher (2015) found that students often did not know any ways of influencing the sustainable development of the food system; however, the seven recommendations of von Koerber et al. (2017) show that there are many options that can be implemented at low costs that are even cheaper than the unsustainable alternative (e.g., preference for plant-based foods or resource-saving housekeeping).

Cultural dimension

Although we considered different definitions of culture in our evaluation, we primarily followed the Cambridge Dictionary's social science definition of culture, which describes it as follows: The way of life of a particular people, especially as shown in their ordinary behavior and habits, their attitudes toward each other, and their moral and religious beliefs (*culture*, n.d.). A total of seven students were unable to see the connection between the cultural dimension and sustainable nutrition (Table 4.10; *Cultural aspects are not connected to sustainable diets*). All seven students showed a very narrow understanding of culture, which probably explains this barrier. For example, some students reduced culture to "paintings of former times" (RF10 – Hannah) or to "what once was, what remains of that time" (HM11 – Daniel), and thus to the past preserved by traditional constructs. Also, a reduction in cultural festivals such as "Oktoberfest" or "Carnival" (HM14 – Nicolas) led to difficulties in combining cultural aspects with sustainable nutrition. Even if it was recognized that the term culture also refers to current trends, these could not always be transferred to the field of nutrition but were exclusively related to the fashion sector (RF5 – Emilia: "Trends are actually more about clothing than about nutrition"). A possible explanation for this could be that, in the short life span of adolescents (M_{Age} = 15.59, *SD* = 0.78), the slow changes in the food sector are difficult to experience. In contrast, changes in the fashion sector happen very quickly and are easier for adolescents to identify. Nevertheless, it is surprising that, despite the presence of a huge variety of ethnic restaurants from different countries in Germany, culture was not associated with nutrition by some students. Such a concept carries the risk that culturally determined eating habits that are contrary to sustainable nutrition (e.g., high meat consumption or its association with masculinity) will not be questioned.

Furthermore, a total of seven students considered the cultural dimension to be exclusively reduced to religion (Table 4.10; *Equating culture with religion*) and frequently referred their statements to the Islamic religion. With approximately 4.5 million Muslims in Germany, Islam is the third largest religion in Germany. It is therefore not surprising that, for some students, the rules of halal, especially the abstention from pork, are representative of religion-specific nutritional habits. Nevertheless, according to Germanys Federal Statistical Office (2019), 58% of the German population belongs to Christian religions. We therefore assume that Christian eating habits and the prevalent renunciation of food restrictions are considered normal and have therefore not been addressed by the students.

Furthermore, it was difficult for the students to separate the social and cultural dimension (Table 4.10; *Equating culture and society*). The students also criticized the distinct dimensions of sustainable nutrition posited by von Koerber et al. (2017) and suggested they should be considered together. Von Koerber et al. only poorly justified the extension of the dimensions of sustainable nutrition by the cultural dimension by factoring "the respective cultural background [that] influences food habits" (von Koerber et al., 2017, p. 35) and do not present it in a clear-cut way in relation to the social dimension. In older literature regarding the concept, cultural aspects were summarized within the social dimension (von Koerber et al., 2012). The definition of culture is inextricably linked to social groups of

people, which is why the cultural and social dimensions overlap greatly in content. We suspect that students were therefore unable to conceptually separate the dimensions from one another.

Conclusions and educational implications for teaching

Before explaining the comprehensive conclusions and educational implications of this research for teaching, it is important to not ignore possible limitations regarding the results. First of all, due to the selection of participants by the teachers, we cannot exclude the possibility that some of the participants had a particularly high interest in the topic of nutrition, even though the students were only told that the interview was about nutrition (not sustainable nutrition). Furthermore, we recognize that education based policies have limited impact on the modification of nutritional habits. For example, despite well-developed educational concepts, they have not been able to prevent the increase in obesity worldwide (WHO, 2020b). Other factors, such as the socioeconomic status of parents, have a major influence on the nutritional behavior of young people (Zarnowiecki et al., 2014). However, in samples with nearly the same socioeconomic status, nutritional interventions in schools showed an effect on the nutritional behavior of students (Ochoa-Avilés et al., 2017).

Considering these limitations, the following conclusions and educational implications can be drawn from the results described in this article. In the context of RQ1, we identified a self-centered perspective of many students on the topic of sustainable nutrition, with a frequent focus on the health dimension. For this reason, we suggest that it should be clarified, especially for students without much previous experience on the topic or at the beginning of a teaching unit, that sustainable nutrition and nutrition in general are not exclusively health-related topics. By promoting systems thinking, the connections between sustainable nutrition and the ecological, social, and economic dimensions should be highlighted. Although we advocate strongly for the promotion of a multidimensional perspective, we emphasize that the health and ecological dimensions should not be neglected, given their importance for sustainable nutrition, even though these were already present in the students' conceptions. The health dimension in particular can be used as a starting point to make sustainable nutrition more easily accessible for students without much previous experience.

Terminology of sustainable nutrition

Since the negative interpretations of the terminology (Table 4.9; *Negative associations*) are contrary to the positive meaning of sustainable nutrition in the sense of sustainable development, interventions must be taken in the classroom in the direction of scientifically accurate conceptions of sustainable nutrition. For example, cognitive conflicts could be used to trigger conceptual change (Posner et al., 1982; Strike & Posner, 1992). For this purpose, impulses such as the use of the term "sustainable" in a known context (e.g., sustainable energy) would be useful. In class, media reports, advertisements, or product descriptions could be used as materials. This includes products advertised as sustainable, which seem to

have a potential for cognitive conflicts due to the inherent contradictions to the students' conceptions.

In contrast to the *negative associations* mentioned above, the origin of the other alternative conceptions (Table 4.9; *Healthy diet, Lasting into the future*) already contains correct elements of the scientific conception that could be useful for the learning process. To achieve a modification toward scientific conceptions, the promotion of a wider understanding of the term is critical; perspectives restricted to the context of food or one's own body must be broadened. Since the term "sustainable" is subject to inflationary use in everyday life and the media in a wide variety of situations, teaching practice should promote the development of a differentiated understanding of the term.

Health dimension

Due to the numerous alternative conceptions regarding the recommended intake of macronutrients contradicting official nutritional recommendations, we advocate for resources outlining the recommendations of nutrition societies, such as the Nutrition Circle of the German Nutrition Society (DGE, 2020), which shows dietary guidelines, or the Eat Well guide for the United Kingdom (Public health England et al., 2016), because they demonstrate in everyday practice that each individual nutrient performs vital functions in the organism. Knowledge about actual macronutrient requirements can eliminate uncertainties regarding dietary behavior in everyday life. Because we identified fear of an *undersupply due to a plant-based diet* (Table 4.10), we propose the use of alternative dietary recommendations for vegetarians and vegans, such as vegetarian food pyramids, to alleviate this fear and enable students to adopt a healthy plant-based diet. Resources describing the positions of nutrition societies on vegetarian and vegan diets could also help to dispel those fears; however, attention should be drawn to the necessity of supplementing certain nutrients as well as regular medical observations.

Ecological dimension

As we found some students to have difficulties recognizing the environmental impact of food consumption (Table 4.10; *Ecological aspects are not connected to sustainable nutrition*) and to understand the *environment as a service provider for the food supply* (Table 4.10), sustainable nutrition education should aim to illustrate the environmental impact of the food system and individual nutritional behavior. To prevent students' resignation, however, positive examples for the implementation of sustainable nutrition from an ecological perspective should also be provided. The recommendations of von Koerber et al. (2017) are excellently suited for this purpose. To encourage the students' perceived effectiveness, the reduction of one's ecological footprint through a sustainable diet (e.g., preference for plant-based foods) compared to a meat-based diet could be illustrated. Ideas for comparing different meat alternatives in biology and geography classes according to selected sustainability criteria can be found in Fiebelkorn and Kuckuck (2019).

Although other students considered the connection between sustainable nutrition and the ecological dimension, we found that students considered certain behaviors, especially the

emission of CO_2, to be harmful to the environment but did not link them to the greenhouse effect; therefore, the relationship between CO_2 emissions and the greenhouse effect should be known by all students in order to correctly evaluate the positive effects of sustainable nutrition. Niebert and Gropengießer (2014) provide a detailed overview of different methods to illustrate the relationship between CO_2 emissions and the greenhouse effect.

Social dimension

Regarding the social dimension, we found that it bears little relevance in students' conceptions of sustainable nutrition. Moreover, we identified a frequently occurring egocentric perspective and shortcomings in students' abilities to adopt the perspective of other people in situations that are dissimilar to their own (e.g., workers in the value chain of food products); thus, teaching should aim to encourage students to change perspectives. This can be done both through direct contact with actors in agribusiness (e.g., farmers or food traders) and by using media that portray the food situations in other countries. In this way, a global perspective can be developed and a better understanding of people in countries with food poverty may be promoted. Furthermore, to better understand the interests and needs of different groups, group discussions with defined roles can be useful. The use of reports presenting problematic working conditions or child labor in the food industry could also be an effective means of stimulating a change in perspective. Here too, however, great care should be taken not to emotionally overwhelm the students and to avoid resignation. Instead, options for action for consumers to improve working conditions (e.g., regional and seasonal products and Fair Trade products; von Koerber et al., 2017) should be highlighted; however, it is important to emphasize the freedom of the consumer and to also address students' perceived barriers that may make it difficult for them to consume socially sustainable products (e.g., low income of parents or limited control over food purchases in the family).

Economic dimension

Education for sustainable nutrition should aim to teach students that the central idea of sustainable development is the promotion of the different dimensions "in a balanced and integrated manner" (United Nations General Assembly, 2015, p. 3). Because the economic dimension had little relevance in the students' conceptions (results on RQ1; Figure 4.3), the importance of this dimension and its compatibility with sustainable nutrition should also be emphasized in biology classrooms. Examples could include the large number of jobs in the food sector as well as the creation of new jobs in new food areas, such as vegan and vegetarian products, or the support of regional agricultural businesses.

We found that some students perceived the economic dimension at the macro and micro levels as an antagonist of sustainable nutrition (Table 4.10; *Economy is in conflict with sustainable nutrition*); therefore, it is important to give students examples of economic actors in the food sector who, for example, manage their companies in a sustainable way, e.g., by marketing organic food, saving on packaging, and standing for fair working conditions, all within profitable business models. In this way, students can recognize that

there is not necessarily a contradiction between economically strong companies and sustainable food. Students' perceived effectiveness can be fostered by discussing in class what opportunities consumers have to support sustainable companies (e.g., every purchase decision supports a particular company).

Because, at the microeconomic level, students often cited the higher costs of sustainable nutrition as a barrier to consuming sustainable products, we recommend providing concrete examples of sustainable nutrition that can be implemented at low costs (e.g., preference for plant-based foods, resource-saving housekeeping, regional and seasonal products; preference for minimally processed foods; von Koerber et al., 2017).

Cultural dimension

Because some students could not make a connection between culture and sustainable food, which could lead to adopting culturally determined unsustainable eating habits without questioning, we suggest a critical examination of students' own eating habits and their cultural determinants as well as helping them to become more familiar with the eating habits of other cultures (e.g., consumption of insects—entomophagy; Fiebelkorn, 2017). In addition, an evaluation of different nutritional styles according to sustainability criteria (Fiebelkorn & Kuckuck, 2019) could strengthen cultural sensitivity and ultimately lead to increased acceptance of "foreign" eating habits. To reduce any fears of new foods, or so-called "food neophobia," it may also help to look at the origin and history of popular foods or dishes such as bananas, pizza, or döner kebab. In Germany, for example, the Federal Ministry of Food and Agriculture offers materials for time travel through nutrition, which can be used for teaching arrangements (BMEL, 2018). Students will quickly notice that many culturally accepted foods were considered novel until some time ago, and that supposedly novel foods (e.g., insects in Germany) already have a history in their own country (Fiebelkorn, 2017).

Furthermore, it was difficult for the students to separate the social and cultural dimensions. Despite the predominant consideration of the three sustainability dimensions (ecological, economic, social) in the past, the cultural dimension is currently also taken into account in the context of ESD (Rieckmann, 2017). In our opinion, this dimension is of particular importance in many areas, but especially in the field of nutrition, and should also be considered in teaching practice. Nevertheless, our results show that a separate consideration of the cultural and social dimensions leads to numerous confusions for students and is difficult to understand. For this reason, and because the two dimensions overlap greatly in content, we agree with the students' suggestion to combine the two dimensions and support the consideration of cultural aspects under the social dimension.

General conclusion

In conclusion, it can be said that the nutrition issue is particularly well suited to ESD, as it combines health, ecological, social, and economic aspects to a greater extent than most other topics with a regional-global scope. Teachings on this topic should aim to ensure that students understand nutrition as a system based on the four dimensions (cultural aspects

should be considered under the social dimension) of sustainable nutrition. Interventions should be implemented to encourage students to give up their egocentric views and improve their ability to change perspectives. In addition, clear options for action and their effect on the food system should be communicated to increase the students' perceived effectiveness in the sustainable development of the food system.

5 General discussion

This dissertation project aimed to clarify young people's learning prerequisites in the context of education for sustainable nutrition, approaching this overarching question from two distinct perspectives. The first two research foci took a quantitative approach to examine sustainable dietary intention and behavior in young people (research focus II) and their potential determinants, including the human-nature relationship (research focus I). Research focus III took a qualitative approach by exploring students' conceptions of sustainable nutrition via interviews.

This chapter critically discusses the studies' results in light of previous research findings, outlines limitations, and derives guidelines for practical classroom implementation. The first part of the general discussion is structured according to the theoretical framework presented in chapter 2.1.3 (see Figure 5.1) and takes into account the results of study 1 (chapter 4.1) and study 2 (chapter 4.2). The second part is dedicated to the findings of the qualitative study (study 3; chapter 4.3) and derives guidelines for instructional design. In the concluding remarks, the political and educational significance of the findings is discussed.

5.1 Fostering sustainable dietary intention and behavior among young people, considering their relationship with nature and its determinants

As outlined in the discussion structure (see Figure 5.1), the discussion first addresses the findings on the psychological (basic human values) and cultural factors (cultural background) that may promote the human-nature relationship (research focus I). Next, the factors that influence sustainable dietary intention and behavior in young people are discussed (research focus II).

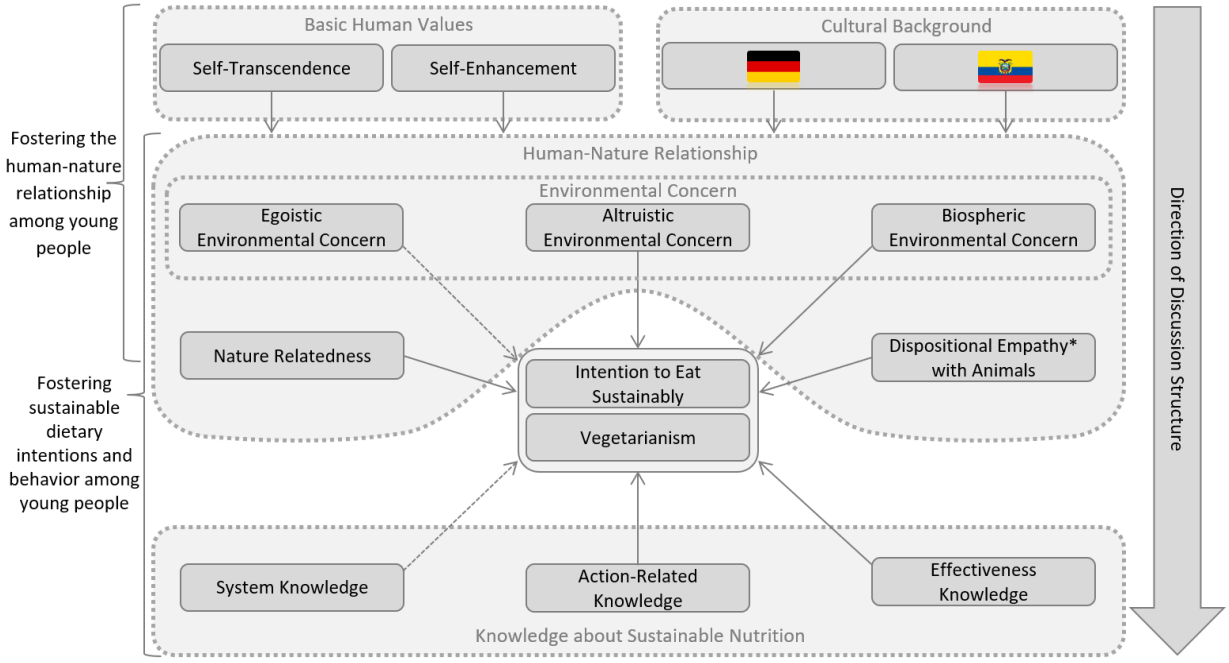


Figure 5.1 Discussion structure based on the theoretical framework of psychological factors as a learning prerequisite.

*Note: Solid lines show the empirically verified relationships. Dashed lines show relationships that are unexpected based on the literature. The gray shaded spheres represent the adaptation of the model to the context of sustainable nutrition. *Dispositional empathy with animals was exclusively investigated in the second study (research focus II).*

5.1.1 Fostering the human-nature relationship among young people

Before discussing the results and providing recommendations for educational practice, it should be noted that the samples are not representative of all students in Germany or Ecuador since the German sample consists exclusively of students from secondary schools located in and around cities in Northwest Germany. The Ecuadorian sample is even more exclusive, as it consists of students from private secondary schools located in and around the city of Cuenca in Southern Ecuador. Moreover, the quantitative studies employed a correlational approach, using a questionnaire with self-report psychometric scales. Social desirability response bias can therefore not be discounted (Holtgraves, 2004). Furthermore, the studies' design limits confidence about the causality of the identified relationships, which have not been tested through experimental investigations.

The human-nature relationship was represented by nature relatedness and environmental concern, with the latter consisting of egoistic, altruistic, and biospheric dimensions. Since nature relatedness (Capaldi et al., 2014; Mayer & Frantz, 2004; Otto & Pensini, 2017; Rosa et al., 2018; Whitburn et al., 2020) and biospheric environmental concern (Milfont et al., 2006; Schultz, 2001; Schultz et al., 2004, 2005) were positively related to PEB in previous studies, the results of the study are discussed especially with regard to possible implications for promoting these factors.

Culturally specific differences regarding the human-nature relationship

Young Ecuadorians reported feeling more closely related to nature than young people from Germany. Furthermore, country-specific differences in the dimensional structure of environmental concern were found. In the German sample, altruistic environmental concern was more pronounced than biospheric and egoistic concern. The prominence of altruistic concern in the overall structure of environmental concern has frequently been observed. For example, this was the case in nine of the eleven adult samples from the United States and different Latin American countries surveyed by Schultz (2001). It was, therefore, all the more surprising that the Ecuadorian sample was most concerned about the consequences of environmental problems for biospheric reasons, followed by egoistic and altruistic reasons. Both the more pronounced nature attachment and the prevalence of the Ecuadorian sample's biospheric environmental concern can be explained by the high value ascribed to nature by Ecuadorian culture (Lalander, 2016) and politics (Asamblea Constituyente de Ecuador, 2008).

The study also highlighted country-specific differences in the role of gender in explaining biospheric environmental concern and nature relatedness. Whereas female gender in the German sample had a positive effect on nature relatedness, the reverse was observed in the Ecuadorian sample. The results for the German sample align with previous research demonstrating that in most nations, compared to men, women hold stronger environmental attitudes (Stern et al., 1993; Zelezny et al., 2000) and have greater empathy with nature (Tam, 2013b). However, Zelezny et al. (2000) demonstrated that Ecuador might be an exception in this respect. They found it was the only one in a comparison among 14

countries where men had stronger environmental attitudes and more biospheric environmental attitudes than women.

This exceptional situation of Ecuador, in terms of the character of the human-nature relationship and the notable gender difference, points to the possibility of a socialization process that allows Ecuadorian boys to develop and express nature relatedness and an environmental concern based on the intrinsic value of nature (biospheric environmental concern). Possible causes are the indigenous concept of *Buen Vivir* and the influence of male political actors. For instance, Rafael Correa, president of Ecuador from 2007 to 2017, strongly promoted life in harmony with nature. He may have acted as a role model for many Ecuadorian boys.

Two recommendations for the political and educational sector can be derived from the cultural differences observed between Germany and Ecuador. First, the results suggest that political programs and the narrative of a fulfilling life in harmony with nature (*Buen Vivir*) emphasize the value of the natural environment and may positively influence young citizens' human-nature relationships at the individual, psychological level. This offers promising opportunities for policymakers, for example, to increase social acceptance of and even participation in environmental protection activities, as nature relatedness and biospheric concern are positively linked to PEB. Second, Ecuador exemplifies that nature relatedness and biospheric environmental concern do not have to be feminine traits and can be fostered by both genders through the socialization process. Education, which forms a crucial element of the socialization process, should convey that nature relatedness and biospheric environmental concern are not bound to any specific gender, especially in Germany, where this element might be lacking.

Culture-unspecific factors promoting the human-nature relationship

The cross-cultural study also identified shared factors that predicted the development of the human-nature relationship in both cultures, Ecuador and Germany. These factors can therefore be considered crucial targets for promotion through educational interventions. Table 5.1 gives an overview of the common connections between predictor variables included in the study and dimensions of the human-nature relationship, that is, relationships that were observed in both cultures.

Table 5.1 Overview of the hypothesized connections between the explanatory variables included in the study and the human-nature relationship.

Independent variables	Connection	Dependent variables
Self-transcendence	→	Nature relatedness
Self-enhancement	X	Altruistic environmental concern
Time spent in nature	→	Biospheric environmental concern
Self-transcendence	→	Egoistic environmental concern
Self-enhancement	→	

Note: → = Predictor variable, X = No connection. The connection of the independent variables refers to all dependent variables. Example: Self-transcendence predicted nature relatedness and altruistic and biospheric environmental concern.

In accordance with the available literature, self-transcendence was a powerful predictor for biospheric and altruistic concern (Schultz, 2001) and nature relatedness (Sothmann & Menzel, 2017) in both samples. Since the self-transcendence dimension reflects prosocial values oriented toward the welfare of people in the immediate social environment (benevolence), all people and nature, including all living beings (universalism; Schwartz, 2012), it represents biospheric and altruistic value orientations (Stern et al., 1995), which is reflected in its predictive relationship to altruistic and biospheric environmental concern.

Consistent with previous studies, self-enhancement only positively affected egoistic environmental concern (Schultz, 2001; Schultz et al., 2005) and did not predict nature relatedness or biospheric environmental concern in either the German or Ecuadorian sample. Although the results of study 1 regarding self-transcendence and self-enhancement are largely in line with prior studies, these observations have never before been made in an international sample of high school students. These novel findings allow new conclusions to be drawn for the instructional promotion of the human-nature relationship.

From the above, it could be concluded that self-transcendence serves as an important psychological prerequisite for developing nature relatedness and environmental concern, especially its biospheric dimension, and should be promoted by educational interventions.

Although time spent in nature was found to positively predict nature relatedness (see Table 5.1), the study's correlational design precludes a definitive statement about the direction of this effect. However, previous experimental studies have also noted a positive effect of exposure to nature on college students' nature connectedness (Mayer et al., 2009), suggesting that time spent in nature contributed to greater nature relatedness. However, it is also possible that a bidirectional relationship between these two variables exists. Having a desire to connect with nature may lead to spending more time in nature, which in turn positively affects connectedness with nature and vice versa (see also MacKerron & Mourato, 2013; Mayer et al., 2009; Nisbet, Zelenski, & Murphy, 2011). Although the effect in the German sample was small, time spent in nature also positively influenced biospheric environmental concern (see also Table 4.4), illustrating the relevance of nature experience in promoting nature relatedness. Therefore, it can be deduced that students should be given plenty of opportunities to come into contact with nature. This can be achieved in the educational context, for example, through nature-based education or excursions to natural areas.

5.1.2 Fostering sustainable dietary intention and behavior among young people

Before discussing the results of study 2 in detail, it is germane to highlight limitations relevant to their interpretation. The independent variables investigated regarding their effect on sustainable dietary intention and behavior represent just a subset of possible predictors. It is likely that other relevant factors not considered here contribute to explaining both behavioral intentions and actual behavior. Another limitation relates to studying the intention to eat sustainably as a dependent variable, as intention does not necessarily translate into actual behavior (i.e., the intention-behavior gap; Sheeran & Webb, 2016).

Various barriers can prevent the realization of behavior, even if the intention to perform it is high. To draw conclusions about actual sustainable dietary behavior, this study also examined vegetarianism. However, since vegetarianism is only one aspect of sustainable dietary behavior, future studies should conduct a more holistic assessment of actual sustainable dietary behavior and its predicting factors. Furthermore, the results of this study cannot be generalized to the entire student population in Germany, as only students from Northwest Germany were surveyed. Finally, the previously noted limitations associated with the correlational design and self-report psychometric measures also apply to this study, which carries the risk of social desirability response bias (Holtgraves, 2004) and falsely assumed causalities.

Following the discussion structure (see Figure 5.1), this part of the general discussion addresses the identified factors that influence sustainable dietary intention and behavior in young people. Table 5.2 shows which factors affected the two dependent variables, intention to eat sustainably and vegetarianism.

Table 5.2 Overview of hypothesized connections between the explanatory variables included in the study and the intention to eat sustainably and vegetarianism.

Independent variables	Connection	Dependent variables
Nature relatedness	→	
Egoistic environmental concern	X	
Altruistic environmental concern	X	
Biospheric environmental concern	→	Intention to eat sustainably
Dispositional empathy with animals	X	
Knowledge about sustainable nutrition	→	
Perceived consumer effectiveness	→	
Nature relatedness	X	
Egoistic environmental concern	X	
Altruistic environmental concern	X	
Biospheric environmental concern	→	Vegetarianism
Dispositional empathy with animals	→	
Knowledge about sustainable nutrition	→	
Perceived consumer effectiveness	→	

Note: → = Predictor variable, X = No connection. The connection of the independent variables refers to all dependent variables.

Nature relatedness

Consistent with previous studies conducted with student biology teachers (Weber et al., 2020; Weber & Fiebelkorn, 2019), study 2 found a positive effect of nature relatedness on the intention to eat sustainably. This finding also aligns with studies that showed a positive correlation between nature relatedness or comparable variables and PEB (Capaldi et al., 2014; Mayer & Frantz, 2004; Otto & Pensini, 2017; Rosa et al., 2018; Whitburn et al., 2020). It can be assumed that nature related young people identify with nature and are therefore more likely to associate environmental degradation to themselves and consequently more likely to engage in environmentally friendly behaviors, such as following a sustainable diet. At first glance, however, it seems surprising that nature relatedness was not a significant predictor for vegetarianism, as this represents a concrete example of sustainable dietary

behavior. One possible reason for this could lie in the motivations that underpin the adoption of a vegetarian diet. The most frequently mentioned reason for vegetarianism is avoiding animal suffering, followed by health motives and, thirdly, environmental motivations (Humane League Labs, 2014; Janssen et al., 2016; Ruby, 2012). Although environmental motivations are important to many vegetarians, and a correlation was observed between vegetarianism and nature relatedness in study 2, it is plausible that nature relatedness is less relevant in explaining vegetarianism when more critical variables, such as dispositional empathy with animals, are taken into consideration. Even if nature relatedness only reliably predicts the intention to eat sustainably, but not vegetarianism, it still represents a relevant psychological factor for promoting sustainable dietary intention. It should therefore be considered as a learning prerequisite for education for sustainable nutrition and encouraged among high school students.

Environmental concern

In line with previous studies on the relationship between environmental concern and PEB (Schultz, 2001; Schultz et al., 2004, 2005), including those across different cultural settings (Milfont et al., 2006), environmental concern based on biospheric reasons was found to be the sole positive predictor for sustainable dietary intention and behavior in young people. This result contradicts Weber et al.'s (2020) observation that altruistic environmental concern was the only dimension predicting the intention to eat sustainably in a sample of student biology teachers. This difference between high school students and preservice biology teachers might be explained by the reasonable assumption that student biology teachers have a more holistic conception of sustainable nutrition and are more likely to grasp the social aspects of sustainable nutrition. From the current study results, it can be deduced that the biospheric dimension of environmental concern should be promoted in educational interventions aimed at fostering sustainable dietary intention and behavior among high school students.

Dispositional empathy with animals

Dispositional empathy with animals was a significant predictor of vegetarianism, which complements previous research (Kern & Fiebelkorn, 2020; Rothgerber & Mican, 2014; Zickfeld et al., 2018). Vegetarianism is similar to the first recommendation for a sustainable diet (i.e., preference for plant-based foods; von Koerber et al., 2017). However, unlike the remaining recommendations that cover dietary behaviors aiming to protect the environment, vegetarianism represents a behavior that is often motivated by animal ethics. The observed correlation between nature relatedness and vegetarianism (Table 4.5) nevertheless suggests environmental motivations also play a role in this type of sustainable behavior. The observation that dispositional empathy with animals had no explanatory power for the intention to eat sustainably could feasibly be explained by the overshadowing effect of more strongly linked variables such as nature relatedness.

Even though dispositional empathy with animals did not predict the intention to eat sustainably, its association to vegetarianism arguably qualifies it as a learning requirement

that should be promoted for education for sustainable nutrition. Tasks that train students to take the perspective of animals have been shown to promote dispositional empathy with animals (Berenguer, 2007; Schultz, 2000; Sevillano et al., 2007). To connect more clearly with the topic of sustainable nutrition, the exercise should focus on farm animals (Kern & Fiebelkorn, 2020). An attempt should be made to convey a realistic picture of meat production to establish the connection between meat and its animal origins (Kunst & Hohle, 2016).

Knowledge about sustainable nutrition and PCE

In addition to human-nature relationship variables, knowledge about sustainable nutrition, consisting of system, action-related, and effectiveness knowledge, emerged as relevant factors in explaining sustainable dietary intention and behavior, but the effect was very small. It is also conceivable that knowledge about sustainable nutrition moderates the established effects of nature relatedness and biospheric environmental concern on sustainable dietary intention since knowledge about the environmental impact of one's nutritional behavior must first be constructed to recognize its role in protecting nature. This possibility should therefore be considered in future studies using moderator analysis.

For methodological reasons, it was not possible to conduct separate assessments of the three knowledge dimensions. Based on the current results, it can therefore not be determined which knowledge dimensions should be the focus for promoting sustainable dietary intention and behavior in the context of education for sustainable nutrition. The knowledge test developed here can serve as a basis for further research. However, it should be extended to fully capture the dimensions of action-related and effectiveness knowledge, as these were captured by a relatively small number of test items.

Consistent with previous studies that have demonstrated a positive effect of PCE on pro-environmental intention and behavior (Coelho et al., 2017; de Boer et al., 2016; Joshi & Rahman, 2019; Kabadayı et al., 2015; Kim & Choi, 2005; Lee et al., 2014) and on the willingness to consume less meat (de Boer et al., 2016), PCE was found to be a significant explanatory variable for both the intention to eat sustainably and vegetarianism. This result highlights that even among high school students, understanding how individual behavior (i.e. dietary choices) contributes to solving environmental problems encourages the intention to act and the execution of the behavior (Kim & Choi, 2005). Therefore, education for sustainable nutrition should provide appropriate information and examples to illustrate the direct effect of food choices on the environment (Coelho et al., 2017; Kabadayı et al., 2015). For example, reflecting on the ecological footprint of one’s nutritional behavior or evaluating different products using life cycle analyses (Rieckmann, 2017) could help students realize that their dietary efforts contribute to protecting the environment and addressing global issues. Educational practice already has didactic concepts that focus on evaluating different foods according to their ecological footprint and other sustainability criteria (Fiebelkorn & Kuckuck, 2020) using data-based decision making (Fiebelkorn et al., 2020; Fiebelkorn & Kuckuck, 2019).

5.2 Students' conceptions of sustainable nutrition

Before discussing the results of the investigation into high school students' conceptions of sustainable nutrition, it is important to note that due to the qualitative nature of the study, it was not possible to interview a large number of students, which limits the representativeness of the results. Participant selection was also conducted by the teachers. The possibility that some of the participants had a specific interest in nutrition cannot be ruled out, which may also affect the representativeness of the results. However, this bias is most likely minimal because students were only told that the interview was about nutrition (not sustainable nutrition).

This subchapter discusses the findings of the qualitative content analysis regarding students' conceptions of sustainable nutrition and derives recommendations for instructional design. The discussion first addresses the identified alternative conceptions about the term 'sustainable nutrition' and then turns to the conceptions about the different dimensions of sustainable nutrition.

The qualitative content analysis identified negative interpretations of the term 'sustainable nutrition' and conceptions that equated it with a healthy diet. Based on this, classroom interventions must give possibilities for students to accommodate such conceptions to reconstruct them toward the scientifically accurate representation of sustainable nutrition. For example, cognitive conflicts could be used to trigger a conceptual change (Posner et al., 1982; Strike & Posner, 1992), which supports the accommodation process (Tobinski & Fritz, 2014).

Overall, the qualitative study found that the health dimension of sustainable nutrition was particularly prominent in students' naïve conceptions. In this context, the results echo those of other studies on students' and laypeople's conceptions of and attitudes toward nutrition issues (BMEL, 2017; Gralher, 2015; Techniker Krankenkasse, 2017). In addition, some alternative conceptions were found within this dimension, including ideas about the recommended intake of macronutrients that contradicted official dietary recommendations. These reflected popular weight-loss diets rather than healthy diet recommendations prescribed by nutritional societies. Therefore, for teaching practice, the use of clear nutritional recommendations describing which food groups should be consumed in what amounts to optimally meet macro- and micronutrient needs is essential. For example, the Eat Well guide for the United Kingdom (Public health England et al., 2016) and the Nutrition Circle of the German Nutrition Society (DGE, 2020) are well suited to this purpose. To address the uncertainties around the vegan diet, providing dietary guidelines for vegetarians and vegans, such as vegetarian food pyramids or the vegan food plate by ProVeg International (2018), is recommended. Moreover, due to the students' focus on the health dimension, it should be emphasized that sustainable nutrition and nutrition more generally are not exclusively health-related topics. The connections between sustainable nutrition and the ecological, social, and economic dimensions should be highlighted by promoting systems thinking. Since the health dimension was strongly represented in the conceptions of

students with a poorly elaborated conception of sustainable nutrition (20 out of 46 students exclusively considered the health dimension in their naïve conceptions), the health dimension can be used as a starting point to make sustainable nutrition more accessible for students without much previous experience.

The ecological dimension was the second most commonly noted aspect in the students' conceptions about sustainable nutrition. This result confirms findings from previous studies on conceptions about sustainability topics, in which a focus on ecological aspects was identified (Lockley & Jarrath, 2013; Menzel & Bögeholz, 2006). Nevertheless, in line with the observations of Gralher (2015), some students had difficulty grasping the influence of their dietary behavior on the environment. To counter this alternative conception, education for sustainable nutrition should illustrate the environmental impact of one's dietary behavior. At the same time, care should be taken to provide students with examples of implementable actions that can reduce the environmental impact of their diet. The recommendations of von Koerber et al. (2017) are excellently suited for this purpose.

Consistent with earlier research on students' conceptions about sustainable development (Lockley & Jarrath, 2013), the social dimension played a minimal role in students' conceptions about sustainable nutrition. Some students were not able to link sustainable nutrition to its social dimension in any way. This indicates an egocentric perspective and a deficit in students' ability to adopt the perspective of others in unfamiliar situations (e.g., workers in the value chain of food products). Education for sustainable nutrition should try to create situations that encourage students to take on the perspective of food actors (e.g., cocoa farmers). Suitable means to train perspective-shifting include encounters with local food producers. Exploring media that portray the situation of food distribution or food cultivation in other countries can help develop a global perspective and an enhanced understanding of people in countries experiencing food poverty. For example, the Fairtrade Schools website (2021) provides a range of free teaching materials to support global learning in the classroom.

The economic dimension also featured marginally in students' conceptions of sustainable nutrition, consistent with earlier findings (Lockley & Jarrath, 2013). When it was considered, it was often perceived as conflicting with sustainable nutrition (Krüger & Strüver, 2018). Such an alternative conception negates the possibility of achieving "sustainable development in its three dimensions—economic, social, and environmental—in a balanced and integrated manner" (United Nations General Assembly, 2015). It also undermines the students' perceived effectiveness in their role as food consumers to transform the food system into a more sustainable one. Education for sustainable nutrition should emphasize the importance of the economic dimension and explicitly address its compatibility with sustainable nutrition. For students to recognize that there is not necessarily a contradiction between economic progress and sustainable nutrition, examples of economic actors in the food sector could be given who sustainably manage their companies within profitable business models, e.g., by marketing organic food, saving on packaging, and promoting fair working conditions.

Classroom discussions of consumer opportunities to support sustainable companies (e.g., every purchase decision supports a particular company) are recommended to promote students' perceived consumer effectiveness. Since students often cited the higher cost of sustainable nutrition as a barrier to consuming sustainable products, teachers should address these concerns by clarifying that not all recommendations need to be followed. The focus should be on recommendations that can be implemented at low costs (e.g., preference for plant-based foods, resource-saving housekeeping, regional and seasonal products, preference for minimally processed foods; von Koerber et al., 2017).

The qualitative results also highlight that very few students' naïve ideas about sustainable nutrition captured the cultural dimension. Even when asked about this explicitly, many students failed to make the connection between culture and sustainable nutrition. This disconnect could lead to students adopting culturally determined, unsustainable eating habits without questioning. Examples of culturally conditioned food habits include the association of meat consumption with masculinity (Ruby & Heine, 2011) and disgust towards unfamiliar food practices, such as the consumption of insects (Dupont & Fiebelkorn, 2020). Education for sustainable nutrition should support critical questioning of culturally determined dietary beliefs and engage students in discussions around other cultures' eating habits in comparison (e.g., consumption of insects—entomophagy; Fiebelkorn, 2017). Since more than half of the interviewed students had difficulty separating the social and cultural dimensions, it is recommended that the cultural aspects are discussed as part of the social dimension. This is not intended to minimize the crucial role of culture in nutrition. However, because the social and cultural dimensions overlap to some extent, considering them separately might only serve to confuse students further.

It is important to note that these results, especially the students' alternative conceptions of sustainable nutrition, are not seen exclusively as barriers to successful learning but also as opportunities and foundations on which new knowledge structures can be built.

5.3 Synthesis of the results

This subchapter aims to draw comparisons and identify connections between the three studies' findings to reveal possible synergies from implementing the teaching practice recommendations. This only includes results that, should they be considered in policy and education, would positively affect several learning prerequisites for education for sustainable nutrition. Results that relate only to the improvement of individual learning requirements are not included in this part of the general discussion; however, this is not a reflection of their importance.

In examining young people's learning prerequisites for education for sustainable nutrition, nature relatedness and biospheric environmental concern were identified as key determinants of sustainable dietary intention and behavior (study 2). The results of the cross-cultural study (study 1) indicated that political support and government policies that emphasize the value of nature, while also embracing appropriate narratives of living a good life in harmony with nature, can promote nature relatedness and biospheric environmental

concern among young people. Given the results of study 2, this may indirectly promote sustainable dietary intention and behavior. Study 1 also identified self-transcendence as a culturally independent predictor of nature relatedness and biospheric concern. Furthermore, study 1 found a positive effect of time spent in nature on nature relatedness and biospheric environmental concern. Interventions such as nature-based environmental education provide students with opportunities to spend time in nature and have been shown to promote nature relatedness among students (Barrable & Booth, 2020; Liefländer et al., 2013; Otto & Pensini, 2017). The results of study 1 would indicate that such interventions might also promote biospheric environmental concern. Therefore, the results of studies 1 and 2 give sufficient reason to assume that the promotion of self-transcendence and time spent in nature indirectly influences sustainable dietary intention and behavior via nature relatedness and biospheric environmental concern.

Knowledge about sustainable nutrition showed only a small direct effect on sustainable dietary intention and behavior (study 2). However, based on the results of study 3, it can be argued that knowledge about sustainable nutrition may act as a moderator variable that could strengthen the established effect of nature relatedness and biospheric environmental concern on sustainable dietary intention and behavior. This assumption is based on the observation in study 3 that many students experienced difficulties grasping the impact of their dietary behavior on the environment. If students feel connected with nature and are concerned about environmental problems due to biospheric motives, but they do not see a connection between their dietary behavior (system knowledge), or do not understand how strong the impact of certain dietary practices on the environment is (effectiveness knowledge), then they will not see a reason for adopting a sustainable diet. Consequently, it is reasonable to hypothesize that addressing these connections (promoting knowledge about sustainable nutrition), as called for based on the results of study 3, could strengthen the effect of nature relatedness and biospheric environmental concern on sustainable dietary intention and behavior. This assumption was not explicitly addressed in this dissertation and should be investigated in future studies.

The qualitative study revealed that the economic dimension was given little consideration in students' conceptions, and when it was considered, it was often perceived as an antagonist to sustainable nutrition. Opportunities to influence the food system through consumer behavior were therefore not recognized. The recommendations from study 3 emphasize the importance of the economic dimension to transforming the food system and reinforce students' power as consumers. Both aspects would benefit the accommodation process, i.e., the adaptation of naïve conceptions to new information (Piaget, 1974, 1983; Posner et al., 1982), and promote students' PCE, which was identified in study 2 as the strongest predictor of sustainable dietary intention and behavior.

5.4 Conclusion

This dissertation's findings advocate that teachers should understand students as learners who already hold conceptions of the subject matter, in this case of sustainable nutrition,

before they are confronted with it in the classroom. Teachers should be aware of these pre-existing conceptions and perceive them both as potential obstacles to learning and as the basis on which students actively construct new knowledge structures (Piaget, 1974, 1983; Posner et al., 1982). This dissertation's findings enable teachers to better understand high school students' conceptions about sustainable nutrition and will help them systematically address these in the classroom (see also Duit & Treagust, 2003; Kattmann, 2015). Since alternative conceptions were found to be relatively robust (Duit, 1993, 1995; Posner et al., 1982), it might not be sufficient to present a scientifically accurate account for students to restructure their conceptions. Instead, confronting the alternative conceptions should provoke a cognitive conflict (Posner et al., 1982; Strike & Posner, 1992) that supports the accommodation process (Tobinski & Fritz, 2014).

However, the results also show that teachers should recognize that subject-matter knowledge, in this case, knowledge about sustainable nutrition, is a necessary but not sufficient prerequisite for the development of a sustainable dietary intention or behavior (see also Roczen et al., 2010). On the contrary, teachers should focus less on teaching knowledge and more on promoting PCE, which was the strongest predictor of high school students' sustainable dietary intention or behavior. In addition, the human-nature relationship should also be perceived as an essential learning prerequisite for education for sustainable nutrition. In particular, the promotion of the self-transcendence value dimension and first-hand nature experiences should be taken into account in educational interventions because they promote nature relatedness and biospheric environmental concern, which in turn are significant predictors of the intention to eat sustainably in high school students. Alongside biospheric environmental concern, dispositional empathy with animals was identified as a predictor for a concrete sustainable dietary behavior, in this case, vegetarianism. This part of the human-nature relationship should be an additional consideration in developing educational interventions on sustainable nutrition.

In the broader context of education for sustainable development, the results of this dissertation can contribute to empowering "learners to take informed decisions and responsible actions [in the field of nutrient] for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity" (UNESCO, 2014, p. 12).

Educating young people to become informed and responsible citizens who take decisions and responsible actions in favor of ecological, social, and economic sustainability alone will not accomplish the transformations of the food system toward sustainable development in the necessary timeframe. There is widespread scientific consensus that transforming the food system will only be possible with wide-ranging political measures (FAO et al., 2020; Rockström et al., 2020; Willett et al., 2019). However, a focus on sustainable nutrition within the context of education for sustainable development can support the policy-led process by educating responsible consumers who take decisions and actions in favor of a sustainable food system.

6 Summary

The current food system is considered one of the leading causes of many global problems, such as climate change and biodiversity loss. Education for sustainable development (ESD) that promotes sustainable diets among young people can contribute significantly to overcoming these problems. Indeed, sustainable nutrition represents an ideal teaching context for ESD because it combines the ecological, social, and economic dimensions of sustainable development in a regional-global context better than most other topics. However, to develop appropriate teaching-learning arrangements, the learning prerequisites for education for sustainable nutrition should first be considered. These include both students' conceptions about the subject matter and psychological factors that encourage sustainable dietary intention and behavior.

Because of their particular importance for the performance of pro-environmental behaviors, such as adopting a sustainable diet, the first study examined the human-nature relationship of 2173 German (M_{age} = 14.56 years, *SD* = 1.45; female: 55.1%) and 451 Ecuadorian (M_{age} = 14.63 years, *SD* = 1.77; female: 55.3%) secondary school students. More specifically, the study examined the effect of selected basic human values, gender, and time spent in nature on nature relatedness and environmental concern in the two cultures. Results showed that the Ecuadorian students were more related to nature than their German counterparts. In addition, culture-specific differences were identified in the dimensional structure of environmental concern and the role of gender in nature relatedness and biospheric environmental concern. The value dimension of self-transcendence and time spent in nature were determinants of nature relatedness and biospheric environmental concern in both cultures. With respect to educational practice, the study provides empirical evidence that the value dimension of self-transcendence and time spent in nature should be promoted to strengthen the human-nature relationship.

The second study aimed to identify factors predicting sustainable dietary intentions and behavior in young people. For this purpose, in a second quantitative study conducted with 624 German secondary school students (M_{age} = 16.63 years; SD = 1.15; female: 48.2%) data regarding their intention to eat sustainably, their dietary behavior (vegetarian/vegan or omnivorous), and several factors related to environmentally friendly behaviors in previous studies were collected. The study identified perceived consumer effectiveness, biospheric environmental concern, and knowledge about sustainable nutrition as determinants of the intention to eat sustainably and adopting a vegetarian diet, the latter being an example of a sustainable diet. While nature relatedness was only relevant for explaining the intention to eat sustainably, dispositional empathy with animals was exclusively linked to vegetarianism. Thus, the study provides important information on the factors that should be considered when developing educational concepts to promote sustainable diets.

In the third study semi-structured individual interviews were used to collected data on the conceptions about sustainable nutrition from 46 German secondary school students (M_{age} = 15.59, SD = 0.78; female = 47.8%;). The study investigated to what extent the different

dimensions of sustainable nutrition (health, environment, economy, society, and culture) were represented in students' conceptions. The results showed that the health dimension dominated the students' conceptions of sustainable nutrition. However, the more dimensions the students considered in their conceptions, the less the health dimension was represented and the more the environmental dimension was represented. The dimensions of society, economy, and especially culture were rarely present in the students' conceptions. Furthermore, some students held alternative conceptions about sustainable nutrition and could not establish a relationship between sustainable nutrition and the dimensions of environment, society, economy, and culture, which indicated a predominantly egocentric view on nutrition, focused on their own body.

Since students' conceptions, as well as psychological factors that promote sustainable dietary intention and behavior, are essential learning prerequisites for education for sustainable nutrition, the results of this dissertation provide the basis for successfully developing teaching-learning arrangements on sustainable nutrition. Finally, recommendations for integrating the results into educational practice are provided.

7 Zusammenfassung

Das derzeitige Lebensmittelsystem gilt als einer der Hauptverursacher zahlreicher globaler Probleme wie dem Klimawandel und dem Rückgang der Biodiversität. Bildung für nachhaltige Entwicklung (BNE), die eine nachhaltige Ernährung bei jungen Menschen fördert, kann wesentlich zur Überwindung dieser Probleme beitragen. Zudem stellt das Thema einer nachhaltige Ernährung einen in höchster Form geeigneten Beispielkontext für BNE dar, weil es so gut wie kaum ein anderes Thema die ökologische, soziale und ökonomische Dimension einer nachhaltigen Entwicklung in einem regional-globalen Bezugsrahmen vereint. Für die Entwicklung geeigneter Lehr-Lernarrangements sollten jedoch die Lernvoraussetzung bezüglich einer Bildung für nachhaltigen Ernährung berücksichtigt werden, welche sowohl die Präkonzepte zum Unterrichtsgegenstand als auch psychologische Faktoren umfassen, die nachhaltige Ernährungsabsichten und Ernährungsverhaltensweisen fördern.

Aufgrund ihrer besonderen Bedeutung für die Ausführung umweltfreundlicher Verhaltensweisen, wie eine nachhaltige Ernährung, untersuchte die erste Studie die Mensch-Natur-Beziehung von 2173 deutschen (M_{Alter} = 14,56 Jahre, SD = 1,45; weiblich: 55,1%) und 451 ecuadorianischen (M_{Alter} = 14,63 Jahre, SD = 1,77; weiblich: 55,3%) Schüler*innen der Sekundarstufe. Im Speziellen wurde die Rolle ausgesuchter grundlegender menschlicher Werte, des Geschlechts und der in der Natur verbrachten Zeit für die Entwicklung von Naturverbundenheit und Umweltbetroffenheit in den zwei Kulturen beleuchtet. Die Ergebnisse zeigten, dass die ecuadorianischen Schüler*innen naturverbundener als Schüler*innen in Deutschland waren. Darüber hinaus wurden kulturspezifische Unterschiede hinsichtlich der dimensionalen Struktur von Umweltbetroffenheit sowie der Rolle des Geschlechts für die Entwicklung von Naturverbundenheit und biospherisch motivierte Umweltbetroffenheit ermittelt. Die Wertedimension Selbst-Überwindung sowie die in der Natur verbrachte Zeit stellten in beiden Kulturen Determinanten für Naturverbundenheit und biospherisch motivierte Umweltbetroffenheit dar. Mit Blick auf die unterrichtliche Praxis sprechen die Befunde der Studie dafür, dass die Wertedimension Selbst-Überwindung und Zeit in der Natur gefördert werden sollten, um die Mensch-Natur-Beziehung bei Schüler*innen sowohl in Ecuador als auch in Deutschland zu stärken.

Die zweite Studie verfolgte das Ziel, Faktoren zu identifizieren, die nachhaltige Ernährungsabsichten und -verhalten bei Jugendlichen vorhersagen. Zu diesem Zweck wurden in einer zweiten quantitativen Studie 624 deutsche Schüler*innen der Sekundarstufe (M_{Alter} = 16,63 Jahre; SD = 1,15; weiblich: 48,2%) hinsichtlich ihrer Intention, sich nachhaltig zu ernähren, zu ihren Ernährungsgewohnheiten (vegetarisch/vegan oder omnivor) und zu mehreren Faktoren befragt, die in früheren Studien im Zusammenhang mit umweltfreundlichen Verhaltensweisen standen. Die Studie identifizierte die wahrgenommene Konsument*inneneffektivität, biospherisch motivierte Umweltbetroffenheit sowie Wissen über nachhaltige Ernährung als Determinanten für die Intention sich nachhaltige zu ernähren und für die Ausführung einer vegetarischen Ernährungsweise, welche ein partielles Beispiel einer nachhaltigen Ernährung darstellt.

Während Naturverbundenheit lediglich für die Erklärung von der Intention sich nachhaltige zu ernähren relevant war, sagte die dispositionelle Empathie gegenüber Tieren nur Vegetarismus vorher. Damit gibt die Studie wichtige Hinweise darauf, welche Faktoren bei der Entwicklung didaktischer Konzepte zur Förderung nachhaltiger Ernährungsweisen berücksichtigt werden sollten.

Mittels semistrukturierten Einzelinterviews wurden in der dritten Studie die Vorstellungen von 46 deutsche Schüler*innen Sekundarstufe (M_{Alter} = 15,59, *SD* = 0,78; weiblich = 47,8%;) bezüglich einer nachhaltigen Ernährung erhoben. Dabei wurde ermittelt, wie präsent die Dimensionen einer nachhaltigen Ernährung (Gesundheit, Umwelt, Wirtschaft, Gesellschaft und Kultur) in den Vorstellungen der Schüler*innen sind. Die Ergebnisse zeigten, dass die Schüler*innenvorstellungen bezüglich einer nachhaltigen Ernährung von der gesundheitlichen Dimension dominiert wurden. Je mehr Dimensionen die Schüler*innen jedoch in Ihren Vorstellungen berücksichtigten, desto weniger wurde die gesundheitliche Dimension fokussiert und desto stärker war die Dimension Umwelt in den Vorstellungen vertreten. Die Dimensionen Gesellschaft, Wirtschaft und besonders Kultur fanden insgesamt wenig Berücksichtigung in den Vorstellungen der Schüler*innen. Darüber hinaus verfügten einige Schüler*innen über alternative Vorstellungen bezüglich des Ausdrucks einer nachhaltigen Ernährung und konnten keine Beziehung zwischen einer nachhaltigen Ernährung und den Dimensionen Umwelt, Gesellschaft, Wirtschaft und Kultur herstellen, was auf eine vorherrschend egozentrische Sichtweise auf Ernährung hindeutet, die die Grenzen des eigenen Körpers nicht überschritt.

Da die Vorstellungen von Schüler*innen bezüglich einer nachhaltigen Ernährung, aber auch psychologische Faktoren, welche eine nachhaltige Ernährung begünstigen, wichtige Lernvoraussetzungen für eine Bildung für nachhaltige Ernährung darstellen, bilden die Ergebnisse die Grundlage für die erfolgreiche Entwicklung von Lehr-Lernarrangements zu dieser Thematik. Vorschläge zur Integration der Ergebnisse in die unterrichtliche Praxis werden gegeben.

8 References

Acosta, A. (2015). *Buen vivir: Vom Recht auf ein gutes Leben*. Oekom.

Adamitzki, S., Groth, H., Hoppe, P., Hoppe, T., Jakobsen, J., Kroll, D., Leiding, U., Mittler, D., Moschner-Rahe, K., Sudeik, T., Volkmer, J., & Wolthaus, P. (2020). *Blickpunkt Biologie 1*. Westermann.

Adarme-Vega, T., Lim, D. K. Y., Timmins, M., Vernen, F., Li, Y., & Schenk, P. M. (2012). Microalgal biofactories: a promising approach towards sustainable omega-3 fatty acid production. *Microbial Cell Factories*, *11*(1), 96. https://doi.org/10.1186/1475-2859-11-96

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Aleksandrowicz, L., Green, R., Joy, E. J. M., Smith, P., & Haines, A. (2016). The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: a systematic review. *PLoS ONE*, *11*(11). https://doi.org/10.1371/journal.pone.0165797

Alexander, P., Brown, C., Arneth, A., Dias, C., Finnigan, J., Moran, D., & Rounsevell, M. D. A. (2017). Could consumption of insects, cultured meat or imitation meat reduce global agricultural land use? *Global Food Security*, *15*, 22–32. https://doi.org/10.1016/j.gfs.2017.04.001

Alexandratos, N., & Bruinsma, J. (2012). World agriculture towards 2030/2050: the 2012 revision. In *ESA Working paper* (No. 12–03). www.fao.org/economic/esa

American Psychological Association. (2016). Revision of ethical standard 3.04 of the "Ethical Principles of Psychologists and Code of Conduct" (2002, as amended 2010). *American American Psychologist*, *71*(9), 900.

Antil, J. H. (1984). Socially responsible consumers: profile and implications for public policy. *Journal of Macromarketing*, *5*(2), 18–39. https://doi.org/10.1177/027614678400500203

Aragon, A. A., Schoenfeld, B. J., Wildman, R., Kleiner, S., VanDusseldorp, T., Taylor, L., Earnest, C. P., Arciero, P. J., Wilborn, C., Kalman, D. S., Stout, J. R., Willoughby, D. S., Campbell, B., Arent, S. M., Bannock, L., Smith-Ryan, A. E., & Antonio, J. (2017). International society of sports nutrition position stand: diets and body composition. *Journal of the International Society of Sports Nutrition*, *14*(1), 16. https://doi.org/10.1186/s12970-017-0174-y

Asamblea Constituyente de Ecuador. (2008). *Constitución del Ecuador*. http://www.asambleanacional.gov.ec/documentos/constitucion_de_bolsillo.pdf

Baack, K., & Steinert, C. (2015). *Natura 7/8 - Biologie für Gymnasien*. Klett.

Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: an investigation of adults with Asperger Syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, *34*(2), 163–175.

Barrable, A., & Booth, D. (2020). Increasing nature connection in children: a mini review of interventions. *Frontiers in Psychology*, *11:492*. https://doi.org/10.3389/fpsyg.2020.00492

Bartsch, S. (2008). *Jugendesskultur: Bedeutung des Essens für Jugendliche im Kontext Familie und Peergroup*. BZgA.

Bartsch, S. (2015). Subjektive Theorien von Studierenden zur Nachhaltigen Ernährung. Explorationsstudie. *Haushalt in Bildung & Forschung*, *4*(4), 78–92. https://doi.org/10.3224/hibifo.v4i4.21295

Batson, C. D. (1987). Prosocial motivation: is it ever truly altruistic? In L. Berkowitz (Ed.), *Advances in experimental social psychologogy* (pp. 65–122). Academic Press.

Batson, C. D. (2014). *The altruism question: toward a social-psychological answer*. Psychology Press.

Batson, C. D., Chang, J., Orr, R., & Rowland, J. (2002). Empathy, attitudes, and action: can feeling for a member of a stigmatized group motivate one to help the group? *Personality and Social Psychology Bulletin*, *28*(12), 1656–1666. https://doi.org/10.1177/014616702237647

Berenguer, J. (2007). The effect of empathy in proenvironmental attitudes and behaviors. *Environment and Behavior*, *39*(2), 269–283. https://doi.org/10.1177/0013916506292937

Bergau, M., Hoffmann, L., Ixmeier, R., Kalusche, D., Ley, S., Nelk, S., Schäfe, B., Walcher, M., & Willmer-Klimp, C. (2015). *Prisma Biologie 9/10 - Differenzierende Ausgabe, Lehrerband* (1st ed.). Klett.

Bergau, M., Hoffmann, L., Ixmeier, R., Kalusche, D., Ley, S., Nelke, S., Röhrich, R., Schäfer, B., & Willmer-Klimp, C. (2018). *Prisma Biologie 7/8 - Differenzierende Ausgabe, Lehrerband* (2nd ed.). Klett.

Berglund, T., & Gericke, N. (2016). Separated and integrated perspectives on environmental, economic, and social dimensions – an investigation of student views on sustainable development. *Environmental Education Research*, *22*(8), 1115–1138. https://doi.org/10.1080/13504622.2015.1063589

Beutel, A. M., & Marini, M. M. (1995). Gender and values. *American Sociological Review*, *60*(3), 436–448.

Beyer, I., Remé, R., & Steinert, C. (2016). *Natura 9/10 - Biologie für Gymnasien*. Klett.

BMEL (Federal Ministry of Food and Agriculture) (Ed.). (2017). *Deutschland, wie es isst: Der BMEL-Ernährungsreport 2017*. http://www.bmel.de/SharedDocs/Downloads/Broschueren/Ernaehrungsreport2017.pdf?__blob=publicationFile

BMEL (Federal Ministry of Nutrition and Agriculture). (2018). *Zeitreise durch die Ernährung - Essen im Wandel*. https://www.bmel.de/SharedDocs/Downloads/Broschueren/ZeitreiseErnaehrung.pdf?_

_blob=publicationFile

BMU (Federal Ministry for the Environment Nature Conservation and Nuclear Safety). (2014). *Fifth national report under the convention on biological diversity*. https://www.cbd.int/doc/world/de/de-nr-05-en.pdf

BMU (Federal Ministry for the Environment Nature Conservation and Nuclear Safety), & BFN (Federal Agency for Nature Conservation). (2010). *Naturbewusstsein 2009: Bevölkerungsumfrage zu Natur und biologischer Vielfalt*. BMU.

BMU (Federal Ministry for the Environment Nature Conservation and Nuclear Safety), & BFN (Federal Agency for Nature Conservation). (2018). *Naturbewusstsein 2017: Bevölkerungsumfrage zu Natur und biologischer Vielfalt*. BMU.

BMU (Federal Ministry for the Environment Nature Conservation and Nuclear Safety), & BFN (Federal Agency for Nature Conservation). (2020). *Naturbewusstsein 2019: Bevölkerungsumfrage zu Natur und biologischer Vielfalt*. BMU.

BMU (Federal Ministry for the Environment Nature Conservation and Nuclear Safety), & BMZ (Federal Ministry for Economic Cooperation and Development). (2016). *Committed to biodiversity: Germany's international cooperation to implementing the convention on biological diversity for sustainable development*. BMU & BMZ.

Bortz, J., & Döring, N. (2006). *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler* (4th ed.). Springer.

Brämer, R. (1999). *Jugendreport Natur: Naturverklärung – Emprirische Befunde zum jugendlichen Naturbild*. https://www.wanderforschung.de/files/rep971255855059.pdf

Brämer, R. (2004). *Jugendreport Natur '03: Nachhaltige Entfremdung*. https://www.wanderforschung.de/files/report03kz1240583282.pdf

Brämer, R. (2010). *Natur: Vergessen? – Erste Befunde des Jundreports Natur 2010.* https://www.wanderforschung.de/files/1011068-jugendreport2010-2aufl-p120_1607021617.pdf

Brämer, R., Koll, H., & Schild, H.-J. (2016). *7. Jugendreport Natur 2016: Natur = Nebensache? – Erste Ergebnisse*. https://www.wanderforschung.de/files/jugendreport2016-web-final-160914-v3_1903161842.pdf

Brennan, R. L., & Prediger, D. J. (1981). Coefficient Kappa: some uses, misuses, and alternatives. *Educational and Psychological Measurement*, *41*(3), 687–699. https://doi.org/10.1177/001316448104100307

Brügger, A., Kaiser, F. G., & Roczen, N. (2011). One for all?: connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *European Psychologist*, *16*(4), 324–333. https://doi.org/10.1027/1016-9040/a000032

Brügger, A., & Otto, S. (2017). Naturbewusstsein psychologisch: Was ist Naturbewusstsein, wie misst man es und wie wirkt es auf Umweltschutzverhalten? In J. Rückert-John (Ed.), *Gesellschaftliche Naturkonzeptionen* (pp. 215–237). Springer Fachmedien Wiesbaden. http://link.springer.com/10.1007/978-3-658-15733-3_11

Bryant, C., & Dillard, C. (2020). *Educated choices program: an impact evaluation of a classroom intervention to reduce animal product consumption*. https://doi.org/10.31219/osf.io/hecyk

Burlingame, Barbara. (2012). Preface. In B. Burlingame, S. Ernini, Nutrition and Consumer Protection Division, & FAO (Eds.), *Sustainable diets and biodiversity: directions and solutions for policy, research and action* (pp. 6–8). FAO.

Burlingame, Barbara, Dernini, S., Nutrition and Consumer Protection Division, & FAO (Eds.). (2012). *Sustainable diets and biodiversity: directions and solutions for policy, research and action*. FAO.

Çabuk, S., Tanrikulu, C., & Gelibolu, L. (2014). Understanding organic food consumption: attitude as a mediator. *International Journal of Consumer Studies*, *38*(4), 337–345. https://doi.org/10.1111/ijcs.12094

Caine-Bish, N. L., & Scheule, B. (2009). Gender differences in food preferences of school-aged children and adolescents. *Journal of School Health*, *79*(11), 532–540. https://doi.org/10.1111/j.1746-1561.2009.00445.x

Campbell, B. M., Beare, D. J., Bennett, E. M., Hall-Spencer, J. M., Ingram, J. S. I., Jaramillo, F., Ortiz, R., Ramankutty, N., Sayer, J. A., & Shindell, D. (2017). Agriculture production as a major driver of the Earth system exceeding planetary boundaries. *Ecology and Society*, *22*(4), 8. https://doi.org/10.5751/ES-09595-220408

Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: a meta-analysis. *Frontiers in Psychology*, *5:976*. https://doi.org/10.3389/fpsyg.2014.00976

Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., Narwani, A., Mace, G. M., Tilman, D., Wardle, D. A., Kinzig, A. P., Daily, G. C., Loreau, M., Grace, J. B., Larigauderie, A., Srivastava, D. S., & Naeem, S. (2012). Biodiversity loss and its impact on humanity. *Nature*, *486*(7401), 59–67. https://doi.org/10.1038/nature11148

Casaló, L. V., Escario, J.-J., & Rodriguez-Sanchez, C. (2019). Analyzing differences between different types of pro-environmental behaviors: do attitude intensity and type of knowledge matter? *Resources, Conservation and Recycling*, *149*(October 2018), 56–64. https://doi.org/10.1016/j.resconrec.2019.05.024

Cely, N. (2014). Balancing profit and environmental sustainability in Ecuador: lessons learned from the Chevron case. *Duke Environmental Law and Policy Forum*, *24*, 353–373.

Chai, B. C., van der Voort, J. R., Grofelnik, K., Eliasdottir, H. G., Klöss, I., & Perez-Cueto, F. J. A. (2019). Which diet has the least environmental impact on our planet? A systematic review of vegan, vegetarian and omnivorous diets. *Sustainability*, *11*(15), 4110. https://doi.org/10.3390/su11154110

Clark, M., Hill, J., & Tilman, D. (2018). The diet, health, and environment trilemma. *Annual Review of Environment and Resources*, *43*(1), 109–134. https://doi.org/10.1146/annurev-environ-102017-025957

Coelho, F., Pereira, M. C., Cruz, L., Simões, P., & Barata, E. (2017). Affect and the adoption of pro-environmental behaviour: a structural model. *Journal of Environmental Psychology*, *54*, 127–138. https://doi.org/10.1016/j.jenvp.2017.10.008

Costanza, R., D'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, *387*(6630), 253–260. https://doi.org/10.1038/387253a0

culture. (n.d.). Cambridge Dictionary. Retrieved May 10, 2020, from https://dictionary.cambridge.org/de/worterbuch/englisch/culture

Cunha, M., André, S., Aparício, G., Santos, E., & Nunes, C. (2016). Organization of housework in heterosexual couples: systematic review of the literature. *Procedia - Social and Behavioral Sciences*, *217*, 459–468. https://doi.org/10.1016/j.sbspro.2016.02.014

Currie, C., Zanotti, C., Morgan, A., Currie, D., de Looze, M., Roberts, C., Samdal, O., Smith, O. R. F., & Barnekow, V. (Eds.). (2012). *Social determinants of health and well-being among young people: health behaviour in school-aged children (HBSC) study: international report from the 2009/2010 survey* (No. 6; Health Policy for Children and Adolescents). WHO Regional Office for Europe.

Damerell, P., Howe, C., & Milner-Gulland, E. J. (2013). Child-orientated environmental education influences adult knowledge and household behaviour. *Environmental Research Letters*, *8*(1), 1–7. https://doi.org/10.1088/1748-9326/8/1/015016

Davidson, D. J., & Freudenburg, W. R. (1996). Gender and environmental risk concerns: a review and analysis of available research. *Environment and Behavior*, *28*(3), 302–339. https://doi.org/10.1177/0013916596283003

de Boer, J., de Witt, A., & Aiking, H. (2016). Help the climate, change your diet: a cross-sectional study on how to involve consumers in a transition to a low-carbon society. *Appetite*, *98*, 19–27. https://doi.org/10.1016/j.appet.2015.12.001

de Freitas Zompero, A., Figueiredo, H. R. S., dos Santos Garbim, T. H., & Vieira, K. M. (2019). Conceptions of Brazilian elementary and high school students about food nutrients. *Creative Education*, *10*(05), 862–873. https://doi.org/10.4236/ce.2019.105064

DGE (German Nutrition Society), ÖGE (Austrian Nutrition Society), & SGE (Swiss Nutrition Society). (2017). *D-A-CH-Referenzwerte für die Nährstoffzufuhr* (3rd ed.). DGE; ÖEG; SGE.

DGE (German Nutrition Society. (2020). *DGE-Ernährungskreis*. https://www.dge.de/ernaehrungspraxis/vollwertige-ernaehrung/ernaehrungskreis/

Díaz-Siefer, P., Neaman, A., Salgado, E., Celis-Diez, J. L., & Otto, S. (2015). Human-environment system knowledge: a correlate of pro-environmental behavior. *Sustainability*, *7*(11), 15510–15526. https://doi.org/10.3390/su71115510

Diehl, J. M. (1999). Food preferences of 10- to 14-year-old boys and girls. *Schweizerische Medizinische Wochenschrift*, *129*(5), 151—161.

Dillon, J., Rickinson, M., Sanders, D., & Teamey, K. (2005). On food, farming and land management: towards a research agenda to reconnect urban and rural lives. *International Journal of Science Education*, *27*(11), 1359–1374. https://doi.org/10.1080/09500690500153865

Döring, N., & Bortz, J. (2016). *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften* (5th ed.). Springer. https://doi.org/10.1007/978-3-642-41089-5

Dornhoff, M., Hörnschemeyer, A., & Fiebelkorn, F. (2020). Students' conceptions of sustainable nutrition. *Sustainability*, *12*(13), 5242. https://doi.org/10.3390/su12135242

Dornhoff, M., Sothmann, J.-N., Fiebelkorn, F., & Menzel, S. (2019). Nature relatedness and environmental concern of young people in Ecuador and Germany. *Frontiers in Psychology*, *10:453*. https://doi.org/10.3389/fpsyg.2019.00453

Dresing, T., & Pehl, T. (2015). *Praxisbuch Interview, Transkription & Analyse: Anleitung und Regelsysteme für qualitativ Forschende* (6th ed.). Self-published.

Duit, R. (1993). Research on students' conceptions - developments and trends. *The Proceedings of the Third International Seminar on Misconceptions and Educational Strategies in Science and Mathematics*.

Duit, R. (1995). Zur Rolle der konstruktivistischen Sichtweise in der naturwissenschaftsdidaktischen Lehr-und Lernforschung. *Zeitschrift für Pädagogik*, *41*(6), 905–923.

Duit, R., Gropengießer, H., Kattmann, U., Komorek, M., & Parchmann, I. (2012). The model of educational reconstruction - a framework for improving teaching and learning science. In D. Jorde & J. Dillon (Eds.), *Science education research and practice in Europe: retrospective and prospective* (pp. 13–37). Sense Publishers. https://doi.org/10.13140/2.1.2848.6720

Duit, R., & Treagust, D. F. (2003). Conceptual change: a powerful framework for improving science teaching and learning. *International Journal of Science Education*, *25*(6), 671–688. https://doi.org/10.1080/09500690305016

DUK (German Comission for UNESCO). (2012). *Lehr- und Lernmaterialien zum Jahresthema Ernährung. UN-Dekade "Bildung für nachhaltige Entwicklung."* DUK.

Dupont, J., & Fiebelkorn, F. (2020). Attitudes and acceptance of young people toward the consumption of insects and cultured meat in Germany. *Food Quality and Preference*, *85*, 103983. https://doi.org/10.1016/j.foodqual.2020.103983

Eckhard, T., & BMBF (Federal Ministry of Education and Research) (Eds.). (2019). *The Education System in the Federal Republic of Germany 2016/2017*. KMK (Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany).

Ellis, E. C., Goldewijk, K. K., Siebert, S., Lightman, D., & Ramankutty, N. (2010). Anthropogenic transformation of the biomes, 1700 to 2000. *Global Ecology and Biogeography*, *19*(5), 589–606. https://doi.org/10.1111/j.1466-8238.2010.00540.x

Fairtrade International. (2020a). *SDG1: No poverty*. https://www.fairtrade.net/issue/sdg1

Fairtrade International. (2020b). *SDG2: Zero hunger*. https://www.fairtrade.net/issue/sdg2

Fairtrade Schools. (2021). *Free teaching resources, lesson and assembly plans*. https://schools.fairtrade.org.uk/

FAO. (2009). *The state of food and agriculture: livestock in balance*. FAO.

FAO. (2016a). *State of the world's forests 2016: forests and agriculture: land-use challenges and opportunities*. FAO. http://www.fao.org/3/a-i5588e.pdf

FAO. (2016b). *The state of world fisheries and aquaculture 2016. Contributing to food security and nutrition for all*. FAO.

FAO. (2017). *Food and agriculture: driving action across the 2030 Agenda for Sustainable Development*. FAO.

FAO, IFAD, UNICEF, WFP, & WHO. (2019). *The state of food security and nutrition in the world 2019. Safeguarding against economic slowdowns and downturns.* FAO. https://doi.org/10.26596/wn.201910395-97

FAO, IFAD, UNICEF, WFP, & WHO. (2020). *The state of food security and nutrition in the world 2020. Transforming food systems for affordable healthy diets.* FAO. https://doi.org/10.4060/ca9692en

FAO Regional Office for Asia and the Pacific, Bangkok, T. (2019). *Ecosystem approach to fisheries and aquaculture: implementing the FAO Code of Conduct for Responsible Fisheries*. FAO.

FAO, & WWC. (2015). *Towards a water and food secure future: critical perspectives for policy-makers*. FAO, WWC.

Federal Statistical Office. (2019). *Bevölkerung Religionszugehörigkeit in 1000*. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Bevoelkerungsstand/Tabellen/bevoelkerung-religion.html

Fiebelkorn, F. (2017). Insekten als Nahrungsmittel der Zukunft. *Biologie in Unserer Zeit*, *47*(2), 104–110. https://doi.org/10.1002/biuz.201710617

Fiebelkorn, F., & Kuckuck, M. (2019). Insekten oder In-vitro-Fleisch – was ist nachhaltiger ? Eine Beurteilung mithilfe der Methode des „Expliziten Bewertens". *Praxis Geographie*, *6*(14), 14–21.

Fiebelkorn, F., & Kuckuck, M. (2020). Die Welt zu Gast im Obstregal – Wie nachhaltig ist mein Supermarkt? *Unterricht Biologie*, *44*(458), 6–11.

Fiebelkorn, F., & Menzel, S. (2013). Student teachers' understanding of the terminology, distribution, and loss of biodiversity: perspectives from a biodiversity hotspot and an industrialized country. *Research in Science Education*, *43*(4), 1593–1615. https://doi.org/10.1007/s11165-012-9323-0

Fiebelkorn, F., Puchert, N., & Dossey, A. T. (2020). An exercise on data-based decision-making: comparing the sustainability of meat and edible insects. *The American Biology Teacher*, *82*(8), 522–528.

Field, A. (2018). *Discovering statistics using IBM SPSS Statistics* (5th ed.). Sage.

Fischer, R. (2004). Standardization to account for cross-cultural response bias. *Journal of Cross-Cultural Psychology*, *35*(3), 263–282. https://doi.org/10.1177/0022022104264122

Fredrickson, J., Kremer, P., Swinburn, B., de Silva, A., & McCabe, M. (2015). Weight perception in overweight adolescents: associations with body change intentions, diet and physical activity. *Journal of Health Psychology*, *20*(6), 774–784. https://doi.org/10.1177/1359105315580223

Freedman, M. R., King, J., & Kennedy, E. (2001). Popular diets: a scientific review. *Obesity Research*, *9*, 1–40.

Fremerey, C., & Bogner, F. (2014). Learning about drinking water: how important are the three dimensions of knowledge that can change individual behavior? *Education Sciences*, *4*(4), 213–228. https://doi.org/10.3390/educsci4040213

Frick, J. (2003). *Umweltbezogenes Wissen: Struktur, Einstellungsrelevanz und Verhaltenswirksamkeit.* [Doctoral dissertation, University of Zurich]. https://doi.org/https://doi.org/10.5167/uzh-163134

Frick, J., Kaiser, F. G., & Wilson, M. (2004). Environmental knowledge and conservation behavior: exploring prevalence and structure in a representative sample. *Personality and Individual Differences*, *37*(8), 1597–1613. https://doi.org/10.1016/j.paid.2004.02.015

Fuchs, E. (Ed.). (2014). *Schulbuch in der Forschung. Analysen und Empfehlungen für die Bildungspraxis*. V&R unipress.

García Castro, L. (2014). *Adaptación de la escala presor (the perceived role of ethics and social responsibility) en un grupo de ejecutivos peruanos.* [Bachelor's Thesis, Peruvian University of Applied Sciences]. http://hdl.handle.net/10757/337380

Gausmann, E., Eggert, S., Hasselhorn, M., Watermann, R., & Bögeholz, S. (2010). Wie verarbeiten Schüler/innen Sachinformationen in Problem- und Entscheidungssituationen nachhaltiger Entwicklung? *Zeitschrift für Pädagogik*, *56*, 204–215.

Gensicke, T. (2015). Die Wertorientierungen der Jugend (2002–2015). In Shell Deutschland Holding (Ed.), *Jugend 2015. Eine pragmatische Generation im Aufbruch. 17. Shell Jugendstudie* (pp. 237–272). Fischer.

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., &

Tempio, G. (2013). *Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities*. FAO. https://doi.org/10.1016/j.anifeedsci.2011.04.074

Gerrig, R. J., & Zimbardo, P. G. (2015). *Psychologie* (20th ed.). Pearson.

Gilligan, C. (1982). *In a different voice*. Harvard University Press.

Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). How do motives and knowledge relate to intention to perform environmental behavior? Assessing the mediating role of constraints. *Ecological Economics*, *165*, 106394. https://doi.org/10.1016/j.ecolecon.2019.106394

Global Panel on Agriculture and Food Systems for Nutrition. (2016). *Food systems and diets: facing the challenges of the 21st century*. Global Panel on Agriculture and Food Systems for Nutrition.

Gonçalves, V. O., & Martínez, J. P. (2014). Imagen corporal y percepción de la influencia de los medios de comunicación: diferencias de género en una muestra de adolescentes. *Revista Inter Ação*, *39*(3), 461–478. https://doi.org/10.5216/ia.v39i3.27535

Goodland, R., & Anhang, J. (2009). Livestock and climate change: what if the key actors in climate change are... cows, pigs, and chickens? *World Watch Magazine*, *Nov/Dec*.

Gordon, L. J., Bignet, V., Crona, B., Henriksson, P. J. G., Van Holt, T., Jonell, M., Lindahl, T., Troell, M., Barthel, S., Deutsch, L., Folke, C., Haider, L. J., Rockström, J., & Queiroz, C. (2017). Rewiring food systems to enhance human health and biosphere stewardship. *Environmental Research Letters*, *12*(10), 100201. https://doi.org/10.1088/1748-9326/aa81dc

Gralher, M. (2015). *Nachhaltige Ernährung verstehen: Ein Beitrag zur didaktischen Rekonstruktion der Bildung für nachhaltige Entwicklung*. Schneider Hohengehren.

Grunenberg, H., & Kuckartz, U. (2003). *Umweltbewusstsein im Wandel: Ergebnisse der UBA-Studie Umweltbewusstsein in Deutschland 2002*. Leske + Budrich. https://doi.org/10.1007/978-3-322-97605-5

Günther, W., Bechthold, A., Boeing, H., Dinter, J., Ellinger, S., Hauner, H., Kroke, A., Leschik-Bonnet, E., Linseisen, J., Lorkowksi, S., Schulze, M., & Stehle, P. (2015). *Evidenzbasierte Leitlinie - Fettzufuhr und Prävention ausgewählter ernährungsmitbedingter Krankheiten* (2nd ed.). DGE.

Gussow, J. D. (1999). Dietary guidelines for sustainability: twelve years later. *Journal of Nutrition Education*, *31*(194–200).

Gussow, J. D., & Clancy, K. L. (1986). Dietary guidelines for sustainability. *Journal of Nutrition Education*, *18*(1), 1–5.

Hamann, S. (2004). *Schülervorstellungen zur Landwirtschaft im Kontext einer Bildung für nachhaltige Entwicklung.* [Doctoral dissertation, Ludwigsburg University of Education]. https://d-nb.info/972692010/34

Hanss, D., & Doran, R. (2020). Perceived behavioral control. In W. Leal Filho, A. M. Azul, L.

Brandli, P. G. Özuyar, & T. Wall (Eds.), *Responsible Consumption and Production* (pp. 535–535). Springer International Publishing. https://doi.org/10.1007/978-3-319-95726-5_300103

Hasegawa, T., Havlík, P., Frank, S., Palazzo, A., & Valin, H. (2019). Tackling food consumption inequality to fight hunger without pressuring the environment. *Nature Sustainability*, *2*(9), 826–833. https://doi.org/10.1038/s41893-019-0371-6

Hauner, H., Bechthold, A., Boeing, H., Brönstrup, A., Buyken, A., Leschik-Bonnet, E., Linseisen, J., Schulze, M., Strohm, D., & Wolfram, G. (2012). Evidence-Based guideline of the German Nutrition Society: carbohydrate intake and prevention of nutrition-related diseases. *Annals of Nutrition and Metabolism*, *60*(s1), 1–58. https://doi.org/10.1159/000335326

Hedges, L., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Academic Press.

Heo, J., & Muralidharan, S. (2019). What triggers young millennials to purchase eco-friendly products?: the interrelationships among knowledge, perceived consumer effectiveness, and environmental concern. *Journal of Marketing Communications*, *25*(4), 421–437. https://doi.org/10.1080/13527266.2017.1303623

Hertrampf, A., & Bender, U. (2016). What do prospective teachers know about sustainable nutrition? *Ernaehrungs Umschau*, *63*(10), 206–212. https://doi.org/10.4455/eu.2016.043

Heseker, H., Dankers, R., & Hirsch, J. (2018). *Schlussbericht für das Bundesministerium für Ernährung und Landwirtschaft (BMEL): Ernährungsbezogene Bildungsarbeit in Kitas und Schulen (ErnBildung)*. http://www.bmel.de/SharedDocs/Downloads/Ernaehrung/Kita-Schule/StudieErnahrungsbildunglang.pdf?__blob=publicationFile

HHS (U.S. Department of Health and Human Services), & USDA (U.S. Department of Agriculture). (2015). *2015–2020 Dietary Guidelines for Americans* (8th ed.). HHS & USDA.

Hoffman, M. L. (2008). Empathy and prosocial behavior. In M. Lewis, J. M. Havuland-Jones, & L. F. Barret (Eds.), *Handbook of Emotions* (3rd ed., pp. 440–455). Guilford Press. https://doi.org/10.2307/2076468

Hofstede, G. (1980). *Culture's consequences: International differences in work-related values*. Sage.

Holt-Giménez, E., Shattuck, A., Altieri, M., Herren, H., & Gliessman, S. (2012). We already grow enough food for 10 billion people … and still can't end hunger. *Journal of Sustainable Agriculture*, *36*(6), 595–598. https://doi.org/10.1080/10440046.2012.695331

Holtgraves, T. (2004). Social desirability and self-reports: testing models of socially desirable responding. *Personality and Social Psychology Bulletin*, *30*(2), 161–172. https://doi.org/10.1177/0146167203259930

Hörnschemeyer, A. (2020). *Nachhaltige Ernährung = ungesunde Ernährung? Eine qualitative Analyse lernhinderlicher Vorstellungen von Schülerinnen und Schülern der 10. Jahrgangsstufe zum Terminus „nachhaltige Ernährung“*. [Unpublished Master's thesis, Osnabrück University].

Humane League Labs. (2014). *Diet change and demographic characteristics of vegans, vegetarians, semi-Vegetarians, and omnivores*. http://www.humaneleaguelabs.org/blog/2014-04-07-large-scale-survey-vegans-vegetarians-and-meat-reducers/

Independent Group of Scientists appointed by the Secretary-General. (2019). *Global sustainable development report 2019: the future is now – science for achieving sustainable development*. United Nations.

Inglehart, R. (1995). Public support for environmental protection: objective problems and subjective values in 43 societies. *Political Science and Politics*, *28*(1), 57–72.

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* (S. Díaz, J. Settele, E. S. Brondízio, H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, … C. N. Zayas (Eds.)). IPBES. https://doi.org/10.5281/zenodo.3553579

IPCC (Intergovernmental Panel on Climate Change). (2019). *IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (A. Arneth, H. Barbosa, T. Benton, K. Calvin, E. Davin, F. Denton, R. van Diemen, F. Driouech, A. Elbehri, J. Evans, M. Ferrat, J. Harold, E. Haughey, M. Herrero, J. House, M. Howden, M. Hurlbert, G. Jia, T. G. Johansen, … Z. Zommers (Eds.)). IPCC.

Irianto, H. (2015). Consumers' attitude and intention towards organic food purchase: an extension of theory of planned behavior in gender perspective. *International Journal of Management, Economics and Social Sciences (IJMESS)*, *4*(1), 17–31.

IUCN (International Union for Conservation of Nature). (2017a). *Red list category summary country totals (animals)*. http://cmsdocs.s3.amazonaws.com/summarystats/2017-3_Summary_Stats_Page_Documents/2017_3_RL_Stats_Table_6a.pdf

IUCN (International Union for Conservation of Nature). (2017b). *Red list category summary country totals (plants)*. http://cmsdocs.s3.amazonaws.com/summarystats/2017-3_Summary_Stats_Page_Documents/2017_3_RL_Stats_Table_6b.pdf

Janssen, M., Busch, C., Rödiger, M., & Hamm, U. (2016). Motives of consumers following a vegan diet and their attitudes towards animal agriculture. *Appetite*, *105*, 643–651. https://doi.org/10.1016/j.appet.2016.06.039

Jenkins, D. J. A., Sievenpiper, J. L., Pauly, D., Sumaila, U. R., Kendall, C. W. C., & Mowat, F. M. (2009). Are dietary recommendations for the use of fish oils sustainable? *Cmaj*, *180*(6), 633–637. https://doi.org/10.1503/cmaj.081274

Jolliffe, D., & Farrington, D. P. (2006). Development and validation of the basic empathy scale. *Journal of Adolescence*, *29*(4), 589–611. https://doi.org/10.1016/j.adolescence.2005.08.010

Jonkisz, E., Moosbrugger, H., & Brandt, H. (2012). Planung und Entwicklung von Tests und Fragebogen. In H. Moosbrugger & A. Kelava (Eds.), *Testtheorie und Fragebogenkonstruktion* (2nd ed., pp. 27–74). https://doi.org/10.1007/978-3-642-20072-4_3

Joshi, Y., & Rahman, Z. (2019). Consumers' sustainable purchase behaviour: modeling the impact of psychological factors. *Ecological Economics*, *159*, 235–243. https://doi.org/10.1016/j.ecolecon.2019.01.025

Kabadayı, E. T., Dursun, İ., Alan, A. K., & Tuğer, A. T. (2015). Green purchase intention of young Turkish consumers: effects of consumer's guilt, self-monitoring and perceived consumer effectiveness. *Procedia - Social and Behavioral Sciences*, *207*, 165–174. https://doi.org/10.1016/j.sbspro.2015.10.167

Kagawa, F. (2007). Dissonance in students' perceptions of sustainable development and sustainability: implications for curriculum change. *International Journal of Sustainability in Higher Education*, *8*(3), 317–338. https://doi.org/10.1108/14676370710817174

Kaiser, F. G., & Frick, J. (2002). Entwicklung eines Messinstrumentes zur Erfassung von Umweltwissen auf der Basis des MRCML-Modells. *Diagnostica*, *48*(4), 181–189. https://doi.org/10.1026//0012-1924.48.4.181

Kaiser, F. G., & Fuhrer, U. (2003). Ecological behavior 's dependency on different forms of knowledge. *International Association for Applied Psychology*, *52*(4), 598–614. https://onlinelibrary.wiley.com/doi/pdf/10.1111/1464-0597.00153

Kals, E., Schumacher, D., & Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and Behavior*, *31*(2), 178–202.

Kang, J., Liu, C., & Kim, S. H. (2013). Environmentally sustainable textile and apparel consumption: the role of consumer knowledge, perceived consumer effectiveness and perceived personal relevance. *International Journal of Consumer Studies*, *37*(4), 442–452. https://doi.org/10.1111/ijcs.12013

Kattmann, U. (2007). Didaktische Rekonstruktion – eine praktische Theorie. In D. Krüger & H. Vogt (Eds.), *Theorien in der biologiedidaktischen Forschung: Ein Handbuch für Lehramtsstudenten und Doktoranden* (pp. 93–104). Springer.

Kattmann, U. (2015). *Schüler besser verstehen: Alltagsvorstellungen im Biologieunterricht*. Aulis.

Kattmann, U., Duit, R., Gropengießer, H., & Komorek, M. (1997). Das Modell der Didaktischen Rekonstruktion - Ein Rahmen für naturwissenschaftliche Forschung und Entwicklung. *Zeitschrift für Didaktik der Naturwissenschaften*, *3*(3), 3–18.

Kelava, A., & Moosbrugger, H. (2012). Deskriptivstatistische Evaluation von Items (Itemanalyse) und Testwertverteilungen. In H. Moosbrugger & A. Kelava (Eds.), *Testtheorie und Fragebogenkonstruktion* (2nd ed., pp. 75–102). Springer. https://doi.org/10.1007/978-3-642-20072-4_4

Kellert, S. R., & Wilson, E. O. (1993). *The biophilia hypothesis*. Island Press.

Kern, K., & Fiebelkorn, F. (2020). Zusammenhänge zwischen der Empathie gegenüber Nutztieren, Umweltbetroffenheit und dem Konsum von Fleisch – Eine explorative Studie mit deutschen Konsument*innen. *Umweltpsychologie*, *24*(1), 103–112.

Kilbourne, W., & Pickett, G. (2008). How materialism affects environmental beliefs, concern, and environmentally responsible behavior. *Journal of Business Research*, *61*(9), 885–893. https://doi.org/10.1016/j.jbusres.2007.09.016

Kim, Y., & Choi, S. M. (2005). Antecedents of green purchase behavior: an examination of collectivism, environmental concern, and PCE. *Advances in Consumer Research*, *32*, 592–599.

Krauss, C. (2014, March 4). Big victory for Chevron over claims in Ecuador. *The New York Times*. https://www.nytimes.com

Krüger, T., & Strüver, A. (2018). Narrative der ‚guten Ernährung': Ernährungsidentitäten und die Aneignung öffentlicher Nachhaltigkeitsdiskurse durch Konsument*innen. *Zeitschrift für Wirtschaftsgeographie*, *62*(3–4), 217–232. https://doi.org/10.1515/zfw-2017-0006

Küchler-Krischun, J., & Walter, A. M. (Eds.). (2007). *National strategy on biological diversity*. BMU. https://www.bfn.de/fileadmin/ABS/documents/Biodiversitaetsstragie_englisch.pdf

Kuckartz, U., & Rädiker, S. (2019). *Analyzing qualitative data with MAXQDA: text, audio, and video*. Springer International Publishing. https://doi.org/10.1007/978-3-030-15671-8

Kunst, J. R., & Hohle, S. M. (2016). Meat eaters by dissociation: how we present, prepare and talk about meat increases willingness to eat meat by reducing empathy and disgust. *Appetite*, *105*, 758–774. https://doi.org/10.1016/j.appet.2016.07.009

Lairon, D. (2012). Biodiversity and sustainable nutrition with a food-based approach. In Barbara Burlingame & S. Dernini (Eds.), *Sustainable diets and biodiversity: Directions and Solutions for Policy, Research and Action* (pp. 30–35). FAO; Biodiversity International.

Lalander, R. (2016). The Ecuadorian resource dilemma: Sumak Kawsay or development? *Critical Sociology*, *42*(4–5), 623–642. https://doi.org/10.1177/0896920514557959

Lambert, C. (2017). Environmental destruction in Ecuador: crimes against humanity under the Rome Statute? *Leiden Journal of International Law*, *30*(3), 707–729. https://doi.org/10.1017/S0922156517000267

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310

Lee, Y. ki, Kim, S., Kim, M. seong, & Choi, J. gu. (2014). Antecedents and interrelationships of three types of pro-environmental behavior. *Journal of Business Research*, *67*(10), 2097–2105. https://doi.org/10.1016/j.jbusres.2014.04.018

Liefländer, A. K., Fröhlich, G., Bogner, F. X., Schultz, P. . W., & Wesley Schultz, P. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research*, *19*(3), 370–384. https://doi.org/10.1080/13504622.2012.697545

Liu, P., Teng, M., & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviors?: the mediating role of environmental attitudes and behavioral intentions. *Science of The Total Environment*, *728*, 138126. https://doi.org/10.1016/j.scitotenv.2020.138126

Lockley, J., & Jarrath, M. (2013). The nature of sustainability as viewed by european students. *Journal of Education for Sustainable Development*, *7*(1), 113–124. https://doi.org/10.1177/0973408213495611

Lopez-Cevallos, D. F., & Chi, C. (2010). Health care utilization in Ecuador: a multilevel analysis of socio-economic determinants and inequality issues. *Health Policy and Planning*, *25*(3), 209–218. https://doi.org/10.1093/heapol/czp052

Louv, R. (2008). *Last child in the woods: saving our children from nature-deficit disorder*. Algonquin books.

Lower Saxony Ministry of Education. (2015a). *Kerncurriculum für das Gymnasium - Schuljahrgänge 5 - 10. Naturwissenschaften*. Lower Saxony Ministry of Education. https://db2.nibis.de/1db/cuvo/datei/nw_gym_si_kc_druck.pdf

Lower Saxony Ministry of Education. (2015b). *Kerncurriculum für die Hauptschule - Schuljahrgänge 5 - 10. Naturwissenschaften*. Lower Saxony Ministry of Education. http://db2.nibis.de/1db/cuvo/datei/kc_naturwissenschaften_hs.pdf

Lower Saxony Ministry of Education. (2015c). *Kerncurriculum für die Realschule - Schuljahrgänge 5 – 10. Naturwissenschaften*. Lower Saxony Ministry of Education. https://db2.nibis.de/1db/cuvo/datei/kc_naturwissenschaften_rs.pdf

Macdiarmid, J. I., Douglas, F., & Campbell, J. (2016). Eating like there's no tomorrow: public awareness of the environmental impact of food and reluctance to eat less meat as part of a sustainable diet. *Appetite*, *96*, 487–493. https://doi.org/10.1016/j.appet.2015.10.011

Mackay, C. M. L., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? a meta-analysis. *Journal of Environmental Psychology*, *65*. https://doi.org/10.1016/j.jenvp.2019.101323

MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change*, *23*(5), 992–1000. https://doi.org/10.1016/j.gloenvcha.2013.03.010

Mann, M., & Treagust, D. F. (2010). Students' conceptions about energy and the human body. *Science Education International*, *21*(3), 144–159.

Maslow, A. H. (1954). *Motivation and personality*. Harper & Row.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*(4), 503–515. https://doi.org/10.1016/j.jenvp.2004.10.001

Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior*, *41*(5), 607–643. https://doi.org/10.1177/0013916508319745

Mayring, P. (2014). *Qualitative content analysis: theoretical foundation, basic procedures and software solution*. https://doi.org/10.1016/S1479-3709(07)11003-7

Melina, V., Craig, W., & Levin, S. (2016). Position of the Academy of Nutrition and Dietetics: vegetarian diets. *Journal of the Academy of Nutrition and Dietetics*, *116*(12), 1970–1980. https://doi.org/10.1016/j.jand.2016.09.025

Mensink, G. B. ., Barbosa, C. L., & Brettschneider, A.-K. (2016). Verbreitung der vegetarischen Ernährungsweise in Deutschland. *Journal of Health Monitoring*, *1*(2), 2–15. https://doi.org/10.17886/RKI-GBE-2016-033

Menzel, S., & Bögeholz, S. (2006). Vorstellungen und Argumentationsstrukturen von Schüler(inne)n der elften Jahrgangsstufe zur Biodiversität, deren Gefährdung und Erhaltung. *Zeitschrift für Didaktik der Naturwissenschaften*, *12*, 199–217.

Menzel, S., & Bögeholz, S. (2010). Values, beliefs and norms that foster Chilean and German pupils' commitment to protect biodiversity. *International Journal of Environmental & Science Education*, *5*(1), 31–49. http://www.ijese.com/

Milfont, T. L., Duckitt, J., & Cameron, L. D. (2006). A cross-cultural study of environmental motive concerns and their implications for proenvironmental behavior. *Environment and Behavior*, *38*(6), 745–767. https://doi.org/10.1177/0013916505285933

Millenium Ecosystem Assessment. (2005). *Ecosystems and human well-being: biodiversity synthesis*. World Resources Institute. https://doi.org/10.1057/9780230625600

Ministerio del Ambiente del Ecuador. (2015). *Quinto informe nacional para el convenio sobre la diversidad biológica*. https://www.cbd.int/doc/world/ec/ec-nr-05-es.pdf

Ministerio del Ambiente del Ecuador. (2016). *Estrategia nacional de biodiversidad 2015-2030*. https://www.cbd.int/doc/world/ec/ec-nbsap-v2-p01-es.pdf

Mittermeier, R. A., Turner, W. R., Larsen, F. W., Brooks, T. M., & Gascon, C. (2011). Global biodiversity conservation: the critical role of hotspots. In F. E. Zachos & J. C. Habel (Eds.), *Biodiversity Hotspots* (pp. 3–22). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-20992-5_1

Modlinska, K., Adamczyk, D., Maison, D., & Pisula, W. (2020). Gender differences in attitudes to vegans/vegetarians and their food preferences, and their implications for promoting sustainable dietary patterns–a systematic review. *Sustainability*, *12*(16), 6292. https://doi.org/10.3390/su12166292

Monni, S., & Pallottino, M. (2015). Beyond growth and development: buen vivir as an alternative to current paradigms. *International Journal of Environmental Policy and Decision Making*, *1*(3), 184. https://doi.org/10.1504/ijepdm.2015.074300

Mottet, A., de Haan, C., Falcucci, A., Tempio, G., Opio, C., & Gerber, P. (2017). Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. *Global Food Security*, *14*, 1–8. https://doi.org/10.1016/j.gfs.2017.01.001

Muller, A., Schader, C., El-Hage Scialabba, N., Brüggemann, J., Isensee, A., Erb, K.-H., Smith, P., Klocke, P., Leiber, F., Stolze, M., & Niggli, U. (2017). Strategies for feeding the world more sustainably with organic agriculture. *Nature Communications*, *8*(1), 1290. https://doi.org/10.1038/s41467-017-01410-w

Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, *403*(6772), 853–858. https://doi.org/10.1038/35002501

nach [after]. (n.d.). Duden Online. https://www.duden.de/node/153411/revision/153447

nachlässig [careless]. (n.d.). Duden Online. https://www.duden.de/node/153535/revision/153571

nachteilig [disadvantageous]. (n.d.). Duden Online. https://www.duden.de/node/153642/revision/153678

Niebert, K., & Gropengießer, H. (2014). Understanding the greenhouse effect by embodiment – analysing and using students' and scientists' conceptual resources. *International Journal of Science Education*, *36*(2), 277–303. https://doi.org/10.1080/09500693.2013.763298

Niedersächsische Landesschulbehörde. (2015). *Umfragen an Schulen: RdErl. d. MK v. 1.1.2014 - 25b-81402 (SVBl. 1/2014 S.4), geändert durch RdErl. v. 1.12.2015 (SVBl. 12/2015 S. 598) - VORIS 22410 - 1*. http://www.nds-voris.de/jportal/?quelle=jlink&query=VVND-224100-MK-20140101-SF&psml=bsvorisprod.psml&max=true

Nisbet, E. K., & Zelenski, J. M. (2013). The NR-6: a new brief measure of nature relatedness. *Frontiers in Psychology*, *4:813*. https://doi.org/10.3389/fpsyg.2013.00813

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale: linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, *41*(5), 715–740. https://doi.org/10.1177/0013916508318748

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2011). Happiness is in our nature: exploring nature relatedness as a contributor to subjective well-being. *Journal of Happiness Studies*, *12*(2), 303–322. https://doi.org/10.1007/s10902-010-9197-7

Nordlund, A. M., & Garvill, J. (2002). Value structures behind proenvironmental behavior. *Environment and Behavior*, *34*(6), 740–756. https://doi.org/10.1177/001391602237244

O'Neill, D. W., Fanning, A. L., Lamb, W. F., & Steinberger, J. K. (2018). A good life for all within planetary boundaries. *Nature Sustainability*, *1*(2), 88–95. https://doi.org/10.1038/s41893-018-0021-4

Ochoa-Avilés, A., Verstraeten, R., Huybregts, L., Andrade, S., Van Camp, J., Donoso, S., Ramírez, P. L., Lachat, C., Maes, L., & Kolsteren, P. (2017). A school-based intervention improved dietary intake outcomes and reduced waist circumference in adolescents: a cluster randomized controlled trial. *Nutrition Journal*, *16*(1), 79. https://doi.org/10.1186/s12937-017-0299-5

OECD. (2016). *PISA 2015 results (Volume I): excellence and equity in education*. OECD Publishing. https://doi.org/10.1787/9789264266490-en

OECD, & FAO. (2020). *OECD-FAO agricultural outlook 2020-2029*. FAO, OECD Publishing. https://doi.org/10.1787/1112c23b-en

Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change*, *47*, 88–94. https://doi.org/10.1016/j.gloenvcha.2017.09.009

Paço, A., & Lavrador, T. (2017). Environmental knowledge and attitudes and behaviours towards energy consumption. *Journal of Environmental Management*, *197*, 384–392. https://doi.org/10.1016/j.jenvman.2017.03.100

Panayotou, T. (2016). Economic growth and the environment - a reader in ecology, culture, and sustainable living. In N. Haenn & R. Wilk (Eds.), *The environment in anthropology* (2nd ed., pp. 140–148). New York University Press.

Phillips, F. (2005). Vegetarian nutrition. *Nutrition Bulletin*, *30*(2), 132–167. https://doi.org/10.1111/j.1467-3010.2005.00467.x

Piaget, J. (1974). *Der Aufbau der Wirklichkeit beim Kinde*. Klett.

Piaget, J. (1983). *Meine Theorie der geistigen Entwicklung*. Fischer.

Posner, G., Strike, K., Hewson, P., & Gertzog, W. (1982). Accommodation of a scientific conception: toward a theory of conceptual change. *Science Education*, *66*(2), 211–227.

ProVeg International. (2018). *The vegan food plate: a simple guide to healthy vegan nutrition*. https://proveg.com/plant-based-food-and-lifestyle/the-vegan-food-plate-a-simple-guide-to-healthy-vegan-nutrition/

Public health England, Welsh Government, Food Standards Scotland, & Food Standards Agency in Northern Ireland. (2016). *Eatwell guide*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510363/UPDATED_Eatwell_guide_2016_FINAL_MAR23.pdf

Rasnake, L. K., Laube, E., Lewis, M., & Linscheid, T. R. (2005). Children's nutritional judgments: relation to eating attitudes and body image. *Health Communication*, *18*(3), 275–289. https://doi.org/10.1207/s15327027hc1803_5

Raymond, C. M., Brown, G., & Weber, D. (2010). The measurement of place attachment: personal, community, and environmental connections. *Journal of Environmental Psychology*, *30*(4), 422–434. https://doi.org/10.1016/j.jenvp.2010.08.002

Reinmann, G., & Mandl, H. (2006). Unterrichten und Lernumgebungen gestalten. In A. Krapp & B. Weidenmann (Eds.), *Pädagogische Psychologie* (5th ed., pp. 613–658). Beltz.

Reuters. (2017, July 19). Victoria para Chevron en caso de contaminación en Ecuador, concede la Corte Suprema de Estados Unidos. *El Universo*. https://www.eluniverso.com

Reynolds, K. D., Baranowski, T., Bishop, D. B., Farris, R. P., Nicklas, T. A., Elmer, P. J., & Binkley, D. (1999). Patterns in child and adolescent consumption of fruit and vegetables: effects of gender and ethnicity across four sites. *Journal of the American College of Nutrition*, *18*(3), 248–254. https://doi.org/10.1080/07315724.1999.10718859

Richter, M., Boeing, H., Grünewald-Funk, D., Heseker, H., Kroke, A., Leschik-Bonnet, E., Oberritter, H., Strohm, D., & Watzl, B. (2016). Vegan diet - position of the German Nutrition Society. *Ernaehrungs Umschau International*, *4*, 92–102. https://doi.org/10.4455/eu.2016.021

Richter, T., & Schumacher, K. P. (2011). Who really cares about higher education for sustainable development? *Journal of Social Sciences*, *7*(1), 24–32. https://doi.org/10.3844/jssp.2011.27.35

Rieckmann, M. (2012). Future-oriented higher education: which key competencies should be fostered through university teaching and learning? *Futures*, *44*(2), 127–135. https://doi.org/10.1016/j.futures.2011.09.005

Rieckmann, M. (2017). *Education for sustainable development goals: learning objectives*. UNESCO.

Rieckmann, M., Adomßent, M., Härdtle, W., & Aguirre, P. (2011). Sustainable development and conservation of biodiversity hotspots in Latin America: the case of Ecuador. In *Biodiversity hotspots: Distribution and protection of conservation priority areas* (pp. 435–454). Springer. https://doi.org/10.1007/978-3-642-20992-5_22

Riemeier, T. (2007). Moderater Konstruktivismus. In D. Krüger & H. Vogt (Eds.), *Theorien in der biologiedidaktischen Forschung* (pp. 69–79). Springer. https://doi.org/10.1007/978-3-540-68166-3

Rimal, A. P., Moon, W., & Balasubramanian, S. (2005). Agro-biotechnology and organic food purchase in the United Kingdom. *British Food Journal*, *107*(2), 84–97. https://doi.org/10.1108/00070700510579162

Ritchie, H., & Roser, M. (2019). *Land Use*. https://ourworldindata.org/land-use

Rittenau, N. (2018). *Vegan-Klischee ade! Wissenschaftliche Antworten auf kritische Fragen zu veganer Ernährung* (3rd ed.). Ventil Verlag.

Roberts, J. A. (1996). Green consumers in the 1990s: profile and implications for advertising. *Journal of Business Research*, *36*(3), 217–231. https://doi.org/10.1016/0148-2963(95)00150-6

Rockström, J., Edenhofer, O., Gaertner, J., & Declerck, F. (2020). Planet-proofing the global food system. *Nature Food*, *1*(January), 3–5. https://doi.org/10.1038/s43016-019-0010-4

Rockström, J., Falkenmark, M., Karlberg, L., Hoff, H., Rost, S., & Gerten, D. (2009). Future water availability for global food production: the potential of green water for increasing resilience to global change. *Water Resources Research*, *45*(7). https://doi.org/10.1029/2007WR006767

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., … Foley, J. A. (2009). A safe operating space for humanity. *Nature*, *461*(7263), 472–475. https://doi.org/10.1038/461472a

Roczen, N., Kaiser, F. G., & Bogner, F. X. (2010). Umweltkompetenz – Modellierung, Entwicklung und Förderung. Projekt Umweltkompetenz. In E. Klieme, D. Leutner, & M. Kenk (Eds.), *Kompetenzmodellierung. Eine aktuelle Zwischenbilanz des DFG-Schwerpunktprogramms* (pp. 126–134). Beltz. http://www.beltz.de

Roczen, N., Kaiser, F. G., Bogner, F. X., & Wilson, M. (2014). A competence model for environmental education. *Environment and Behavior*, *46*(8), 972–992. https://doi.org/10.1177/0013916513492416

Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature Experiences and Adults' Self-Reported Pro-environmental Behaviors: The Role of Connectedness to Nature and Childhood Nature Experiences. *Frontiers in Psychology*, *9:1055*. https://doi.org/10.3389/fpsyg.2018.01055

Rosi, A., Mena, P., Pellegrini, N., Turroni, S., Neviani, E., Ferrocino, I., Di Cagno, R., Ruini, L., Ciati, R., Angelino, D., Maddock, J., Gobbetti, M., Brighenti, F., Del Rio, D., & Scazzina, F. (2017). Environmental impact of omnivorous, ovo-lacto-vegetarian, and vegan diet. *Scientific Reports*, *7*(1), 6105. https://doi.org/10.1038/s41598-017-06466-8

Rothgerber, H., & Mican, F. (2014). Childhood pet ownership, attachment to pets, and subsequent meat avoidance. The mediating role of empathy toward animals. *Appetite*, *79*, 11–17. https://doi.org/10.1016/j.appet.2014.03.032

Ruby, M. B. (2012). Vegetarianism. A blossoming field of study. *Appetite*, *58*(1), 141–150. https://doi.org/10.1016/j.appet.2011.09.019

Ruby, M. B., & Heine, S. J. (2011). Meat, morals, and masculinity. *Appetite*, *56*(2), 447–450. https://doi.org/10.1016/j.appet.2011.01.018

Sangkumchaliang, P., & Huang, W. C. (2012). Consumers' perceptions and attitudes of organic food products in Northern Thailand. *International Food and Agribusiness Management Review*, *15*(1), 87–102. https://doi.org/10.22004/ag.econ.120860

Scarborough, P., Appleby, P. N., Mizdrak, A., Briggs, A. D. M., Travis, R. C., Bradbury, K. E., & Key, T. J. (2014). Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK. *Climatic Change*, *125*(2), 179–192. https://doi.org/10.1007/s10584-014-1169-1

Schmidt, P., Bamberg, S., Davidov, E., Herrmann, J., & Schwartz, S. H. (2007). Die Messung von Werten mit dem "Portraits Value Questionnaire." *Zeitschrift für Sozialpsychologie*, *38*(4), 261–275. https://doi.org/10.1024/0044-3514.38.4.261

Schultz, P. W. (2000). Empathizing with nature: the effects of perspective taking on concern for environmental issues. *Journal of Social Issues*, *56*(3), 391–406. https://doi.org/10.1111/0022-4537.00174

Schultz, P. W. (2001). The structure of environmental concern: concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*(4), 327–339. https://doi.org/10.1006/jevp.2001.0227

Schultz, P. W. (2002). Inclusion with nature: the psychology of human-nature relations. In P. Schmuck & P. W. Schultz (Eds.), *Psychology of sustainable development* (pp. 61–78). Kluwer Academic Publishers.

Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Franěk, M. (2005). Values and their relationship to environmental concern and conservation behavior. *Journal of Cross-Cultural Psychology*, *36*(4), 457–475. https://doi.org/10.1177/0022022105275962

Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology*, *24*(1), 31–42. https://doi.org/10.1016/S0272-4944(03)00022-7

Schultz, P. W., & Zelezny, L. (1999). Values as predictors of environemtnal attitudes: evidence for consistency across 14 counties. *Journal of Environmental Psychology*, *19*(3), 255–265. https://doi.org/10.1006/jevp.1999.0129

Schwartz, S. H. (1992). Universals in the content and structure of values: theory and empirical tests in 20 countries. *Advances in Experimental Social Psychology*, *25*, 1–65. https://doi.org/10.1016/S0065-2601(08)60281-6

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues*, *50*(4), 19–45. https://doi.org/10.1111/j.1540-4560.1994.tb01196.x

Schwartz, S. H. (2009). *Draft users manual: Proper use of the Schwartz Value Survey, version 14 January 2009, compiled by Romie F. Littrell*. Centre for Cross Cultural Comparisons.

Schwartz, S. H. (2012). An overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture*, *2*(1), 1–20. https://doi.org/10.9707/2307-0919.1116

Schwartz, S. H., & Sagiv, L. (1995). Identifying culture-specifics in the content and structure of values. *Journal of Cross-Cultural Psychology*, *26*(1), 92–116. https://doi.org/10.1177/0022022195261007

Schwartz, S. H., Verkasalo, M., Antonovsky, A., & Sagiv, L. (1997). Value priorities and social desirability: much substance, some style. *British Journal of Social Psychology*, *36*, 3–18. https://doi.org/10.1111/j.2044-8309.1997.tb01115.x

Segovia-Siapco, G., & Sabaté, J. (2019). Health and sustainability outcomes of vegetarian dietary patterns: a revisit of the EPIC-Oxford and the Adventist Health Study-2 cohorts. *European Journal of Clinical Nutrition*, *72*(S1), 60–70. https://doi.org/10.1038/s41430-018-0310-z

Sevillano, V., Aragonés, J. I., & Schultz, P. W. (2007). Perspective taking, environmental concern, and the moderating role of dispositional empathy. *Environment and Behavior*, *39*(5), 685–705. https://doi.org/10.1177/0013916506292334

Sheeran, P. (2002). Intention—behavior relations: a conceptual and empirical review. *European Review of Social Psychology*, *12*(1), 1–36. https://doi.org/10.1080/14792772143000003

Sheeran, P., & Webb, T. L. (2016). The intention-behavior gap. *Social and Personality Psychology Compass*, *10*(9), 503–518. https://doi.org/10.1111/spc3.12265

Smith, P. B. (2004). Acquiescent response bias as an aspect of cultural communication style. *Journal of Cross-Cultural Psychology*, *35*(1), 50–61. https://doi.org/10.1177/0022022103260380

Soga, M., & Gaston, K. J. (2016). Extinction of experience: the loss of human-nature interactions. *Frontiers in Ecology and the Environment*, *14*(2), 94–101. https://doi.org/10.1002/fee.1225

Sothmann, J.-N., & Menzel, S. (2016). Wohlbefinden von Jugendlichen - die Bedeutung von Alter, Naturverbundenheit, Natürlichkeit und Ästhetik von Natur. *Umweltpsychologie*, *20*(2), 36–58.

Sothmann, J.-N., & Menzel, S. (2017). A scale for differentiating affective and cognitive nature connection dimensions, externally validated in terms of self-transcendence and environmental concern. *International Journal of Environmental and Science Education*, *12*(8), 1847–1869.

Spiller, A., Zühlsdorf, A., Jürkenbeck, K., & Schulze, M. (2021). Jugendumfrage - weniger Fleisch, mehr Future. In *Fleischatlas 2021 - Daten und Fakten über Tiere als Nahrungsmittel*. Heinrich-Böll-Stiftung, Bund für Umwelt und Naturschutz Deutschland e. V.

Spini, D. (2003). Measurement equivalence of 10 value types from the Schwartz Value Survey across 21 countries. *Journal of Cross-Cultural Psychology*, *34*(1), 3–23. https://doi.org/10.1177/0022022102239152

Steffen, W., Richardson, K., Rockstrom, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., de Vries, W., de Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sorlin, S. (2015). Planetary boundaries: guiding human development on a changing planet. *Science*, *347*(6223), 1259855–1259855. https://doi.org/10.1126/science.1259855

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., & De Haan, C. (2006). *Livestock's long shadow: environmental issues and options*. FAO.

Stern, P. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Stern, P., & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues*, *50*(3), 65–84.

Stern, P., Dietz, T., Abel, T., Guagnano, G., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, *6*, 81–97.

Stern, P., Dietz, T., & Kalof, L. (1993). Value orientations, gender, and environmental concern. *Environment and Behavior*, *25*(5), 322–348. https://doi.org/10.1177/0013916593255002

Stern, P., Kalof, L., Dietz, T., & Guagnano, G. A. (1995). Values, beliefs, and proenvironmental action: attitude formation toward emergent attitude objects. *Journal of Applied Social Psychology*, *25*(18), 1611–1636. https://doi.org/10.1111/j.1559-1816.1995.tb02636.x

Stewart, K., & Cole, M. (2009). The conceptual separation of food and animals in childhood. *Food, Culture & Society*, *12*(4), 457–476. https://doi.org/10.2752/175174409X456746

Strike, K. A., & Posner, G. J. (1992). A revisionist theory of conceptual change. In R. A. Duschl & R. J. Hamilton (Eds.), *Philosophy of science, cognitive psychology, and educational theory and practice* (pp. 147–176). State University of New York Press.

Tabassum-Abbasi, Abbasi, T., & Abbasi, S. A. (2016). Reducing the global environmental impact of livestock production: the minilivestock option. *Journal of Cleaner Production*, *112*, 1754–1766. https://doi.org/10.1016/j.jclepro.2015.02.094

Tam, K.-P. (2013a). Concepts and measures related to connection to nature: similarities and differences. *Journal of Environmental Psychology*, *34*, 64–78. https://doi.org/10.1016/j.jenvp.2013.01.004

Tam, K.-P. (2013b). Dispositional empathy with nature. *Journal of Environmental Psychology*, *35*, 92–104. https://doi.org/10.1016/j.jenvp.2013.05.004

Techniker Krankenkasse (Ed.). (2017). *Iss was, Deutschland. TK-Studie zur Ernährung 2017*. https://www.tk.de/resource/blob/2026618/1ce2ed0f051b152327ae3f132c1bcb3a/tk-ernaehrungsstudie-2017-data.pdf

Temmen, M. A., & Fiebelkorn, F. (2020). Zusammenhänge zwischen Emotionaler Intelligenz, Naturempathie und Umweltbetroffenheit – Eine explorative Studie mit Studierenden der Universität Osnabrück. *Umweltpsychologie*, *24*(1), 31–39.

Terhart, E. (1999). Konstruktivismus und Unterricht. Gibt es einen neuen Ansatz in der Allgemeinen Didaktik? *Zeitschrift für Pädagogik*, *45*(5), 629–647. http://www.beltz.de

Thompson, M., Ellis, R., & Wildavsky, A. (1990). *Cultural theory*. Westview Press.

Tobinski, D., & Fritz, A. (2014). Lerntheorien und pädagogisches Handeln. In A. Fritz, W. Hussy, & D. Tobinski (Eds.), *Pädagogische Psychologie* (2nd ed., pp. 222–247). UTB.

Tsakiridou, E., Boutsouki, C., Zotos, Y., & Mattas, K. (2008). Attitudes and behaviour towards organic products: an exploratory study. *International Journal of Retail & Distribution Management*, *36*(2), 158–175. https://doi.org/10.1108/09590550810853093

Uddin, S. M. F., & Khan, M. N. (2018). Young consumer's green purchasing behavior: opportunities for green marketing. *Journal of Global Marketing*, *31*(4), 270–281. https://doi.org/10.1080/08911762.2017.1407982

UIS (UNESCO Institute for Statistics). (2018). *Government expenditure per student, secondary*. https://data.worldbank.org/indicator/SE.XPD.SECO.PC.ZS?end=2017&locations=EC-DE&start=1971&view=chart

UNCED (United Nations Conference on Environment and Development). (1992). *Agenda 21*. http://www.un.org/depts/german/conf/agenda21/agenda_21.pdf

UNESCO. (2014). *UNESCO Roadmap Education for Sustainable Development*. UNESCO. https://en.unesco.org/sites/default/files/roadmap_1.pdf

United Nations. (2015). *Paris Agreement*. https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

United Nations. (2017). *The Sustainable Development Goals Report*. https://doi.org/10.18356/3405d09f-en

United Nations. (2019). *World population prospects 2019: highlights*. United Nations.

United Nations Environment Programme. (2010). *Here and now! Education for sustainable consumption: recommendations and guidelines*. http://wedocs.unep.org/handle/20.500.11822/8011

United Nations General Assembly. (2015). *Resolution adopted by the General Assembly on 25 September 2015. Transforming our world: the 2030 Agenda for Sustainable Development*. United Nations.

Van Loo, E. J., Diem, M. N. H., Pieniak, Z., & Verbeke, W. (2013). Consumer attitudes, knowledge, and consumption of organic yogurt. *Journal of Dairy Science*, *96*(4), 2118–2129. https://doi.org/10.3168/jds.2012-6262

Vanhulst, J., & Beling, A. E. (2014). Buen vivir: Emergent discourse within or beyond sustainable development? *Ecological Economics*, *101*, 54–63. https://doi.org/10.1016/j.ecolecon.2014.02.017

VERBI. (2018). *MAXQDA 2018* (No. 2018). VERBI Software GmbH.

Vermeir, I., & Verbeke, W. (2006). Sustainable food consumption: exploring the consumer "attitude - behavioral intention" gap. *Journal of Agricultural and Environmental Ethics*, *19*(2), 169–194. https://doi.org/10.1007/s10806-005-5485-3

von Braun, J. (2017). Children as agents of change for sustainable development. In A. M. Battro, P. Léna, M. S. Sorondo, & J. von Braun (Eds.), *Children and sustainable development* (pp. 17–30). Springer.

von Glasersfeld, E. (1995). *Radical constructivism: a way of knowing and learning*. Falmer Press.

von Koerber, K., Bader, N., & Leitzmann, C. (2017). Wholesome nutrition: an example for a sustainable diet. *Proceedings of the Nutrition Society*, *76*(01), 34–41. https://doi.org/10.1017/S0029665116000616

von Koerber, K., Männle, T., & Leitzmann, C. (2012). *Vollwert-Ernährung: Konzeption einer zeitgemäßen und nachhaltigen Ernährung* (11th ed.). Haug.

WCED (World Commission on Environment and Development). (1987). *Our Common Future: Report of the World Commission on Environment and Development*. Oxford University Press. http://www.un-documents.net/our-common-future.pdf

Weber, A., Büssing, A. G., Jarzyna, R., & Fiebelkorn, F. (2020). Do German student biology teachers intend to eat sustainably? Extending the theory of planned behavior with nature relatedness and environmental concern. *Sustainability*, *12*(12), 4909. https://doi.org/10.3390/su12124909

Weber, A., & Fiebelkorn, F. (2019). Nachhaltige Ernährung, Naturverbundenheit und Umweltbetroffenheit von angehenden Biologielehrkräften – Eine Anwendung der Theorie des geplanten Verhaltens. *Zeitschrift für Didaktik der Naturwissenschaften*, *25*, 181–195. https://doi.org/10.1007/s40573-019-00098-3

Weis, T. (2013). The meat of the global food crisis. *Journal of Peasant Studies*, *40*(1), 65–85. https://doi.org/10.1080/03066150.2012.752357

Whitburn, J., Linklater, W., & Abrahamse, W. (2020). Meta-analysis of human connection to nature and proenvironmental behavior. *Conservation Biology*, *34*(1), 180–193. https://doi.org/10.1111/cobi.13381

WHO. (2020a). *Fact sheets - Malnutrition*. https://www.who.int/news-room/fact-sheets/detail/malnutrition

WHO. (2020b). *Obesity and overweight*. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., … Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

Wilson, E. O. (1984). *Biophilia: the human bond with other species*. Harvard University Press.

World Bank National Accounts data & OECD National Accounts data. (2018). *GDP per capita*. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2017&locations=EC-DE&start=1971&view=chart

Wray-Lake, L., Flanagan, C. A., & Osgood, D. W. (2010). Examining trends in adolescent environmental attitudes, beliefs, and behaviors across three decades. *Environment and Behavior*, *42*(1), 61–85. https://doi.org/10.1177/0013916509335163

Writz, M. A. (2017). *Dorsch – Lexikon der Psychologie* (18th ed.). Hofgrefe.

Wuppertal Institut. (2020). *CO-neutral bis 2035: Eckpunkte eines deutschen Beitrags zur Einhaltung der 1,5-°C-Grenze* (2nd ed.). https://epub.wupperinst.org/frontdoor/deliver/index/docId/7606/file/7606_CO2-neutral_2035.pdf

Young, A., Khalil, K. A., & Wharton, J. (2018). Empathy for animals: a review of the existing literature. *Curator*, *61*(2), 327–343. https://doi.org/10.1111/cura.12257

Zarnowiecki, D., Ball, K., Parletta, N., & Dollman, J. (2014). Describing socioeconomic gradients in children's diets - does the socioeconomic indicator used matter? *International Journal of Behavioral Nutrition and Physical Activity*, *11*(1), 1–12. https://doi.org/10.1186/1479-5868-11-44

Zelezny, L. C., Chua, P.-P., & Aldrich, C. (2000). Elaborating on gender differences in environmentalism. *Journal of Social Issues*, *56*(3), 443–457. https://doi.org/10.1111/0022-4537.00177

Zickfeld, J. H., Kunst, J. R., & Hohle, S. M. (2018). Too sweet to eat: exploring the effects of cuteness on meat consumption. *Appetite*, *120*, 181–195. https://doi.org/10.1016/j.appet.2017.08.038

Zsóka, Á., Szerényi, Z. M., Széchy, A., & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, *48*, 126–138. https://doi.org/10.1016/j.jclepro.2012.11.030

Appendix

A1 Questionnaires

- **Q1: Nature relatedness and environmental concern of young people in Ecuador and Germany**
    - **German version**
    - **Spanish version**
- **Q2: Fostering sustainable diets among German high school students: the potential of perceived consumer effectiveness, the human-nature relationship, and knowledge**

Q1: Nature relatedness and environmental concern of young people in Ecuador and Germany

- **German version**

5747071933

Natur und Wohlbefinden

UNIVERSITÄT OSNABRÜCK

Liebe Schülerin, lieber Schüler,

indem du diesen Fragebogen ausfüllst, hilfst du uns dabei die Einstellungen von jungen Menschen zu ihrer Umwelt zu verstehen. Dafür ist es wichtig, dass du die Fragen ehrlich beantwortest, denn es interessiert uns deine ganz persönliche Meinung. Es gibt keine richtigen oder falschen Antworten.

Die Befragung findet **anonym** statt und die Daten werden nicht an andere weiter gegeben.

Bitte benutze zum Ausfüllen des Fragebogens einen **Kugelschreiber oder Füller**.

Wenn du noch Fragen an uns hast, kannst du uns gern eine E-Mail an *Jan-Niklas.Sothmann@Biologie.Uni-Osnabrueck.de* schreiben.

Danke, dass du den Fragebogen ausfüllst und viel Spaß dabei!

Jan-Niklas Sothmann und
Prof. Dr. Susanne Menzel
Universität Osnabrück
Fachbereich Biologie/Chemie
Biologiedidaktik
Barbarastr. 11
49076 Osnabrück

Alter: _____ **Geschlecht:** weiblich ☐ männlich ☐

Schulform (z.B. Realschule): _____ **Klassenstufe (z.B. 8):** _____

Wo bist du aufgewachsen?

nur in der Stadt	eher in der Stadt	sowohl in der Stadt als auch auf dem Land	eher auf dem Land	nur auf dem Land
☐	☐	☐	☐	☐

Wie weit ist es von deinem Zuhause bis in die Natur?

sehr weit	weit	weder weit noch nah	nah	sehr nah
☐	☐	☐	☐	☐

Wie viel Zeit verbringst du in der Natur?

sehr viel	viel	teil, teils	wenig	sehr wenig
☐	☐	☐	☐	☐

Was machst du, wenn du dich in der Natur aufhältst?

_____

_____

6376071932

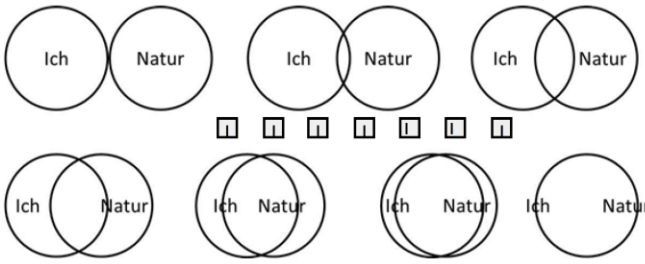
Wie ähnlich ist dir diese Person?	sehr unähnlich	eher unähnlich	teils, teils	eher ähnlich	sehr ähnlich
Es ist der Person wichtig, reich zu sein. Sie möchte viel Geld haben und teure Sachen besitzen.	☐	☐	☐	☐	☐
Die Person hält es für wichtig, dass alle Menschen auf der Welt gleich behandelt werden sollten. Sie glaubt, dass jeder Mensch im Leben gleiche Chancen haben sollte.	☐	☐	☐	☐	☐
Es ist der Person wichtig, ihre Fähigkeiten zu zeigen. Die Person möchte, dass Leute bewundern, was sie tut.	☐	☐	☐	☐	☐
Der Person ist es wichtig, Menschen zuzuhören, die anders sind als man selbst. Auch wenn die Person anderer Meinung ist als andere, will sie diese trotzdem verstehen.	☐	☐	☐	☐	☐
Die Person sucht nach jeder Möglichkeit, Spaß zu haben. Es ist ihr wichtig, Dinge zu tun, die ihr Freude bereiten.	☐	☐	☐	☐	☐
Es ist der Person sehr wichtig, den Menschen um sich herum zu helfen. Sie will für deren Wohl sorgen.	☐	☐	☐	☐	☐
Es ist der Person wichtig, sehr erfolgreich zu sein. Sie hofft, dass die Leute ihre Leistungen anerkennen.	☐	☐	☐	☐	☐
Es ist der Person wichtig, die Führung zu übernehmen und anderen zu sagen, was sie tun sollen. Die Person möchte, dass die anderen tun, was sie sagt.	☐	☐	☐	☐	☐
Der Person ist es wichtig, Freunden gegenüber treu zu sein. Sie will sich für Menschen einsetzen, die ihr nahe stehen.	☐	☐	☐	☐	☐
Die Person ist fest davon überzeugt, dass die Menschen sich um die Natur kümmern sollten. Umweltschutz ist ihr wichtig.	☐	☐	☐	☐	☐
Es ist der Person wichtig, die Freuden des Lebens zu genießen. Sie gönnt sich selbst gern etwas.	☐	☐	☐	☐	☐
Es ist der Person wichtig, auf die Bedürfnisse der anderen einzugehen. Die Person bemüht sich, die Menschen, die sie kennt, zu unterstützen.	☐	☐	☐	☐	☐
Es ist der Person wichtig, im Leben vorwärts zu kommen. Die Person strebt danach, besser zu sein als andere.	☐	☐	☐	☐	☐
Es ist der Person wichtig, Menschen zu verzeihen, von denen sie verletzt wurde. Die Person versucht, in ihnen das Gute zu sehen und nicht nachtragend zu sein.	☐	☐	☐	☐	☐
Die Person möchte das Leben richtig genießen. Es ist ihr wichtig, Spaß zu haben.	☐	☐	☐	☐	☐
Die Person möchte immer die Person sein, die die Entscheidung trifft. Sie ist gern in der Führungsposition.	☐	☐	☐	☐	☐
Es ist der Person wichtig, sich der Natur anzupassen und zu ihr zu passen. Die Person glaubt, dass die Menschen die Natur nicht verändern sollten.	☐	☐	☐	☐	☐

4079071930

Heutzutage hören wir oft Nachrichten darüber, wie die Natur durch die Menschheit zerstört wird. Flüsse werden zum Beispiel durch Chemikalien oder durch Giftmüll von Fabriken verschmutzt, die Meere werden durch Ölkatastrophen in der Tiefsee verseucht und Wälder werden zu Brachland abgeholzt. Viele Tiere und Pflanzen, die in der Natur leben, leiden. **Wir möchten gern wissen, wie du denkst und dich fühlst, wenn du solche Nachrichten hörst**.

	stimme überhaupt nicht zu	stimme eher nicht zu	teils, teils	stimme eher zu	stimme voll zu
Ich kann mich auf die Gefühle von leidenden Pflanzen einlassen.	☐	☐	☐	☐	☐
Ich stelle mir vor, wie ich mich fühlen würde, wenn ich das leidende Tier wäre.	☐	☐	☐	☐	☐
Es fällt mir leicht, mich in die Lage einer leidenden Pflanze zu versetzen.	☐	☐	☐	☐	☐
Ich habe fürsorgliche Gefühle für die leidenden Tiere.	☐	☐	☐	☐	☐
Ich fühle mit leidenden Pflanzen.	☐	☐	☐	☐	☐
Ich versuche zu verstehen, wie sich leidende Tiere fühlen, indem ich mir vorstelle, wie die Dinge aus ihrer Perspektive aussehen.	☐	☐	☐	☐	☐
Ich stelle mir bildlich klar und deutlich vor, wie sich die leidenden Pflanzen in ihrer Situation fühlen.	☐	☐	☐	☐	☐
Ich habe Mitgefühle für die leidenden Tiere.	☐	☐	☐	☐	☐

Bitte kreuze die Abbildung an, die deine Beziehung zur Natur am besten beschreibt.
Wie verbunden bist du mit der Natur?



Menschen auf der ganzen Welt sind von Umweltproblemen durch die Zerstörung der Natur betroffen. Allerdings unterscheiden sich Menschen darin, welche Auswirkungen ihnen am wichtigsten erscheinen.
Wie wichtig sind dir persönlich die Folgen von Umweltproblemen für...?

	nicht wichtig	weniger wichtig	teils, teils	eher wichtig	wichtig
...dich selbst	☐	☐	☐	☐	☐
...deinen Lebensstil	☐	☐	☐	☐	☐
...deine Gesundheit	☐	☐	☐	☐	☐
...deine Zukunft	☐	☐	☐	☐	☐
...Menschen in deinem Land	☐	☐	☐	☐	☐
...alle Menschen	☐	☐	☐	☐	☐

	nicht wichtig	weniger wichtig	teils, teils	eher wichtig	wichtig
...Kinder	☐	☐	☐	☐	☐
...zukünftige Generationen	☐	☐	☐	☐	☐
...Pflanzen	☐	☐	☐	☐	☐
...Meeres-lebewesen	☐	☐	☐	☐	☐
...Vögel	☐	☐	☐	☐	☐
...Säugetiere	☐	☐	☐	☐	☐

1140071936

Inwieweit stimmst du diesen Aussagen zu?	stimme überhaupt nicht zu	stimme eher nicht zu	teils, teils	stimme eher zu	stimme voll zu
Meine Verbindung zur Natur und der natürlichen Umwelt ist Teil meiner Spiritualität.	☐	☐	☐	☐	☐
Meine Beziehung zur Natur ist ein wichtiger Teil meines Selbsts.	☐	☐	☐	☐	☐
Ich fühle mich sehr verbunden mit allen Lebewesen und der Erde.	☐	☐	☐	☐	☐
Ich denke immer daran, wie mein Handeln die Umwelt beeinflusst.	☐	☐	☐	☐	☐
Mein idealer Urlaubsort wäre eine abgelegene Wildnis.	☐	☐	☐	☐	☐
Ich bemerke wilde Tiere, wo immer ich bin.	☐	☐	☐	☐	☐
Ich bin nicht unabhängig, sondern ein Teil der Natur.	☐	☐	☐	☐	☐
Ich denke viel über das Leiden von Tieren nach.	☐	☐	☐	☐	☐
Ich fühle mich oft als Teil eines Lebensnetzwerks.	☐	☐	☐	☐	☐
Ich glaube, dass alle Bewohner der Erde, sowohl menschlich als auch nicht-menschlich, eine gemeinsame Lebenskraft teilen.	☐	☐	☐	☐	☐
Wie ein Baum Teil eines Waldes sein kann, fühle ich mich eingebettet in eine weitere Naturwelt.	☐	☐	☐	☐	☐
Im Großen und Ganzen verläuft mein Leben nahe an meiner Idealvorstellung.	☐	☐	☐	☐	☐
Die Bedingungen in meinem Leben sind exzellent.	☐	☐	☐	☐	☐
Ich bin zufrieden mit dem Leben.	☐	☐	☐	☐	☐
Bis jetzt habe ich dir mir wichtigen Dinge im Leben erreicht.	☐	☐	☐	☐	☐
Wenn ich mein Leben noch einmal leben könnte, würde ich nahezu nichts ändern.	☐	☐	☐	☐	☐

Inwieweit treffen diese Aussagen zu?

Insgesamt betrachte ich mich als eine

nicht sehr glückliche ☐ ☐ ☐ ☐ ☐ glückliche Person.

Verglichen mit den meisten meiner Bekannten, betrachte ich mich als

weniger glücklich ☐ ☐ ☐ ☐ ☐ glücklicher.

Manche Menschen sind generell sehr glücklich. Sie erfreuen sich am Leben, egal was los ist und machen das Beste daraus. In welchem Maß beschreibt dich diese Charakterisierung?

überhaupt nicht ☐ ☐ ☐ ☐ ☐ voll und ganz

Manche Menschen sind generell eher unglücklich. Obwohl sie nicht depressiv sind, scheinen sie nie so glücklich, wie sie sein könnten. In welchem Maß beschreibt dich diese Charakterisierung?

überhaupt nicht ☐ ☐ ☐ ☐ ☐ voll und ganz

Q1: Nature relatedness and environmental concern of young people in Ecuador and Germany

- **Spanish version**

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UNIVERSITÄT OSNABRÜCK

Naturaleza y Bienestar

Queridos alumnos,

llenando este cuestionario nos ayudas a entender las actitudes de los jovenes hacia el medioambiente.
Es importante que contestes a estas preguntas de forma hornesta porque estamos interesados en tu opinión personal.
No hay respuestas falsas ni correctas.
La encuesta es anónima y los datos son confidenciales, es decir la información que consigamos no será divulgada.
Por favor, utiliza un esfero para rellenar el cuestionario.

Si tienes preguntas nos puedes contactar por e-mail: Jan-Niklas.Sothmann[at]Biologie.Uni-Osnabrueck.de

¡Muchas gracias por tu colaboración!

Jan-Niklas Sothmann y
Prof. Dr. Susanne Menzel
Universität Osnabrück
Fachbereich Biologie/Chemie
Biologiedidaktik
Barbarastr. 11
49076 Osnabrück

Edad: _____

Sexo: femenino ☐ masculino ☐

¿Dónde creciste?

solo en la ciudad	la mayoría del tiempo en la ciudad	tanto en la ciudad como en el campo	la mayoría del tiempo en el campo	solo en el campo
☐	☐	☐	☐	☐

¿A qué distancia está tu casa de la naturaleza?

muy lejos	lejos	ni lejos ni cerca	cerca	muy cerca
☐	☐	☐	☐	☐

¿Cuánto tiempo pasas en la naturaleza?

muchisimo	mucho	ni mucho ni poco	poco	muy poco
☐	☐	☐	☐	☐

¿Qué haces cuando estás en la naturaleza?

_____

_____

7991522836

¿Qué tanto se parece esta persona a ti?	Muy diferente	Un poco diferente	Parcialmente diferente, parcialmente parecida	Algo parecida	Muy parecida
Para él/ella es importante ser rico/a. Quiere tener mucho dinero y poder comprar cosas caras.	☐	☐	☐	☐	☐
Piensa que es importante que a todas las personas del mundo se les trate con igualdad. Cree que todos deberían tener las mismas oportunidades en la vida.	☐	☐	☐	☐	☐
Para él/ella es muy importante mostrar sus habilidades. Quiere que la gente lo/la admire por lo que hace.	☐	☐	☐	☐	☐
Le parece importante escuchar a las personas que son distintas a él/ella. Incluso cuando está en desacuerdo con ellas, todavía intenta poder entenderlas.	☐	☐	☐	☐	☐
Busca cualquier oportunidad para divertirse. Para él/ella es importante hacer cosas que le resulten placenteras.	☐	☐	☐	☐	☐
Es muy importante para él/ella ayudar a la gente que lo/la rodea. Se preocupa por su bienestar.	☐	☐	☐	☐	☐
Para él/ella es importante ser una persona muy exitosa. Le gusta impresionar a la gente.	☐	☐	☐	☐	☐
Para él/ella es importante ordenar a los demás lo que tienen que hacer. Desea que las personas hagan lo que se les dice.	☐	☐	☐	☐	☐
Es importante ser leal a sus amigos. Se entrega totalmente a las personas cercanas.	☐	☐	☐	☐	☐
Cree firmemente que las personas deben proteger la Naturaleza, siendo importante el cuidado del medio ambiente.	☐	☐	☐	☐	☐
Disfrutar de los placeres de la vida es importante para él/ella. Le agrada “darse los gustos”.	☐	☐	☐	☐	☐
Es importante atender a las necesidades de los demás. Trata de apoyar a quienes conoce.	☐	☐	☐	☐	☐
Progresar en la vida es importante para él/ella. Se esfuerza en ser mejor que otros.	☐	☐	☐	☐	☐
Para él/ella es importante perdonar a la gente que le ha hecho daño. Trata de ver lo bueno en ellos y no guardarles rencor.	☐	☐	☐	☐	☐
Él/Ella realmente desea disfrutar de la vida. Pasarla bien es muy importante.	☐	☐	☐	☐	☐
Siempre quiere ser él/ella la que toma las decisiones. Le gusta ser líder.	☐	☐	☐	☐	☐
Le es importante adaptarse a la naturaleza e integrarse en ella. Cree que la gente no debería alterar el medio ambiente.	☐	☐	☐	☐	☐

7084522839

Hoy en día a menudo escuchamos noticias informando cómo la naturaleza es destruida por el hombre. Por ejemplo los rios son contaminados por sustancias químicas o residuos tóxicos de fabricas, los mares son contaminados por catástrofes petrolíferas en las aguas profundas y los bosques se convierten en tierras baldías por la deforestación. Muchos animales y plantas que viven en la naturaleza sufren. **Queremos saber cómo piensas y cómo te sientes, cuando escuchas este tipo de noticias.**

	Totalmente en desacuerdo	Algo en desacuerdo	Ni de acuerdo ni en desacuerdo	Algo de acuerdo	Totalmente de acuerdo
Estoy conectado/a con los sentimientos de las plantas que están sufriendo.	☐	☐	☐	☐	☐
Me imagino cómo me sentiría si yo fuera el animal que está sufriendo.	☐	☐	☐	☐	☐
Me resulta fácil ponerme en el lugar de las plantas que están sufriendo.	☐	☐	☐	☐	☐
Tengo sentimientos de preocupación por los animales que están sufriendo.	☐	☐	☐	☐	☐
Siento empatía por las plantas que están sufriendo.	☐	☐	☐	☐	☐
Trato de entender cómo se sienten los animales que están sufriendo, imaginando cómo son las cosas desde su perspectiva.	☐	☐	☐	☐	☐
Siento compasión por los animales que están sufriendo.	☐	☐	☐	☐	☐
Visualizo clara y realistamente en mi mente cómo se sienten las plantas que están sufriendo en esa situación.	☐	☐	☐	☐	☐

Por favor, marca la imagen que te caracteriza mejor. ¿En qué medida estás conectado/a con la naturaleza?

☐ ☐ ☐ ☐ ☐ ☐ ☐

Generalmente, la gente de todas partes del mundo se preocupa sobre los problemas ambientales causados por la explotación de la naturaleza. Sin embargo, hay opiniones diferentes sobre cuáles consecuencias tienen la mayor importancia. **Por favor, califica los temas siguientes. Estoy preocupado(a) sobre los problemas ambientales que tienen consecuencias sobre...**

	No importante	Menos importante	Parcialmete importante, parcialmente no importante	Algo importante	Importante
yo	☐	☐	☐	☐	☐
mi estilo de vida	☐	☐	☐	☐	☐
mi salud	☐	☐	☐	☐	☐
mi futuro	☐	☐	☐	☐	☐
mis compatriotas	☐	☐	☐	☐	☐
toda la gente	☐	☐	☐	☐	☐

	No importante	Menos importante	Parcialmete importante, parcialmente no importante	Algo importante	Importante
niños	☐	☐	☐	☐	☐
mis hijos	☐	☐	☐	☐	☐
plantas	☐	☐	☐	☐	☐
vida acuática	☐	☐	☐	☐	☐
aves	☐	☐	☐	☐	☐
mamíferos	☐	☐	☐	☐	☐

8688522830

¿En qué medida estás de acuerdo con cada una de las siguentes afirmaciones?	Totalmente en desacuerdo	Algo en desacuerdo	Ni de acuerdo ni en desacuerdo	Algo de acuerdo	Totalmente de acuerdo
Mi conexión con la naturaleza y con el medio ambiente forma parte de mi espiritualidad.	☐	☐	☐	☐	☐
Mi relación con la naturaleza es una parte importante de lo que soy.	☐	☐	☐	☐	☐
Me siento muy conectado/a con todos los seres vivos y la tierra.	☐	☐	☐	☐	☐
Siempre pienso en cómo mi forma de actuar influye en el medio ambiente.	☐	☐	☐	☐	☐
Mi lugar ideal para ir de vacaciones sería un aislado espacio natural.	☐	☐	☐	☐	☐
Me doy cuenta de la vida silvestre dondequiera que estoy.	☐	☐	☐	☐	☐
No me siento seperado/a de la naturaleza sino soy parte de ella.	☐	☐	☐	☐	☐
Pienso mucho en el sufrimiento de los animales.	☐	☐	☐	☐	☐
A menudo me considero una parte más de la red de la vida.	☐	☐	☐	☐	☐
Siento que todos los seres vivos, humanos y no humanos, que habitamos el Planeta Tierra compartimos una misma "fuerza vital".	☐	☐	☐	☐	☐
Así como un árbol puede ser parte de un bosque o de la selva, yo me siento formando parte dentro del amplio mundo natural.	☐	☐	☐	☐	☐
En la mayoría de los aspectos mi vida es como yo quiero que sea.	☐	☐	☐	☐	☐
Las circunstancias de mi vida son muy buenas.	☐	☐	☐	☐	☐
Estoy satisfecho/a con mi vida.	☐	☐	☐	☐	☐
Hasta ahora he conseguido de la vida las cosas que considero importantes.	☐	☐	☐	☐	☐
Si pudiera vivir mi vida otra vez no cambiaría casi nada.	☐	☐	☐	☐	☐

¿En qué medida las siguientes afirmaciones se aplican a ti?

En general me considero

Una persona poco feliz ☐ ☐ ☐ ☐ ☐ Una persona muy feliz

Comparado con la mayoría de mis conocidos, me considero:

Una persona menos feliz ☐ ☐ ☐ ☐ ☐ Una persona más feliz

En general, algunas personas son muy felices. Disfrutan de la vida con independencia de lo que les ocurra, gozando al máximo de todo. ¿En qué medida te identificas con esta caracterización?

En absoluto ☐ ☐ ☐ ☐ ☐ Mucho

En general, algunas personas no son muy felices. Sin que estén deprimidas, nunca parecen estar todo lo felices que podrían. ¿En qué medida te identificas con esta caracterización?

En absoluto ☐ ☐ ☐ ☐ ☐ Mucho

Q2: Fostering sustainable diets among German high school students: the potential of perceived consumer effectiveness, the human-nature relationship, and knowledge

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Nachhaltigkeit und Ernährung

Deine Meinung ist gefragt!

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Wie fülle ich den Fragebogen aus?

Liebe Teilnehmerin, lieber Teilnehmer,

mein Name ist Johanna und ich arbeite momentan an meiner Masterarbeit in der Abteilung der Biologiedidaktik an der Universität Osnabrück. Mit dem Ausfüllen dieses Fragebogens hilfst du mir, mehr über das Verständnis und die Einstellung von Schüler*innen über das Thema Nachhaltigkeit und Ernährung herauszufinden.

Die Teilnahme an dem Fragebogen ist selbstverständlich freiwillig und anonym. Die Daten werden ausschließlich zu Forschungszwecken ausgewertet und nicht an Dritte weitergegeben.

Nun noch ein paar Hinweise zum Ausfüllen des Fragebogens:

- Bitte beantworte die Fragen ehrlich und fülle sie alleine aus.

- Benutze zum Ausfüllen bitte einen Kugelschreiber und keine Bunt- oder Filzstifte.

- Je nach Frage kannst du ein oder mehrere Kreuze setzen. Dies geht aus dem Frageformat hervor. Solltest du ein Kreuz falsch gesetzt haben, übermale das Kästchen komplett und fülle es aus. Du kannst danach das gewünschte Kreuz setzen.

Wenn du im Anschluss noch Fragen hast, kontaktiere mich gerne.

Johanna Bischof, E-Mail: jobischof@uos.de

Vielen Dank für deine Mithilfe!

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1. Ein paar Fragen zu dir

Klassenstufe: _____

Alter: _____

Geschlecht: ☐ weiblich ☐ männlich ☐ divers

Ernährst du dich vegetarisch oder vegan? ☐ Ja ☐ Nein

Im Folgenden geht es um Fragen zu einer nachhaltigen Ernährung
Das Konzept einer „Nachhaltigen Ernährung" setzt das Leitbild einer „Nachhaltigen Entwicklung" im Ernährungsbereich um. Das Ziel ist es, eine globale Gerechtigkeit und Chancengleichheit für alle Menschen zu schaffen und auch für zukünftige Generationen zu sichern. Sich nachhaltig zu ernähren bedeutet, sich so zu ernähren, dass die gesamten gesundheitlichen, ökologischen, ökonomischen, sozialen und kulturellen Auswirkungen unseres Ernährungsverhaltens möglichst positiv sind.

2. Was ist dir bei deiner Ernährung wichtig?

Kreuze bitte für jede Aussage an, inwieweit sie auf dich zutrifft. Im nächsten Monat plane ich, ...	Stimme überhaupt nicht zu	Stimme eher nicht zu	teils/ teils	Stimme eher zu	Stimme voll zu
…bevorzugt pflanzliche Nahrungsmittel zu konsumieren.	☐	☐	☐	☐	☐
… auch einmal mehr Nahrungsmittel zu kaufen als ich wirklich benötigen werde.	☐	☐	☐	☐	☐
… ökologisch erzeugte („Bio") Nahrungsmittel zu konsumieren.	☐	☐	☐	☐	☐
… Nahrungsmittel ohne Fair-Trade-Siegel zu konsumieren.	☐	☐	☐	☐	☐
… regionale Nahrungsmittel zu konsumieren.	☐	☐	☐	☐	☐
… bevorzugt Fertigprodukte, also hoch verarbeitete Nahrungsmittel, zu konsumieren.	☐	☐	☐	☐	☐
... saisonale Nahrungsmittel zu konsumieren.	☐	☐	☐	☐	☐
… bevorzugt tierische Nahrungsmittel wie Fleisch, Eier und Milchprodukte zu mir zu nehmen.	☐	☐	☐	☐	☐
... nur so viele Nahrungsmittel zu kaufen, wie ich wirklich benötigen werde.	☐	☐	☐	☐	☐
… bevorzugt konventionell erzeugte Nahrungsmittel, also keine Bio-Produkte, zu konsumieren.	☐	☐	☐	☐	☐
... fair gehandelte Nahrungsmittel zu konsumieren.	☐	☐	☐	☐	☐
… Nahrungsmittel außerhalb der Saison zu konsumieren.	☐	☐	☐	☐	☐
... bevorzugt gering verarbeitete Nahrungsmittel zu konsumieren.	☐	☐	☐	☐	☐
… Nahrungsmittel aus anderen Ländern und von anderen Kontinenten zu konsumieren.	☐	☐	☐	☐	☐

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3. Welche Rolle kommt dem Verhalten des Einzelnen zu?

Kreuze bitte für jede Aussage an, inwieweit du ihr zustimmst.	Stimme überhaupt nicht zu	Stimme eher nicht zu	teils/ teils	Stimme eher zu	Stimme voll zu
Es lohnt sich für den einzelnen Verbraucher, sich um die Erhaltung und Verbesserung der Umwelt zu bemühen.	☐	☐	☐	☐	☐
Wenn ich Nahrungsmittel kaufe, versuche ich zu berücksichtigen, ob diese einen Einfluss auf die Umwelt haben.	☐	☐	☐	☐	☐
Da jeder Einzelne die Reduzierung der Umweltprobleme beeinflussen kann, kann auch mein Verhalten einen bedeutenden Unterschied machen.	☐	☐	☐	☐	☐
Das nachhaltige Ernährungsverhalten von jedem Verbraucher kann die Umwelt und die Gesellschaft positiv beeinflussen.	☐	☐	☐	☐	☐

4. Wer wirkt auf dein Ernährungsverhalten?

Kreuze bitte für jede Aussage an, inwieweit du ihr zustimmst.	Stimme überhaupt nicht zu	Stimme eher nicht zu	teils/ teils	Stimme eher zu	Stimme voll zu
Meine Freunde und Freundinnen finden, dass ich mich nachhaltig ernähren sollte.	☐	☐	☐	☐	☐
Meine Familie findet, dass ich mich nachhaltig ernähren sollte.	☐	☐	☐	☐	☐
Den meisten Personen, die mir wichtig sind, ist meine Ernährung egal.	☐	☐	☐	☐	☐
In den sozialen Medien (z.B. Instagram) wird mir vermittelt, dass ich mich nachhaltig ernähren sollte.	☐	☐	☐	☐	☐

5. Wie ist dein Verhältnis zur Natur?

Kreuze bitte für jede Aussage an, inwieweit du ihr zustimmst.	Stimme überhaupt nicht zu	Stimme eher nicht zu	teils/ teils	Stimme eher zu	Stimme voll zu
Mein idealer Urlaubsort wäre eine abgelegene Wildnis.	☐	☐	☐	☐	☐
Ich denke immer daran, wie mein Handeln die Umwelt beeinflusst.	☐	☐	☐	☐	☐
Ich bemerke wilde Tiere, wo immer ich bin.	☐	☐	☐	☐	☐
Meine Beziehung zur Natur ist ein wichtiger Teil meines Selbst.	☐	☐	☐	☐	☐
Ich fühle mich sehr verbunden mit allen Lebewesen und der Erde.	☐	☐	☐	☐	☐

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6. Wie stehst du der Umwelt und Umweltproblemen gegenüber?

Kreuze bitte für jede Aussage an, inwieweit du ihr zustimmst.	Stimme überhaupt nicht zu	Stimme eher nicht zu	teils/ teils	Stimme eher zu	Stimme voll zu
Wenn die Dinge so weitergehen, werden wir bald eine schwere ökologische Katastrophe erleben.	☐	☐	☐	☐	☐
Ich glaube, dass die Umwelt nicht von den Menschen missbraucht wird.	☐	☐	☐	☐	☐
Das Gleichgewicht der Natur ist sehr empfindlich und leicht störbar.	☐	☐	☐	☐	☐
Durch das rasante Wirtschaftswachstum entstehen keine Umweltprobleme.	☐	☐	☐	☐	☐
Wenn Menschen in die Natur eingreifen, führt das oft zu verheerenden Konsequenzen.	☐	☐	☐	☐	☐
Es ist Unsinn, dass wir bald eine schwere ökologische Katastrophe erleben werden, wenn die Dinge so weiter gehen wie bisher.	☐	☐	☐	☐	☐
Menschen missbrauchen ihre natürliche Umwelt in hohem Maße.	☐	☐	☐	☐	☐
Es ist pessimistisch zu glauben, dass das Gleichgewicht der Natur furchtbar empfindlich und leicht störbar ist.	☐	☐	☐	☐	☐

Wie wichtig sind dir persönlich die Folgen von Umweltproblemen für …?	nicht wichtig	weniger wichtig	teils/ teils	eher wichtig	wichtig
... zukünftige Generationen.	☐	☐	☐	☐	☐
... meinen Lebensstil.	☐	☐	☐	☐	☐
... Säugetiere.	☐	☐	☐	☐	☐
... meine Zukunft.	☐	☐	☐	☐	☐
... Menschen in meinem Land.	☐	☐	☐	☐	☐
... Meereslebewesen.	☐	☐	☐	☐	☐
... Kinder.	☐	☐	☐	☐	☐
... mich selbst.	☐	☐	☐	☐	☐
... Pflanzen.	☐	☐	☐	☐	☐
... meine Gesundheit.	☐	☐	☐	☐	☐
... Vögel.	☐	☐	☐	☐	☐
... alle Menschen.	☐	☐	☐	☐	☐

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7. Inwiefern versetzt du dich in Tiere hinein?

Kreuze bitte für jede Aussage an, inwieweit du ihr zustimmst.	Stimme überhaupt nicht zu	Stimme eher nicht zu	teils/ teils	Stimme eher zu	Stimme voll zu
Ich stelle mir manchmal vor, wie ich mich fühlen würde, wenn ich ein leidendes Tier wäre.	☐	☐	☐	☐	☐
Es fällt mir sehr leicht, mich in die Lage von leidenden Tieren hineinzuversetzen.	☐	☐	☐	☐	☐
Ich sehe in Gedanken klar und deutlich, wie sich leidende Tiere in ihrer Situation fühlen.	☐	☐	☐	☐	☐
Ich fühle mit leidenden Tieren.	☐	☐	☐	☐	☐
Ich habe liebevolle, fürsorgliche Gefühle für leidende Tiere.	☐	☐	☐	☐	☐

8. Was weißt du schon über das Thema Nachhaltigkeit und Ernährung? - Teil 1

Im Folgenden findest du ein paar Fragen zum Thema Nachhaltigkeit und Ernährung. Mit diesen Fragen möchte ich ermitteln, wie viel Wissen du bereits zum Thema hast, du sollst keineswegs bloßgestellt werden.
Es gibt zunächst immer drei Antwortmöglichkeiten, von denen genau **eine richtig** ist. Falls du eine Frage nicht sicher beantworten kannst, ist das nicht schlimm. Kreuze dann einfach „weiß ich nicht" an.

(1) Heute leben knapp 8 Milliarden Menschen auf der Erde. Wie viele Menschen werden im Jahr 2050 voraussichtlich auf der Erde leben?	**(2) Welche zwei Gase sind hauptverantwortlich für den Klimawandel?**	**(3) Um wie viel Grad würde sich die globale Durchschnittstemperatur bis ins Jahr 2100 erhöhen, wenn die Treibhausgasemissionen nicht reduziert werden?**
☐ Etwa 8 Milliarden Menschen	☒ Kohlenstoffdioxid und Methan	☐ Um 0°C
☒ Etwa 10 Milliarden Menschen	☐ Lachgas und Sauerstoff	☐ Um 2°C
☐ Etwa 15 Milliarden Menschen	☐ Helium und Kohlenstoffdioxid	☒ Um 4°C
☐ Weiß ich nicht	☐ Weiß ich nicht	☐ Weiß ich nicht

(4) Was zeichnet das Umweltsiegel „Der blaue Engel" aus?

☐ Weniger Verpackungsmüll

☒ Schonung von Ressourcen und der natürlichen Umwelt bei der Produktion

☐ Faire Arbeitsbedingungen

☐ Weiß ich nicht

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(5) Durch eine vegetarische Ernährung kann eine Person durchschnittlich 1,2 kg CO_2 am Tag einsparen. Wie viele Kilometer Autofahrt sind dies im Vergleich?	(6) Durch eine vegetarische Ernährung können 0,45 Tonnen CO_2 im Jahr eingespart werden. Wie viel CO_2 spart demgegenüber eine vegane Ernährungsweise?
☐ Etwa 1 km	☐ Etwa 0,5 Tonnen
☒ Etwa 5 km	☒ Etwa 2 Tonnen
☐ Etwa 20 km	☐ Etwa 10 Tonnen
☐ Weiß ich nicht	☐ Weiß ich nicht

(7) Wie verhält sich der Wasserverbrauch beim Obstanbau in verschiedenen Regionen?	(8) Für die Erzeugung von welchem Nahrungsmittel wird am meisten Fläche benötigt?
☐ Der Anbau von Obst im Wüstenklima erfordert **weniger** Wasser als in gemäßigten Zonen.	☒ Rindfleisch
☐ Der Anbau von Obst im Wüstenklima erfordert **gleich viel** Wasser wie in gemäßigten Zonen.	☐ Geflügelfleisch
☒ Der Anbau von Obst im Wüstenklima erfordert **mehr** Wasser als in gemäßigten Zonen.	☐ Kartoffel
☐ Weiß ich nicht	☐ Weiß ich nicht

8. Was weißt du schon über das Thema Nachhaltigkeit und Ernährung? - Teil 2

Den ersten Teil der Wissensfragen hast du geschafft. Es folgen nun Fragen mit jeweils fünf Antwortmöglichkeiten, hier ist nun immer **mehr als eine Antwort** richtig.

(1) Was treibt den menschengemachten Treibhauseffekt an?	(2) Was kann man tun, wenn man sich nachhaltig ernähren möchte?
☒ Abholzung von Wäldern	☒ Auf tierische Produkte verzichten
☒ Ausbau der Viehzucht	☒ Möglichst wenig Lebensmittel in den Müll werfen
☐ Pflege von Mooren	☐ Umweltsiegeln misstrauen
☒ Stickstoffhaltiger Dünger	☒ Bio-Produkte verzehren
☐ Ausbau erneuerbarer Energien	☒ Ressourcensparender Umgang beim Einkaufen und im Haushalt

(3) Welche der folgenden Aussagen sind richtig?

- ☐ Innerhalb der Nahrungskette geht von einer Ernährungsstufe in die nächste (z.B. Mais, Rind, Mensch) **kaum** Energie verloren.
- ☒ Die weltweit verfügbaren Nahrungsmittel reichen heute prinzipiell aus, um alle Erdbewohner zu ernähren.
- ☒ Die Energie der Sonne, die von Pflanzen umgewandelt wird, ist letztlich Ursprung aller Lebensvorgänge.
- ☒ Eine Papiertüte zersetzt sich **schneller** im Meer als eine Plastiktüte.
- ☐ Landwirtschaft und Nahrungsmittelindustrie verursachen **kaum** menschengemachte Treibhausgase.

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(4) Wann ist das folgende Obst nicht frisch innerhalb der Saison in Deutschland erhältlich?

- [x] Äpfel im März
- [ ] Erdbeeren im Juni
- [x] Himbeeren im November
- [ ] Pflaumen im September
- [x] Bananen im August

(5) Wann ist das folgende Gemüse nicht frisch innerhalb der Saison in Deutschland erhältlich?

- [ ] Spargel im Mai
- [ ] Grünkohl im Januar
- [x] Zucchini im März
- [x] Kartoffel im April
- [ ] Kürbis im Oktober

(6) Die Erderwärmung bewirkt das Schmelzen der Polkappen und Gletscher. Was hat dies für Auswirkungen?

- [x] Es kommt zum Anstieg des Meeresspiegels.
- [x] Das Schmelzen hat einen Einfluss auf die Salzkonzentration der Ozeane.
- [ ] Küstenregionen sind von der Eisschmelze nicht betroffen.
- [x] Durch die Schmelze wird die Erdoberfläche dunkler und das Sonnenlicht wird anders reflektiert.
- [ ] Das Schmelzen begünstigt die Artenvielfalt.

(7) Welche Eigenschaften haben ökologisch erzeugte Nahrungsmittel („Bio"-Produkte)?

- [x] Sie verbrauchen **weniger** Energie und Rohstoffe.
- [x] Sie fördern eine artgerechte Tierhaltung.
- [x] Sie werden ohne chemisch-synthetische Dünger hergestellt.
- [ ] Sie vermindern Krankheiten wie Übergewicht und Bluthochdruck .
- [ ] Sie bewirken die **gleiche** Freisetzung von Treibhausgasen wie bei traditionell erzeugten Lebensmitteln.

(8) Was ist sinnvoll, um sich nachhaltig zu ernähren?

- [x] Kaufen von fair gehandelten Lebensmitteln
- [ ] Immer das teuerste Produkt bevorzugen
- [ ] Einkauf von Produkten mit viel Verpackung
- [x] Konsum regionaler und saisonaler Erzeugnisse
- [ ] Verzehr von Fertigprodukten

(9) Wie gelangt der Müll ins Meer?

- [x] Viele Schiffe entsorgen ihre Abfälle in den Meeren.
- [ ] Pflanzen sondern Plastikmoleküle über ihre Blätter ab.
- [x] Der Müll gelangt von verdreckten Stränden ins Wasser.
- [ ] Vögel transportieren den Müll von Land ins Wasser.
- [x] Mikroplastik aus Kosmetik gelangt über Abwasser ins Meer.

(10) Welche der folgenden Aussagen über den Konsum von Fleisch sind richtig?

- [x] Fleisch ist ein guter Eisen- und Vitamin B12-Lieferant.
- [x] Bei der Produktion tierischer Nahrungssmittel werden **mehr** Treibhausgasemissionen frei als bei pflanzlichen.
- [x] Der Flächenbedarf zur Erzeugung pflanzlicher Nahrungsmittel ist **geringer** als bei tierischen Produkten.
- [ ] Für die Weltbevölkerung im Jahr 2050 steht voraussichtlich genug Fleisch zur Verfügung.
- [ ] Rund 10% des weltweit produzierten Sojas wird für Nutztiere als Futtermittel verwendet.

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(11) Was macht Kohlenstoffdioxid problematisch?

- ☐ Kohlenstoffdioxid schädigt viele Pflanzenarten.
- ☒ Kohlenstoffdioxid trägt zum Treibhauseffekt bei.
- ☐ In der Atmosphäre gibt es immer weniger Kohlenstoffdioxid.
- ☒ Kohlenstoffdioxid trägt zur Versauerung der Ozeane bei.
- ☐ Das Gas wirkt in zu hoher Konzentration explosiv.

(12) Welche der folgenden Aussagen über die Klimabilanz von Nahrungsmitteln sind richtig?

- ☐ Im beheizten Unterglasanbau ist der Energieverbrauch bei Kopfsalat **genauso hoch** wie im Freiland.
- ☒ Für die Produktion von 1kg Kaffee wird **mehr** Wasser benötigt als für die Erzeugung von 1kg Getreide.
- ☒ Die CO_2 -Bilanz bei Butter fällt deutlich **schlechter** aus als bei Rindfleisch.
- ☐ Tiefgefrorenes Gemüse belastet das Klima **weniger** als frisches, regionales Gemüse.
- ☐ Der CO_2-Verbrauch bei der Produktionskette von Eiern ist **geringer** als bei der Produktion von heimischem Obst.

(14) Was garantiert der Kauf regionaler Lebensmittel?

- ☒ Die Verringerung der Transportwege
- ☐ Automatisch eine gesunde Ernährung
- ☒ Die Stärkung regionaler Wirtschaftskreisläufe
- ☐ Fair ausgezahlten Lohn der Bauern
- ☐ Die Unterstützung von Tierwohlinitiativen

(15) Was verspricht das Fair-Trade-Siegel?

- ☒ Die Einhaltung von Menschenrechten
- ☒ Keine Kinderarbeit
- ☒ Die Einhaltung von Mindestlöhnen
- ☐ Gentechnisch verändertes Saatgut
- ☒ Transparente Handlungsbeziehungen

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Und nun die letzte Frage. Deine Aufgabe ist es dabei, die nachfolgenden Produkte zu beziffern und so in eine Reihenfolge zu bringen.

(16) Ordne die nachfolgenden Lebensmittel nach ihrem CO_2-Ausstoß. Die Zahl 1 steht dabei für einen geringen CO_2-Ausstoß und die Zahl 5 für einen hohen.

5	Rindfleisch
2	Spargel per LKW aus Spanien
4	Geflügelfleisch
1	Tomaten regional während der Saison
3	Eier

Wenn du noch etwas zur Umfrage oder zum Thema sagen möchtest, ist hier Platz dafür:

Vielen Dank für deine Teilnahme!

A2 Interview guide and materials

- **I1: Students' conceptions of sustainable nutrition**
  - **Interview guide**
  - **Used materials for the Interviews**

I1: Students' conceptions of sustainable nutrition

- **Interview guide**

Karte: 1	**Abschnitt:** 1 – Small Talk	**Intention / Forschungsinteresse:** Gewöhnung an Situation

Vorbereiten:

- Wasser und Gläser (keine Plastikflasche auf den Tisch stellen)
- Kekse in Dose (ohne Originalverpackung)
- Stühle und Tische (nach Möglichkeit auf Eck positionieren)
- Zettel und Stifte für Interventionen
- Banane in Plastiktüte in der Tasche bereithalten
- Aufnahmegerät vorbereiten (Ersatzbatterien!)
- Tablet, Stift und Smartphone vorbereiten (aufladen, Kameras abkleben, Flugmodus einstellen)

Ablauf:

- Raum betreten / Begrüßung
- hinsetzen
- Snacks / Getränke anbieten
- Abgabe Einverständniserklärung
- kurzer Small Talk – mögliche Fragen:
  - Wie war dein Tag?
  - Hast du schon einmal ein Interview geführt?
  - Warst du schon einmal hier im Raum? Was ist das für ein Raum?
  - ... (spontan, je nach Situation)
- ggf. Zeitplan abklären: Hat S. im Anschluss an das Interview Termine? Muss ein Zeitrahmen eingehalten werden?

Karte: 2	**Abschnitt:** 2 – Informationen zum Interview	**Intention / Forschungsinteresse:** Aufklärung über Ablauf / Rahmenbedingungen

Ablauf:

- Ich möchte dir vorab noch paar Informationen geben, damit du genau weißt, wie das Interview gleich abläuft. Vielleicht noch einmal kurz etwas zu mir: Ich bin Annelie Hörnschemeyer - du darfst mich übrigens gerne duzen, wenn du möchtest. Ich studiere Biologie und Mathematik an der Universität Osnabrück und möchte Gymnasiallehrerin werden. Momentan schreibe ich meine Abschlussarbeit in der Abteilung Biologiedidaktik.
- Wie Herr / Frau in deiner Klasse bestimmt erzählt hat, führe ich dazu Interviews mit 10. Klässlern zum Thema Ernährung durch. Das wird in der Forschung häufig gemacht, um herauszufinden, wie Schülerinnen und Schüler über ein bestimmtes Thema denken. Diese Vorstellungen sind für Lehrkräfte sehr wichtig, um im Unterricht daran anknüpfen und euch das Thema so gut wie möglich beibringen zu können. Deswegen ist es für mich ganz wichtig, dass du mir deine eigenen, persönlichen Vorstellungen und Gedankengänge erzählst. Du brauchst dir keine Gedanken darüber zu machen, dass du etwas Falsches sagen könntest, denn in diesem Fall gibt es keine falschen und richtigen Antworten. Alles, was dir einfällt, hilft mir weiter. Ich werde vermutlich zwischendurch Nachfragen stellen oder dich bitten, einige Dinge noch einmal genauer zu erklären. Lass dich davon bitte nicht irritieren, ich will dann nur sichergehen, dass ich dich wirklich richtig verstanden habe. Wenn du zwischendurch einmal etwas nicht verstehst, darfst du natürlich auch nachfragen. Wahrscheinlich habe ich mich dann einfach nicht klar genug ausgedrückt. Da es in dem Interview um deine Vorstellungen geht, werde ich mich die meiste Zeit zurückhalten, darüber brauchst du dich nicht wundern. Es wäre schön, wenn du einfach von dir aus möglichst viel erzählst.
- Ich würde unser Interview gerne mit diesem Aufnahmegerät aufzeichnen, wenn du einverstanden bist. Du wirst nicht gefilmt, es geht wirklich nur um die Tonspur. Ich höre mir die Aufnahme nach unserem Interview einmal an und tippe sie am PC ab, damit ich während des Interviews nicht so viel mitschreiben muss. Danach arbeite ich in der Auswertung nur noch mit dem Text weiter. Ich werde natürlich nichts aus diesem Interview an deine Lehrer, Mitschüler oder andere Personen weitererzählen – alles, was du sagst, wird streng vertraulich und anonym behandelt. Damit niemand zurückverfolgen kann, was du gesagt hast, wird dein Name nirgendwo auftauchen bzw. verändert. Du kannst also ganz frei erzählen, was dir in den Kopf kommt. Am besten wäre es, wenn du versuchst, während des Interviews auch keine Namen von anderen Personen wie zum Beispiel von Freunden oder Lehrern zu verwenden – die Namen werde ich aber sonst ebenfalls abändern. Das Interview ist absolut freiwillig und du kannst es jederzeit abbrechen, ohne dass es negative Konsequenzen für dich hat.
- Vielleicht fragst du dich, was ich mit dem Tablet vorhabe. Ich befrage für meine Arbeit insgesamt 16 Schülerinnen und Schüler und habe dafür ein paar Fragen und Stichpunkte vorbereitet, damit alle Interviews ähnlich ablaufen. Das sind also meine „Spickzettel“ (ggf. Karte 1 zeigen) – es kann sein, dass ich zwischendurch darauf schaue oder mir ab und zu eine kleine Notiz mache.
- Ganz am Ende wird es noch einen kurzen Fragebogen zu ein paar allgemeinen Infos zu deiner Person geben, den wir zusammen ausfüllen. Dann bekommst du natürlich auch wie versprochen deinen Gutschein.
- Wenn du keine weiteren Fragen hast, möchte ich jetzt die Aufnahme starten. Bist du damit einverstanden?

<table>
<tr><td>Karte: 3</td><td colspan="2">Abschnitt: 3 – Warming-up
Themenbereich: Einkaufsverhalten und Ernährungsgewohnheiten in der Familie</td><td>Intention / Forschungsinteresse: thematischer Einstieg ins Interview</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Ich habe dir ja schon gesagt, dass ich gerne mit dir über das Thema Ernährung sprechen möchte. Wie sieht das bei euch in der Familie aus? Wie läuft beispielsweise das Einkaufen, Kochen und Essen ab? Erzähl doch einmal ein bisschen.</td></tr>
<tr><td>Inhaltliche Aspekte:
Zuständigkeit Einkaufen / Kochen
Selbstbestimmtheit / Eigenständigkeit bzgl. Ernährung</td><td>Weitere Fragen / Hinweise:
Wer von euch geht einkaufen?
Wer kocht bei euch zuhause?
Wie sieht es bei dir selbst mit dem Kochen aus? Kochst du auch selbst?
Wie machst du das mit dem Essen, wenn du länger Unterricht hast und mittags in der Schule bist?
Wer entscheidet denn so bei euch, was beispielsweise am nächsten Tag gegessen wird?</td><td>Intervention / Sonstiges:</td><td>Erwartungshorizont:
Eltern sind hauptsächlich für das Einkaufen und Kochen zuständig
S. selbst kauft selten ein / kocht nicht oder nur selten selbst
S. ist in Bezug auf Ernährung / Essenswahl z.T. eigenständig und selbstbestimmt</td></tr>
</table>

<table>
<tr><td>Karte: 4</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 1A
Themenbereich: Assoziationen zum Ausdruck „nachhaltige Ernährung“</td><td>Intention / Forschungsinteresse: Was assoziieren SuS mit dem Ausdruck „nachhaltige Ernährung“?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Was verbindest du mit nachhaltiger Ernährung? Schreib mir auf diesen Zettel doch einmal zehn Begriffe auf, die dir dazu als erstes in den Kopf kommen.</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Wenn du den Ausdruck „nachhaltige Ernährung“ hörst, welche zehn Begriffe fallen dir dazu spontan ein?</td></tr>
<tr><td>Inhaltliche Aspekte:
S. notiert zehn Begriffe
Erklärungen zu den Begriffen + weitere Aspekte (Bedeutung, praktische Umsetzung etc.)
alle aufgeschriebenen Wörter sollten angesprochen werden</td><td>Weitere Fragen / Hinweise:
Hast du mit einem der beiden Wörter Schwierigkeiten? ... Hattet ihr den Begriff „Nachhaltigkeit“ vielleicht schon einmal im Unterricht? Versuch doch einmal, dir die Wortbedeutung herzuleiten. → Ggf. weiter anleiten (Wort auseinandernehmen)
Bei langen Denkpausen:
Es geht erst einmal nur um die Begriffe, die dir ganz spontan einfallen. Du kannst gar nichts Falsches aufschreiben.
Wir gehen später noch einmal auf die Begriffe ein, dann kannst du mir erklären, was du damit meinst. Jetzt reichen wirklich erst einmal nur die Wörter.
Woran denkst du gerade?!
Begriffe einzeln durchgehen und jeweils von S. erklären lassen
Nachfragen zu Begriffen (je nach Kontext):
Wie bist du darauf gekommen?
Warum denkst du, dass dieser Punkt wichtig ist?
Wofür könnte dieser Punkt wichtig sein?
Wie könnte das aussehen?</td><td>Intervention / Sonstiges:
Zettel und Stift zum Notieren der Begriffe hinlegen</td><td>Erwartungshorizont:
Gesundheit
Obst / Gemüse
lang anhaltende Sättigung
Vielleicht:
Bioprodukte
vegetarisch, vegan
Fair Trade</td></tr>
</table>

<table>
<tr><td>Karte: 5</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 1B
Themenbereich: prä-instruktionale Vorstellungen von nachhaltiger Ernährung</td><td>Intention / Forschungsinteresse: Welche prä-instruktionalen Vorstellungen haben SuS von nachhaltiger Ernährung?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Versuch bitte einmal, in deinen eigenen Worten zu beschreiben, was du dir unter nachhaltiger Ernährung vorstellst.</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Beschreibe bitte einmal, was du dir unter nachhaltiger Ernährung vorstellst.</td></tr>
<tr><td>Inhaltliche Aspekte:
persönliche Vorstellungen von nachhaltiger Ernährung</td><td>Weitere Fragen / Hinweise:
Bei Schwierigkeiten:
Das muss kein perfektes Konzept sein. Erzähl mir einfach ein bisschen, was du dir darunter vorstellst.
Dir sind ja eben auch ein paar Begriffe zu dem Ausdruck eingefallen, vielleicht helfen die dir weiter?
Das ist gar nicht so einfach, aber versuch es doch einfach einmal. Ich habe dir ja schon am Anfang erklärt, dass mir alles, was dir einfällt, weiterhilft.
Falls Schwierigkeiten mit Begriff „nachhaltig“: s. Block 1A → herleiten lassen
Möglichst viel nachhaken, besonders bei Begriffen, die von S. verwendet, aber nicht weiter erläutert werden!</td><td>Intervention / Sonstiges:</td><td>Erwartungshorizont:
nachhaltige Ernährung = gesunde Ernährung
nachhaltige Ernährung = Ernährung, die langanhaltend sättigt
nachhaltige Ernährung = umweltverträgliche Ernährung</td></tr>
</table>

Definition nachhaltige Entwicklung *(nur für Notfall):* Bei dem Begriff Nachhaltigkeit / einer nachhaltigen Entwicklung geht es darum, dass darum, dass die Bedürfnisse der jetzigen Generation befriedigt werden, ohne die Bedürfnisse nachfolgender Generationen zu gefährden. Man soll sein Verhalten also nicht nur auf die eigene, jetzige Lebenssituation ausrichten, sondern auch daran denken, welche Konsequenzen das derzeitige Handeln für die Zukunft haben kann.

<table>
<tr><td>Karte: 6</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 1C
Themenbereich: Empfehlungen für eine nachhaltige Ernährung</td><td>Intention / Forschungsinteresse: Welche Empfehlungen nennen SuS für eine nachhaltige Ernährung?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Du hast am Anfang gesagt, dass XY vor allem für das Einkaufen (/ Kochen) bei euch zuständig ist. Stell dir doch einmal vor, du sollst ihm / ihr Empfehlungen (/ Ratschläge) geben, wie ihr euch nachhaltiger ernähren könntet. Hast du irgendwelche Ideen, was du ihm / ihr sagen könntest?</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Stell dir einmal vor, XY fragt dich nach Empfehlungen (/ Ratschlägen), um eure Ernährung nachhaltiger zu gestalten. Fallen dir irgendwelche Dinge ein, die man dafür beachten könnte?</td></tr>
<tr><td>Inhaltliche Aspekte:
Einkaufen (z.B. Produkte, Verpackungen, Einkaufsort, Einkaufsweg)
Kochen (z.B. Verarbeitung, Energieverbrauch)</td><td>Weitere Fragen / Hinweise:
Falls defensive Reaktion von S.:
Es müssen nicht unbedingt Empfehlungen für XY sein. Du kannst dir auch einfach vorstellen, dass dich das jemand fragt, der sich überhaupt nicht nachhaltig ernährt. Hättest du dann noch irgendwelche Ideen, was du ihm raten könntest?
Ggf. auch Dinge, die in Familie schon „richtig“ gemacht werden.
Du hast schon etwas zu ... gesagt. Fällt dir noch irgendetwas ein, das man außerdem (z.B. beim Einkaufen oder Kochen) beachten könnte?</td><td>Intervention / Sonstiges:
Empfehlungen notieren, die nicht in den fachlichen Grundsätzen auftauchen</td><td>Erwartungshorizont:
viel Obst / Gemüse
wenig Fleisch
Bioprodukte
auf dem Markt einkaufen / regionale Produkte</td></tr>
</table>

Empfehlungen, die in den fachlichen Grundsätzen nicht oder nicht direkt auftauchen:

<table>
<tr><td>Karte:
7</td><td>Abschnitt: 4 – Hauptphase, Block 2A
Themenbereich:
Nachhaltigkeitsdimensionen</td><td colspan="3">Intention / Forschungsinteresse: Wie interpretieren SuS die Dimensionsabbildung? Was stellen sie sich unter den Dimensionen vor? Welche Zusammenhänge sehen sie zwischen den Dimensionen und dem Thema „Nachhaltige Ernährung“?</td></tr>
<tr><td colspan="5">Leitfrage / Erzählaufforderung:
Du konntest mir schon einiges zu deinen eigenen Vorstellungen sagen, kannst dir aber sicher auch denken, dass Menschen unterschiedliche Vorstellungen zu einem bestimmten Thema haben können. Natürlich haben sich auch Wissenschaftler, die sich mit dem Bereich Ernährung beschäftigen, bereits Gedanken über das Thema „Nachhaltige Ernährung“ gemacht. Dazu habe ich dir eine Abbildung mitgebracht, über die ich gerne mit dir sprechen würde. Guck dir die Abbildung doch erst einmal ganz in Ruhe an.
1) Was glaubst du, was die Abbildung insgesamt darstellen soll?</td></tr>
<tr><td colspan="5">Alternativformulierung(en):
Hast du vielleicht eine Idee, was die Abbildung aussagen soll? Erzähl doch einfach einmal, was dir dazu einfällt.</td></tr>
<tr><td>Inhaltliche Aspekte:
• verschiedene Bereiche, die etwas mit nachhaltiger Ernährung zu tun haben
• Begriffe Gesundheit, Umwelt, Wirtschaft, Gesellschaft, Kultur werden besprochen (durchstreichen)</td><td colspan="2">Weitere Fragen / Hinweise:
2) Hier stehen fünf verschiedene Begriffe am Rand. Kannst du mir einmal erklären, was du dir jeweils allgemein darunter vorstellst?
3) Intervention: Erklärung zu Dimensionen
4) Wie würdest du diese Bereiche mit nachhaltiger Ernährung in Verbindung bringen? Was fällt dir dazu ein?
5) Hast du die Abbildung verstanden? Hast du noch Fragen?
6) Fällt dir noch etwas ein, was du in der Abbildung ergänzen möchtest? Fehlt deiner Meinung nach etwas?</td><td>Intervention / Sonstiges:
Abbildung zu Dimensionen, ggf. weitere Dimension auf der Abbildung ergänzen</td><td>Erwartungshorizont:
• evtl. Probleme mit Gesamtkonzept der Abbildung
• Schwierigkeiten bei Begriffserklärung zu Wirtschaft, Gesellschaft und Kultur
• Abstraktheit der Dimensionen bereitet Probleme</td></tr>
</table>

Erklärung zu Dimensionen: In der Abbildung siehst du außen fünf Bereiche, die alle etwas mit dem Thema nachhaltige Ernährung zu tun haben. Im Bereich Gesundheit geht es nicht *nur* darum, dass man nicht krank ist, sondern dass es einem vollständig – sowohl auf körperlicher (physischer), als auch auf geistiger (psychischer) und sozialer Ebene – gut geht. Der Begriff Umwelt bezeichnet hier die natürliche Umwelt (und die wechselseitigen Beziehungen der verschiedenen Elemente). Dabei geht es sowohl um die belebte Umwelt, also alle Lebewesen, als auch um die unbelebte Umwelt, wozu beispielsweise die Luft, Gewässer oder Böden zählen. Im Bereich Wirtschaft geht es vor allem um Angebot und Nachfrage. Dabei spielen Produktion, Verarbeitung, Handel und Konsum von Gütern eine Rolle, aber auch Jobs und Preise. Gesellschaft bezeichnet allgemein die Gesamtheit der Menschen, die unter bestimmten Verhältnissen zusammenleben. Dabei geht es um soziale Aspekte, die eine bestimmte Gruppe oder auch die Menschen auf der ganzen Welt betreffen können. Im Bereich Kultur geht es um Traditionen und Gewohnheiten von Menschen, aber auch um Trends und Wandel in der Kultur.

<table>
<tr><td>Karte: 8</td><td>Abschnitt: 4 – Hauptphase, Block 2B
Themenbereich: Banane und Dimensionen</td><td colspan="2">Intention / Forschungsinteresse: Wie wenden SuS das Dimensionskonzept auf ein problematisches Nahrungsmittel an?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Ich kann mir vorstellen, dass es ziemlich schwierig ist, sich unter diesen Bereichen konkret etwas vorzustellen. Deswegen möchte ich gemeinsam mit dir versuchen, die Abbildung auf ein konkretes Beispiel anzuwenden. Ich habe dir dazu ein Nahrungsmittel mitgebracht, auf das ich die Bereiche gerne mit dir übertragen würde. Guck dir ruhig noch einmal die Abbildung an und überlege einmal, was dir zu den einzelnen Bereichen in Bezug auf die Banane einfällt.</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Ich möchte jetzt mit dir zusammen versuchen, zu den verschiedenen Bereichen ein paar konkrete Punkte zu erarbeiten, sodass du dir etwas darunter vorstellen kannst. Dazu habe ich dir die Banane mitgebracht, anhand derer wir die verschiedenen Punkte einmal durchsprechen können. Hast du Ideen, wie die Banane mit den einzelnen Bereichen zusammenhängen könnte?</td></tr>
<tr><td>Inhaltliche Aspekte:
Gesundheit (gesundes Nahrungsmittel, Vitamine / Mineralstoffe, Pestizidbelastung der Arbeiter)
Umwelt (Anbau v.a. in Südamerika, Monokulturen, lange Transportwege (CO_2), Plastiktüte / Verpackung)
Wirtschaft (unterbezahlte Arbeitskräfte in Herkunftsländern, Exportprodukt)
Gesellschaft (schlechte Arbeitsbedingungen, ungerechter Lohn)
Kultur (kein traditionelles Nahrungsmittel in Deutschland, „Trendessen“ → Smoothies / Eis)</td><td>Weitere Fragen / Hinweise:
<u>nicht</u> die Reihenfolge der Bereiche vorgeben!
Was fällt dir zu den anderen Bereichen ein, über die du bisher noch nicht gesprochen hast?
ggf. Impuls: Vielleicht denkst du zum Beispiel einmal daran, woher Bananen stammen / wo sie angebaut werden.</td><td>Intervention / Sonstiges:
Banane mit Chiquita-Aufkleber eingepackt in Plastiktüte aus Supermarkt</td><td>Erwartungshorizont:
Es werden Aspekte zu Gesundheit, Umwelt, Wirtschaft und / oder Gesellschaft genannt.
Schwierigkeiten im Bereich Kultur
Schwierigkeiten in Abgrenzung Wirtschaft / Gesellschaft oder Gesellschaft / Kultur
Die Bereiche werden nacheinander (evtl. in Reihenfolge der Abbildung) „abgearbeitet“ und in den Aussagen wenig miteinander verknüpft.</td></tr>
</table>

<table>
<tr><td>Karte: 9</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 3A
Themenbereich: Ergänzungen zu den Empfehlungen für eine nachhaltige Ernährung</td><td>Intention / Forschungsinteresse: Welche weiteren Empfehlungen nennen SuS für eine nachhaltige Ernährung nach den Interventionen zu den Nachhaltigkeitsdimensionen?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Wir haben eben schon einmal über Empfehlungen für eine nachhaltige Ernährung gesprochen, die du XY geben könntest. Fällt dir jetzt noch etwas dazu ein?</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Hast du weitere Ideen für Empfehlungen für eine nachhaltige Ernährung, die du XY geben könntest? Möchtest du noch etwas ergänzen?</td></tr>
<tr><td>Inhaltliche Aspekte:
S. nennt weitere Ideen / Ergänzungen zu den Empfehlungen</td><td>Weitere Fragen / Hinweise:
ggf. Hilfestellung, falls passend:
Wir haben gerade über die verschiedenen Bereiche der Abbildung gesprochen, dabei hast du einige problematische Aspekte bei Bananen genannt. Fällt dir in dem Zusammenhang noch irgendetwas ein, das man bei einer nachhaltigen Ernährung beachten sollte?</td><td>Intervention / Sonstiges:
Empfehlungen notieren, die nicht in den fachlichen Grundsätzen auftauchen</td><td>Erwartungshorizont:
Ergänzung: Fairtrade-Produkte
Ergänzung: regionale Produkte, nicht importierte Lebensmittel
Ergänzung: Verpackungsmüll / Plastikverpackungen meiden</td></tr>
</table>

Empfehlungen, die in den fachlichen Grundsätzen nicht oder nicht direkt auftauchen:

<table>
<tr><td>Karte: 10</td><td>Abschnitt: 4 – Hauptphase, Block 3B
Themenbereich: Vorstellungen zu den Grundsätzen einer nachhaltigen Ernährung</td><td colspan="2">Intention / Forschungsinteresse: Welche Vorstellungen haben SuS zu den präsentierten Grundsätzen einer nachhaltigen Ernährung?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Du hast schon einige Dinge genannt, die man für eine nachhaltige Ernährung beachten könnte. Ich habe dir wieder etwas mitgebracht, das von Wissenschaftlern entwickelt wurde, die ebenfalls ein paar Empfehlungen für eine nachhaltige Ernährung aufgestellt haben. Guck dir die doch einmal kurz an und dann gehen wir die gleich zusammen durch. (Einige Aspekte kommen dir sicher bekannt vor, weil du sie auch eben genannt hast.)

→ S. soll erklären, was er sich unter den Empfehlungen bzw. besonderen Begriffen vorstellt. Unpassende Vorstellungen ggf. korrigieren oder ergänzen, z.B.: „Wissenschaftler meinte damit EIGENTLICH...“.

1. Bevorzugung pflanzlicher Lebensmittel: Anteil tierischer Lebensmittel / besonders Fleisch reduzieren
2. ökologisch erzeugte Lebensmittel: Bio-Lebensmittel
3. regionale und saisonale Erzeugnisse: „regional“: Herkunft des Lebensmittels / Produktion und Verbrauch in derselben Region; „saisonal“: Lebensmittel, die in der einheimischen Saison / Jahreszeit im Freiland wachsen und angebaut werden können
4. Bevorzugung gering verarbeiteter Lebensmittel: Produkte, die nicht in vielen Schritten bearbeitet wurden, wenig Fertigprodukte
5. fair gehandelte Lebensmittel: Fair Trade → faire Preise der Lebensmittel für Erzeuger, Verarbeiter und Händler, fairer Lohn, faire Bedingungen für Arbeitskräfte in Herkunftsländern
6. ressourcenschonendes Haushalten: ggf. Begriffe erklären: Ressourcen = Bestände, Vorräte; Haushalten: sich einteilen / sparsam mit etwas umgehen; Dinge, die bei der Ernährung im weiteren Sinne eine Rolle spielen können (z.B. Stromnutzung, Einkaufswege, Verpackungen von Lebensmitteln, Lebensmittelverschwendung)
7. genussvolle und bekömmliche Speisen: Spaß und Genuss (leckerer Geschmack), Bekömmlichkeit (= Verträglichkeit / leicht verdaulich)</td></tr>
<tr><td>Inhaltliche Aspekte:
Vorstellung zu Grundsätzen und explizit zu folgenden Begriffen wird abgefragt:

pflanzlich, ökologisch erzeugt, regional, saisonal, gering verarbeitet, fair gehandelt, ressourcenschonendes Haushalten, genussvoll, bekömmlich (durchstreichen)</td><td>Weitere Fragen / Hinweise:
• Konzept verstanden? Nachfragen / Verständnisprobleme?
• Möchtest du von deinen eigenen Empfehlungen etwas ergänzen? Fehlt deiner Meinung nach in dieser Tabelle etwas?</td><td>Intervention / Sonstiges:
Tabelle zu Grundsätzen, mögliche Ergänzungen aus Empfehlungen des / der S. parat haben</td><td>Erwartungshorizont:
• Schwierigkeiten bei den Begriffen:
○ „ökologisch erzeugt“
○ „saisonal“
○ „gering verarbeitet“
○ „ressourcenschonendes Haushalten“</td></tr>
</table>

<table>
<tr><td>Karte: 11</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 4A
Themenbereich: nicht geleitete Verknüpfung der Grundsätze und Dimensionen</td><td>Intention / Forschungsinteresse: Wie verknüpfen SuS nicht geleitet die Grundsätze und Dimensionen?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Wir haben in den letzten Minuten über die verschiedenen Bereiche auf dieser Abbildung und über diese Empfehlungen gesprochen. Kannst du einmal versuchen, die Empfehlungen mit den Bereichen aus dieser Abbildung zu verknüpfen?</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Kannst du dir vielleicht vorstellen, wie diese beiden Sachen zusammenhängen könnten?</td></tr>
<tr><td>Inhaltliche Aspekte:
Alle Empfehlungen werden angesprochen und eine Verknüpfung mit den Bereichen wird versucht</td><td>Weitere Fragen / Hinweise:
Hinweis: positive und negative Aspekte möglich, alle denkbaren Verbindungen nennen
wenig konkrete Impulse, Hilfestellungen
mögliche Nachfragen:
Womit würdest du Empfehlung X in Verbindung bringen?
Wie sieht es denn mit den Empfehlungen aus, die du jetzt noch nicht erwähnt hast? Hast du da eine Idee, womit diese vielleicht zusammenhängen könnten?
mögliche Begriffe: Verbindungen / Verknüpfungspunkte / Zusammenhänge / Effekte / Auswirkungen</td><td>Intervention / Sonstiges:
Dimensionsabbildung und Tabelle zu den Grundsätzen nebeneinanderlegen, parallel in Verknüpfungstabelle bereits genannte Bereiche abhaken</td><td>Erwartungshorizont:
1:1 Verknüpfung (S. nimmt je einen Grundsatz und ordnet diesen einer bzw. der wichtigsten Dimension zu)
Bevorzugung pflanzlicher Lebensmittel: Umwelt
ökologisch erzeugte Lebensmittel: Umwelt oder Gesundheit
regionale und saisonale Erzeugnisse: Umwelt oder Wirtschaft
Bevorzugung gering verarbeiteter Lebensmittel: Gesundheit oder Umwelt
fair gehandelte Lebensmittel: Wirtschaft oder Gesellschaft
ressourcenschonendes Haushalten: Umwelt
genussvolle und bekömmliche Speisen: Gesundheit oder Kultur
→ ggf. Verwirrung, weil es sieben Grundsätze und nur fünf Dimensionen gibt</td></tr>
</table>

<table>
<tr><td>Karte: 12</td><td>Abschnitt: 4 – Hauptphase, Block 4B
Themenbereich: geleitete Verknüpfung der Grundsätze und Dimensionen</td><td colspan="2">Intention / Forschungsinteresse: Wie bringen SuS die Grundsätze mit den Dimensionen in Verbindung? Können SuS Verknüpfungen zwischen den Grundsätzen und jeweils allen Dimensionen herstellen?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Du hattest schon einige Ideen, wie man die Bereiche und Empfehlungen miteinander verbinden könnte. Wahrscheinlich hast du bemerkt, dass ich eben etwas mitgeschrieben habe - ich habe eine Tabelle als Hilfestellung vorbereitet und darin die Bereiche abgehakt, zu denen du gerade schon etwas gesagt hast. Überleg doch einmal bitte, ob dir noch etwas zu den freien Feldern einfällt, die du noch nicht angesprochen hast. Du musst dabei nicht der Reihe nach vorgehen - fang einfach mit dem an, was dir am leichtesten fällt.</td></tr>
<tr><td>Inhaltliche Aspekte:
Versuch der Verknüpfung aller Grundsätze mit den jeweils fünf Dimensionen</td><td>Weitere Fragen / Hinweise:
Impulse und Hilfestellungen möglich (spontan)
mögliche Nachfragen:
Eben hast du bei Grundsatz A zum Beispiel schon X, Y, Z angesprochen. Hast du eine Idee, was für einen Zusammenhang diese Empfehlung mit den anderen Bereichen haben könnte?
Kannst du dir irgendwelche Verbindungen zwischen dem X-ten Ratschlag und dem Bereich Z vorstellen?
Versuch doch einmal dir vorstellen, was für Effekte dieses Verhalten im Bereich Z haben könnte.
Jetzt fehlen uns noch ein paar Haken – fällt dir noch irgendetwas ein?
Wenn dir dazu nichts einfällt, ist das gar nicht schlimm, dann kannst du auch gerne mit etwas anderem weitermachen.
mögliche Begriffe: Verbindungen / Verknüpfungspunkte / Zusammenhänge / Effekte / Auswirkungen</td><td>Intervention / Sonstiges:
Verknüpfungs-tabelle hinlegen und weiter abhaken (lassen)</td><td>Erwartungshorizont:
Schwierigkeiten bei der Verknüpfung der Grundsätze mit allen Dimensionen
vermutlich <u>Probleme</u> bei:
Bevorzugung pflanzlicher Lebensmittel: Gesellschaft, Kultur
ökologisch erzeugte Lebensmittel: Wirtschaft, Gesellschaft, Kultur
regionale und saisonale Erzeugnisse: Gesellschaft, Gesundheit, Kultur
Bevorzugung gering verarbeiteter Lebensmittel: Gesellschaft, Wirtschaft
fair gehandelte Lebensmittel: Umwelt, Gesundheit, Kultur
ressourcenschonendes Haushalten: Gesundheit, Kultur, Gesellschaft, Wirtschaft
genussvolle und bekömmliche Speisen: Umwelt, Wirtschaft, Gesellschaft</td></tr>
</table>

<table>
<tr><td>Karte: 13</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 4C
Themenbereich: Bewertung der Dimensionen und Grundsätze einer nachhaltigen Ernährung</td><td>Intention / Forschungsinteresse: Wie bewerten SuS die Dimensionen und Grundsätze einer nachhaltigen Ernährung bzw. die zugehörigen Materialien?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Nachdem wir über die Abbildung und die Empfehlungen gesprochen haben, würde ich gerne einmal deine eigene Meinung dazu hören. Ich habe dir ja gesagt, dass diese Ideen von Wissenschaftlern entwickelt wurden – aber wie findest du die denn so? Was findest du (an der Abbildung bzw. den Empfehlungen) gut, was findest du nicht so gelungen? Kannst du mir dazu vielleicht etwas sagen?</td></tr>
<tr><td>Inhaltliche Aspekte:</td><td>Weitere Fragen / Hinweise:
Gibt es etwas, das dich an der Abbildung / an den Empfehlungen stört?
Würdest du an der Abbildung / an den Empfehlungen etwas verändern, sodass man sie im Unterricht einsetzen kann?</td><td>Intervention / Sonstiges:</td><td>Erwartungshorizont:
Dimensionen werden eher kritisch gesehen, da sie sehr abstrakt sind
Grundsätze werden positiv bewertet, z.T. sind Formulierungen für SuS zu komplex</td></tr>
</table>

<table>
<tr><td>Karte: 14</td><td colspan="2">Abschnitt: 4 – Hauptphase, Block 4D
Themenbereich: post-instruktionale Vorstellungen von nachhaltiger Ernährung</td><td>Intention / Forschungsinteresse: Welche post-instruktionalen Vorstellungen haben SuS von nachhaltiger Ernährung? Welche fachlichen Elemente werden von den SuS aus den Interventionen übernommen?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Kannst du nun noch einmal beschreiben, was du dir (jetzt) unter nachhaltiger Ernährung vorstellst?</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Beschreib doch nun bitte noch einmal, was du dir (jetzt) unter nachhaltiger Ernährung vorstellst.</td></tr>
<tr><td>Inhaltliche Aspekte:
persönliche Vorstellungen von nachhaltiger Ernährung</td><td>Weitere Fragen / Hinweise:</td><td>Intervention / Sonstiges:</td><td>Erwartungshorizont:
S. nimmt Bezug auf prä-instruktionale Vorstellungen, ggf. Ergänzungen
nachhaltige Ernährung hat etwas mit vielen verschiedenen Bereichen zu tun
nachhaltige Ernährung = gesund (Gesundheit), umweltverträglich (Umwelt), sozial / fair (Gesellschaft / Wirtschaft)
Dimension Kultur wird nicht aufgegriffen</td></tr>
</table>

<table>
<tr><td>Karte: 15</td><td>Abschnitt: 4 – Hauptphase, Block 5
Themenbereich: Bisherige Konfrontation und Ideen für den Unterricht</td><td colspan="2">Intention / Forschungsinteresse: Wo werden SuS mit dem Thema „Nachhaltige Ernährung“ konfrontiert? Welche Ideen haben sie für die Integration des Themas in den Unterricht?</td></tr>
<tr><td colspan="4">Leitfrage / Erzählaufforderung:
Wir haben jetzt viel über das Thema „Nachhaltige Ernährung“ gesprochen und du konntest mir ja auch schon einiges dazu erzählen. Wie kommt das? Woher weißt du so viel darüber? Alternative: Hattest du den Ausdruck „nachhaltige Ernährung“ schon einmal vor dem Interview gehört?

Wie ich dir schon am Anfang erzählt habe, ist das Ziel solcher Interviews, die Vorstellungen der Schülerinnen und Schüler herauszufinden, um darauf aufbauend bessere Unterrichtskonzepte zu dem Thema entwickeln zu können. Ich finde es immer ganz spannend, welche Ideen die Schüler selbst haben, um den Unterricht interessanter zu gestalten. Fällt dir irgendetwas ein, was du persönlich für den Unterricht in Bezug auf das Thema „nachhaltige Ernährung“ besonders spannend fändest?</td></tr>
<tr><td colspan="4">Alternativformulierung(en):
Hast du irgendwelche Vorschläge oder Ideen, wie man das Thema „nachhaltige Ernährung“ im Unterricht behandeln könnte, sodass es für die Schüler wirklich interessant ist?</td></tr>
<tr><td>Inhaltliche Aspekte:
Informationsquellen
Ideen zu möglichen Unterrichtsansätzen</td><td>Weitere Fragen / Hinweise:
Wo hast du dich darüber informiert?
Ist dir die Thematik schon einmal vorher irgendwo begegnet?
Hattet ihr das Thema schon einmal im Unterricht?</td><td>Intervention / Sonstiges:</td><td>Erwartungshorizont:
Quellen: Unterricht (Biologie, Erdkunde), Internet, Fernsehen / Nachrichten
Ideen: offen</td></tr>
</table>

Karte: 16	**Abschnitt**: 5 – Ausklangphase	**Intention / Forschungsinteresse:** Abschluss des Interviews

Ablauf:

- Jetzt haben wir einiges besprochen. Gibt es noch etwas, das du gerne hinzufügen möchtest, worüber wir bisher noch nicht gesprochen haben?
- Hattest du irgendwelche Probleme während des Interviews? Gab es Dinge, die dir besonders schwer gefallen sind oder die dich gestört haben? Du darfst ganz ehrlich zu mir sein, vielleicht kann ich dadurch beim nächsten Interview etwas besser machen.
- Aufnahmeende
- Kurzfragebogen ausfüllen
- Perfekt, mehr Informationen brauche ich gar nicht. Ich habe nur noch eine letzte Bitte: Da ich das Interview noch mit anderen Schülerinnen und Schülern durchführen werde, ist es wichtig, dass du keine Informationen zu den Themen, über die wir gesprochen haben, an deine Mitschüler weitergibst. Du kannst dir vermutlich vorstellen, dass es sonst die Ergebnisse meiner Studie verfälschen würde, wenn andere Schüler bereits vor dem Interview die genauen Fragen kennen oder wissen, dass es um das Thema „nachhaltige Ernährung“ geht.
- Bedanken, Gutschein überreichen und Bestätigung unterschreiben lassen, Verabschiedung
- Eigene Reflexionsfragen des Kurzfragebogens ausfüllen

I1: Students' conceptions of sustainable nutrition

- **Used materials for the Interviews**

10 Begriffe zu nachhaltiger Ernährung

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

5 Dimensionen einer nachhaltigen Ernährung

Empfehlungen für eine nachhaltige Ernährung

1.	Bevorzugung pflanzlicher Lebensmittel
2.	Ökologisch erzeugte Lebensmittel
3.	Regionale und saisonale Erzeugnisse
4.	Bevorzugung gering verarbeiteter Lebensmittel
5.	Fair gehandelte Lebensmittel
6.	Ressourcenschonendes Haushalten
7.	Genussvolle und bekömmliche Speisen

Verknüpfungen der Grundsätze und Dimensionen Anhang

	Gesundheit	Umwelt	Wirtschaft	Gesellschaft	Kultur
1. Bevorzugung pflanzlicher Lebensmittel					
2. Ökologisch erzeugte Lebensmittel					
3. Regionale und saisonale Erzeugnisse					
4. Bevorzugung gering verarbeiteter Lebensmittel					
5. Fair gehandelte Lebensmittel					
6. Ressourcenschonendes Haushalten					
7. Genussvolle und bekömmliche Speisen					

A3 Supplementary material

Supplementary material for the reproduction of the analyses of the empirical part can be found in the Open Science Framework under the following link:

https://osf.io/q6xtw/

A4 Curriculum vitae

Persönliche Daten
Maximilian Dornhoff-Grewe
Geboren am 23. Januar 1990 in Bielefeld
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Kurzprofil
Master of Education Gymnasium
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Universitäre und schulische Ausbildung

01/2017 - 01/2021	Wissenschaftlicher Mitarbeiter und Promotion in der Biologiedidaktik der Universität Osnabrück
10/2014 - 11/2016	Master of Education Gymnasium, Biologie und Spanisch an der Universität Osnabrück (Gesamtnote: 1,6) • Masterarbeit im Fach Biologie / Biologiedidaktik mit einmonatigem Auslandsaufenthalt in Ecuador: „Der Zusammenhang zwischen Naturverbundenheit, Wohlbefinden, Werteorientierungen und Environmental Concern - Eine quantitative Studie mit ecuadorianischen SchülerInnen“ (Note: 1,3)
08/2010 – 11/2014	2-Fächer-Bachelor, Biologie und Spanisch an der Universität Osnabrück (Gesamtnote: 2,0) • Bachelorarbeit im Fach Biologie / Ökologie: „Ökologische Gradienten und ihre Vegetation als Lehrgegenstand“ (Note: 1,3)
02/2013 – 06/2013	Auslandssemester an der Universidad de Oviedo, Spanien
08/2000 – 06/2009	Martin-Niemöller-Gesamtschule, Bielefeld Abitur (Gesamtnote: 2,4)

Praktika

09/2015 – 10/2015	Erweitertes Fachpraktikum an den Berufsbildenden Schulen am Schölerberg der Stadt Osnabrück
02/2015 – 03/2015	Basisfachpraktikum am Ratsgymnasium Osnabrück
02/2012 – 03/2012	Allgemeines Schulpraktikum an der Gesamtschule Friedenstal in Herford

Nebentätigkeiten

02/2014 - 03/2017	Koordinator für die Individuelle Lernzeit in der Integrierten Gesamtschule Osnabrück für die Lega S Jugendhilfe gGmbH
09/2012 – 02/2014	Honorarkraft in der Individuellen Lernzeit in der Integrierten Gesamtschule Osnabrück für die Lega S Jugendhilfe gGmbH
07/2012 - 12/2016	Kinderbetreuung im Auftrag von Hoppla / Zappel Frank und seine Freunde Spielarena bei L+T Lengermann & Trieschmann GmbH

Anderer Dienst im Ausland

08/2009 – 08/2010	"Ecoselva ONG " La Merced, Peru "IRCAS", Ñagazu, Villa Rica, Peru

Sprach- und EDV-Kenntnisse

Sprachen	Deutsch:	Muttersprache
	Englisch:	Gute Grundkenntnisse
	Spanisch:	Fließend
	Italienisch:	Grundkenntnisse
EDV	Word, PowerPoint, Excel IBM SPSS, MAXQDA	

A5 Statement of authorship

Erklärung über die Eigenständigkeit der erbrachten wissenschaftlichen Leistung
Ich erkläre hiermit, dass ich die vorliegende Arbeit ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus anderen Quellen direkt oder indirekt übernommenen Daten und Konzepte sind unter Angabe der Quelle gekennzeichnet.

Bei der Auswahl und Auswertung folgenden Materials haben mir die nachstehend aufgeführten Personen in der jeweils beschriebenen Weise entgeltlich und unentgeltlich geholfen.

1. Die Fragebogenerstellung und Erhebung der Daten der ersten quantitativen Studie wurde von Jan-Niklas Sothmann geleitet und von mir unterstützt.
2. Die Erhebung quantitativer Daten wurde von den nachstehend aufgeführten Studierenden im Zuge ihrer Qualifikationsarbeiten unentgeltlich unterstützt: Ruth Merschendorf-Steinkamp, Julia Wesselkamp, Liza Ullmann und Johanna Bischof
3. Bei der Durchführung der qualitativen Studie haben mich die nachstehend aufgeführten Studierenden im Zuge ihrer Qualifikationsarbeiten unentgeltlich unterstützt: Annelie Hörnschemeyer, Jannis Hinrichs, Vera Kock, Lara Warneke und Soraya Kresin
4. Bei der Auswertung qualitativer Daten hat mich Elena Folsche als studentische Hilfskraft entgeltlich unterstützt.
5. Für die Transkription von Interviewmaterialien habe ich zudem die Unterstützung des Dienstleisters Transkripto in Anspruch genommen.

Weitere Personen waren an der inhaltlichen materiellen Erstellung der vorliegenden Arbeit nicht beteiligt. Insbesondere habe ich hierfür nicht die entgeltliche Hilfe von Vermittlungs- bzw. Beratungsdiensten (Promotionsberater oder andere Personen) in Anspruch genommen. Niemand hat von mir unmittelbar oder mittelbar geldwerte Leistungen für Arbeiten erhalten, die im Zusammenhang mit dem Inhalt der vorgelegten Dissertation stehen.

Die Arbeit wurde bisher weder im In- noch im Ausland in gleicher oder ähnlicher Form einer anderen Prüfungsbehörde vorgelegt.

_____ _____

(Ort. Datum) (Unterschrift)