

Article

Method-Based Higher Education in Sustainability: The Potential of the Scenario Method

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Abstract: Both sustainability and education are challenging process-oriented objectives. When the aim is to combine both notions, as in Higher Education in Sustainability (HES), it is indispensable to first establish a common ground between them. In this paper, we characterise this common ground in terms of four aspects: future orientation, normativity, global perspective, and theory engaged in practice. Based on an analysis of the common ground, one method that is well-established in a wide range of sustainability sciences shows high potential for use in HES because it covers all four aspects in detail: the scenario method. We argue that a didactical reconstruction of the scenario method is necessary to utilise its potential and develop adequate forms of teaching in higher education. The scenario method is used to construct and analyse a set of alternative future developments to support decisions that have to be made in the present. Didactical reconstruction reveals a spectrum of objectives for which the scenario method can be employed: (1) projection; (2) teleological planning and (3) an explorative search for possibilities not yet considered. By studying and experimenting with this spectrum of objectives, students in HES can develop fundamental reflexive competencies in addressing the future in different ways that are relevant for both sustainability and education.

Keywords: scenario method; didactics; didactical reconstruction; philosophy of education; methodology; future orientation; higher education; technology assessment

1. Introduction

The phrase “higher education in sustainability” does at first appear to be overloaded with expectations. Both the notion of “education” and of “sustainability” convey ambitious idea(l)s that aim at changing the current state of affairs. The discourse on sustainability combines global justice issues with ecological awareness, creating one overarching paradigm. Education, on the other hand, is a matter of centuries-old struggles to enable the next generation to achieve a life of autonomy, subjectivity, and freedom. The two goals are ambitious—some might say naïve and unrealistic—and both are interpreted in various ways, instrumentalised and treated as a subject of controversy and dispute. Therefore, it may be overambitious to unify both goals in a single concept of higher education in sustainability. It is probably more promising to dig deeper and to reconstruct a *common ground* from which each one can be addressed in its own right [1].

In this paper, we propose that the *common ground* between sustainability and education be described using four aspects which are fundamental to both notions (Section 2). On this basis, certain deficits can be identified in the two most common teaching formats in HES—case study courses and theory-oriented courses. We suggest that these deficits can be overcome by an intermediate, *method-oriented approach* (Section 3). We then use the common aspects of education and sustainability to explore the potential of a method-oriented approach to HES. For this purpose, we apply a concept from didactics, *didactical reconstruction* (Section 4.1), to a method used in various fields of sustainability sciences: the *scenario method* (Section 4.2). This method relates directly to one aspect, namely, future orientation, and touches on several others on closer examination, which makes it a strong basis for HES. We propose the didactical reconstruction of the scenario method in the form of three ideal types describing the spectrum of aims the scenario method can be used for, and derive *adequate teaching formats* for the scenario method (Section 4.3). We conclude with *reflections on the potential* of the scenario method for higher education and sustainability, re-emphasising the fundamental links between the two notions (Section 5).

2. Common Ground between Sustainability and Education

Since Hans Jonas’ theoretical work [2,3] and the Brundlandt report [4], “sustainability”—as an abbreviation for “sustainable development”—has been understood as a normative framework and guiding vision of a state of the world that offers at least minimal justice to all humans (and in its strong version: to the environment at large) whilst taking into account the limitations of the natural systems on which our societies are based. The notion of sustainability is, it has to be conceded, certainly a vague one. Nevertheless, it opens up avenues for discourse about our common future. Since the 1990s, a distinction has been made between weak and strong sustainability, the latter rejecting the assumption that natural capital can be translated into monetary terms or replaced by other forms of capital. Sustainability carries a critical impetus regarding the present state of the world and aims to foster and facilitate a transition. Bryan Norton, a philosopher engaged in sustainability sciences and public sustainability discourses, sees the *open* notion of sustainability as a chance for a normative-reflexive and adaptive approach towards our common future, as an alternative to relying on the one-dimensional technical way of thinking that drives optimisation oriented concepts. Our argumentation follows

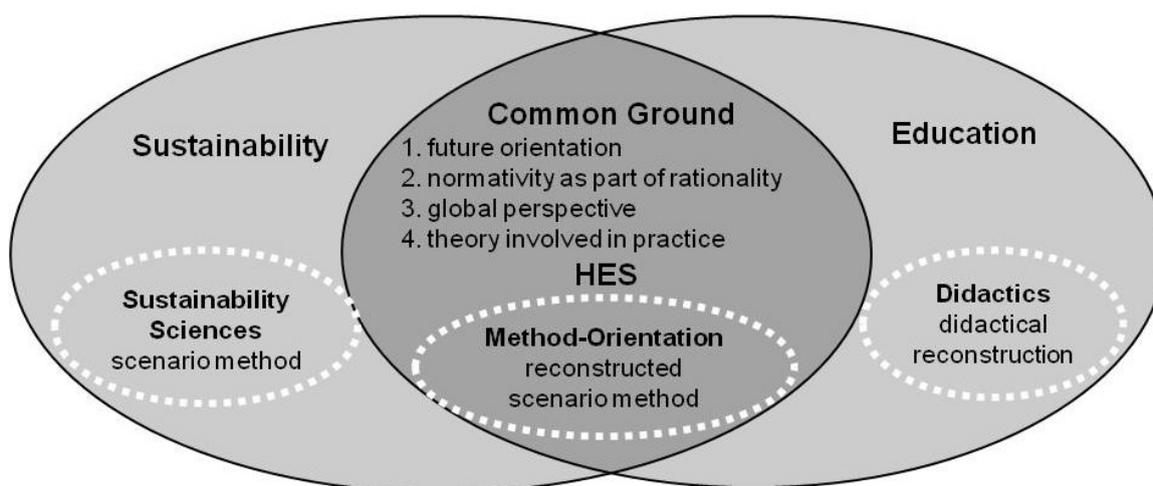
Norton [5] and his pragmatist concept of “normative sustainability”—which is a reflexive type of norm-setting and norm revision and is viewed as an adaptive societal learning process.

The term “sustainability sciences” can be used to describe all those scientific endeavours that contribute to the conceptual development of sustainability, as for example presented in [6,7], that analyse the sustainability of the present situation or potential developments, and that aim to foster a transition towards sustainability [8]. Sustainability sciences contain a broad plurality of perspectives and research areas with no clear cut methodology. Due to the complex nature of sustainability issues and the critical perspective on science itself, large parts of sustainability sciences transgress the border between the public and the academy, between the policy arena and academic research; in other words: they are transdisciplinary [9].

Education (“*Bildung*”) is, again, a complex notion that has not been ultimately defined. However, in most interpretations it combines (a) an individual level describing the development and growth of subjectivity and the facilitation of these ends by others; and (b) a societal level describing the reproduction, development and transformation of society as a whole [10–12]. Such a twofold understanding opens up a perspective on how to relate education to sustainability [13] without instrumentalising the former. The term “didactic” as used in this paper refers to the planning, implementation and evaluation of all means of facilitating or supporting education.

The common ground between the notions of sustainability and education can be described by four aspects which are fundamental to both (Figure 1).

Figure 1. Higher Education in Sustainability (HES) based on the common ground between sustainability and education.



2.1. Future Orientation

Sustainability is part of our modern age, possibly even in a radical way because it is concerned with analysing, planning and influencing the long-term future of the whole world in numerous dimensions. The Brundtland report states in its third chapter: “Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.” [14] Education shares this inherent orientation towards the “future”: To enable subjectivity and autonomy, a systematic orientation towards the future is necessary

in education. This idea was already formulated at the very beginning of educational theory. Immanuel Kant argues in his introduction to pedagogy:

“Children ought to be educated, not for the present, but for a possibly improved condition of man in the future; that is, in a manner which is adapted to the idea of humanity and the whole destiny of man. This principle is of great importance. Parents usually educate their children merely in such a manner that, however bad the world may be, they may adapt themselves to its present conditions. However, they ought to give them an education so much better than this, that a better condition of things may thereby be brought about in the future” [15].

Kant’s argument also illustrates how future orientation can provide a moral basis for inter-generational relations in educational theory, bringing the latter close to the notion of sustainability in the sense of inter- and intra-generational justice.

2.2. Normativity as Part of Rationality

The second link is the notion of normativity as an integral part of rationality rather than as an added feature of rationality or even its opposite. The key element of the normative rationality underlying the discourse on sustainability—as heterogeneous as it is—is a critical reflection on the past and the present. All ideas of a good future are to some extent linked to the shortcomings of the present. Consequently, this gives sustainability sciences a prominent role in cultivating normative rational thought and having to defend it from calls for “value-free” science. Theories on education face similar expectations, but with two normative anchor points: societal development and the (yet to be achieved) autonomy of the developing subject. Normative rationality can play a double role in this context: For the person educating others (*educans*), normative rationality is necessary to reflect on the educational process, and for the one to be educated (*educandus*), normative rationality describes the necessary capacity for rational thinking, which has to be developed as a prerequisite for autonomy (and for eventually becoming the next *educans*) [16].

2.3. Global Perspective

Both sustainability and education carry a universal perspective addressing all mankind (in the case of philosophy of education) and the whole world (in sustainability sciences). The idea of offering one educational basis for all mankind—regardless of class or gender—was formerly a highly political issue [17,18], just as global justice and global ecology, which the discourse on sustainability has managed to combine, are today. Education and sustainability are both faced with the necessity to relate this global perspective to various specific contexts.

2.4. Theory Engaged in Practice

The theoretical discussion on sustainability is deeply rooted in political practice. Societal demands, hopes and transition processes are the driving force of theory development and the context in which further efforts are urgently needed. Sustainability science has, therefore, always been a theory engaged in practice. Educational theory, on the other hand, has evolved parallel to the institutionalisation of education in schools and universities; it is an integral part of the educational system [19]. Both

sustainability sciences and educational theory are involved in societal practices and consequently part of the objects they analyse. This deep involvement can create various difficulties, for example, the need to defend a scientific status whilst viewing it critically.

3. Methods as a Bridge from Sustainability Sciences to HES

Having established these four common aspects of sustainability and education, we can derive a teaching concept for HES. The scope we have in mind consists of an extensive electives programme [20,21], in other words, neither a complete sustainability sciences curriculum nor an isolated course on sustainability. The two elements of sustainability sciences most commonly used as the basis for HES within this scope are case studies and theories [22,23]. *Case studies* focus on examples of sustainability issues and possible solutions to them. They can use fictive cases, use “authentic” documents as teaching material, or even tackle real cases which the project courses try to help resolve [24]. The advantages of this starting point for both students and teachers consist in the motivation gained from specific, practical questions, the additional benefit regarding real-world issues, and the possibility of offering active project work. However, the deficit of an HES concept oriented purely towards case study is that it is difficult to transgress the case at hand: What is typical in a particular case, what is not? What are the not-so-obvious sustainability aspects of the case? *Theory courses*, on the other hand, can offer a broad understanding of sustainability. Different sustainability concepts can be analysed in light of their time and context. Examples can be presented and—ex post—analysed in detail. However, in this teaching approach sustainability can easily become an abstract topic, giving students little basis for actually contributing to it. Is there a third, more apt way to link theory of sustainability and practical projects to project work, rather than having to decide between the two elements?

As we have found, the methodology [25] of sustainability sciences is a promising candidate for such a third way for six reasons. First, although the problems treated as sustainability issues vary widely and the normative aim of sustainability is often interpreted very differently in specific projects, there is at least some coherence in the methodology and methodological reflection. Methods are therefore an appropriate starting point to learn something *about* sustainability sciences as a scientific field, instead of only learning from its findings. Second, methods are used in sustainability sciences to achieve practical relevance whilst still being part of sustainability theory. Third, methods carry in their set-up many lessons learnt from earlier projects. Their change over time is part of the learning process in sustainability sciences. The use of methods makes it possible to utilise acquired experience and changes in sustainability sciences for educational purposes, for example, to develop a critical perspective on the present state of sustainability sciences. Fourth, understanding can be described as a process of developing knowledge [26], combining both creative and formalised aspects to this end. Many transdisciplinary methods from sustainability sciences [27,28] do precisely that. Therefore, they can potentially be adapted to foster understanding in educational contexts as well. Fifth, methods offer many opportunities for active teaching formats, from short exercises to intense project work, which prepare directly for real sustainability projects. Sixth and finally, since working methodically is a foundation of all sciences, it is possible to train students in these basic science skills along the way. This is far more than a bonus effect in soft skills, because basic scientific thinking techniques

(formulating theories, collecting information and analysing it critically, forming valid arguments *etc.*) are much more difficult in transdisciplinary sciences such as sustainability sciences and sometimes the only quality criteria that can be applied.

Our thesis is that method-based teaching represents an approach in its own right, as a third alternative focus between case studies and theory-oriented courses, and that it offers opportunities to relate to the other two approaches.

4. The Scenario Method and its Didactical Reconstruction

Sustainability sciences do not have a canonical structure like physics or mechanical engineering: In HES the question of what can and what should be learnt is open. For method-based teaching, this is a twofold question, because methods can be part of the subject to be studied and part of the way in which other subjects are taught. To which educational end can one use a method like the scenario method on both levels; what knowledge and what competencies can and should students develop with it? A didactical reconstruction of the methods employed in sustainability sciences has to lay open their potential for education and adapt the chosen method for didactical use.

4.1. Didactical Reconstruction

The focal point of didactics is the question of how educational processes can be fostered and facilitated: Which objects and methods should be used? Who addresses whom? The “object”—that is, the didactical impulse—carries a potential for education which can be used in various ways, for example, as a reference for the understanding of abstract principles [29] or as a starting point for educational interaction (a critical discussion is provided in [30]). Didactics is the systematic search for educational potentials. One manner of accomplishing this is through “didactical reconstruction” [31–33]. In this approach, one starts from the educational aim and the object and not, as the main stream of current didactic models do, from the teaching situation. An example is given in [34]. While education describes the aims and results, didactics describes the process of reflection and revision with regard to the means of facilitating education.

Didactical reconstruction is far more than the old “principle of elementarisation” in the pedagogical and educational tradition, also known as “didactical reduction”. In this tradition, the object would be treated as a given, which merely has to be presented in easy-to-follow steps, starting from objects already taught. By contrast, didactical reconstruction describes the “(re-)construction of structures from meaning-bearing units. Both deconstruction and reconstruction are carried out according to normative aspects—the educational aims” ([35], our translation). In other words: Didactical reconstruction is a constructivist view of the object—in contrast to all forms of (scientific) realism on which “didactical reduction” is based. The use of objects in education is not restricted to material ones. Anything can be reconstructed as an object: ideas, biographies, theories, models, or in our case: a method. The reconstruction starts with the object; it does not invent it, but shapes it and works with it. The object itself is not replaced, but specific properties and structures of it are reconstructed. Also, secondary aspects pertaining for example to the students’ motivation and the inclusion of their existing competencies are analysed, always starting from the object and the educational aim. Choosing or

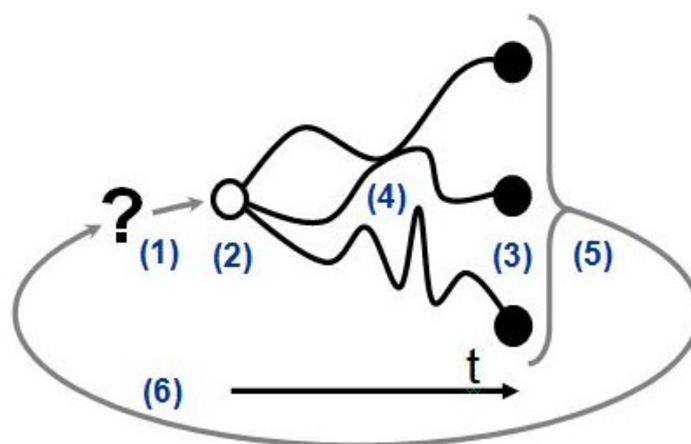
developing appropriate teaching forms—or other didactical settings such as museums, e-learning software or field trips—is only the last step.

We use didactical reconstruction to bring to light the specific potential of the scenario method. This is quite a different aim from finding out how to teach the method or how to teach something specific using it. A reconstructed scenario method should show what it can offer for sustainability and for education alike. As there is ample methodological literature on the properties and qualities of the method in scientific practice, we use this material as a basis to focus on the educational potential of the method.

4.2. Didactical Reconstruction of the Scenario Method

The scenario method is a typical technique in sustainability sciences. It has been applied ever since the beginning of this recent branch of science and it is still being discussed and adapted today [36,37]. Nevertheless, it also plays a role in various other academic (e.g., future studies [38,39]) or non-academic (e.g., strategic management [40]) fields. It is commonly used to write scenario studies as a form of consulting or policy advice. Starting from a future-related question (Figure 2, No. 1), a description of the present state is given (2). From this point on, a set of scenarios unfolds, each scenario consisting of a description of a future state (3) and a plausible path leading to it (4) along a common time line. The scenarios have to be analysed as a set (5) to derive answers or recommendations (6) for the initial question. Apart from its fundamental structure, scenario construction can vary considerably.

Figure 2. Structure of a typical scenario study.



Various criteria have been suggested to distinguish between different forms of scenario studies, for example, according to their temporal scope (short-, mid-, or long-term), their spatial scope (local, national, global or multi-level), their extent of quantification (qualitative, quantitative or combined) and the underlying modelling approach (e.g., system modelling, agent based modelling, conceptual modelling, participatory modelling). Unfortunately, none of these distinctions separates the application of the scenario method in sustainability sciences from the application in other scientific fields. Only by analysing the intentions and consequences can one hope to be able to judge how far the use of the method has been oriented towards sustainable development.

Which distinctions, describing the spectrum of variants of the scenario method, are relevant in an educational context? It is necessary to identify these in order to reconstruct the method accordingly. To do so, we start with the different aims for which the method is used, because these aims each carry an idea of how the results of a scenario study relate to human judgements, decisions and actions. Thus, the different aims directly describe the aspects relevant for education. In this way, we can identify three ideal types of the scenario method: the projective, the explorative and the teleological type. These distinctions are derived from similar methodological differentiations [39,41–46], but the reason for reconstructing the method is in our case to identify the educational potential of the whole spectrum of *ideal types*, and not to answer the methodological question of when to use which *type* of scenario method.

The projective ideal type (1): This type describes extrapolations of historical trends up to the current state and projections of the past into the future. It is therefore based on the assumption that the future is to some degree or in some aspects predefined by the past. In its strong form, it follows the assumption of an (ontological) existence of laws determining the development of socio-technical systems. This brings a problematic proximity to the paradigm of technological determinism to the fore, which leaves few options for human decisions. If prognosis, based on causality, is possible, then decisions are not. In intermediate forms, the only necessary assumption is a *ceteris paribus* clause: If none of the relevant conditions of the system in question is altered in the time span discussed, a certain future state will evolve (with a certain probability). Differences between scenarios result merely from uncertainties in the description of the present and past or in the causal laws derived from these descriptions. The results of a projective scenario study cannot be used to change the course of a development, but merely to develop mitigation strategies within the corridors of possibility set out by the study, for example as shown in [47].

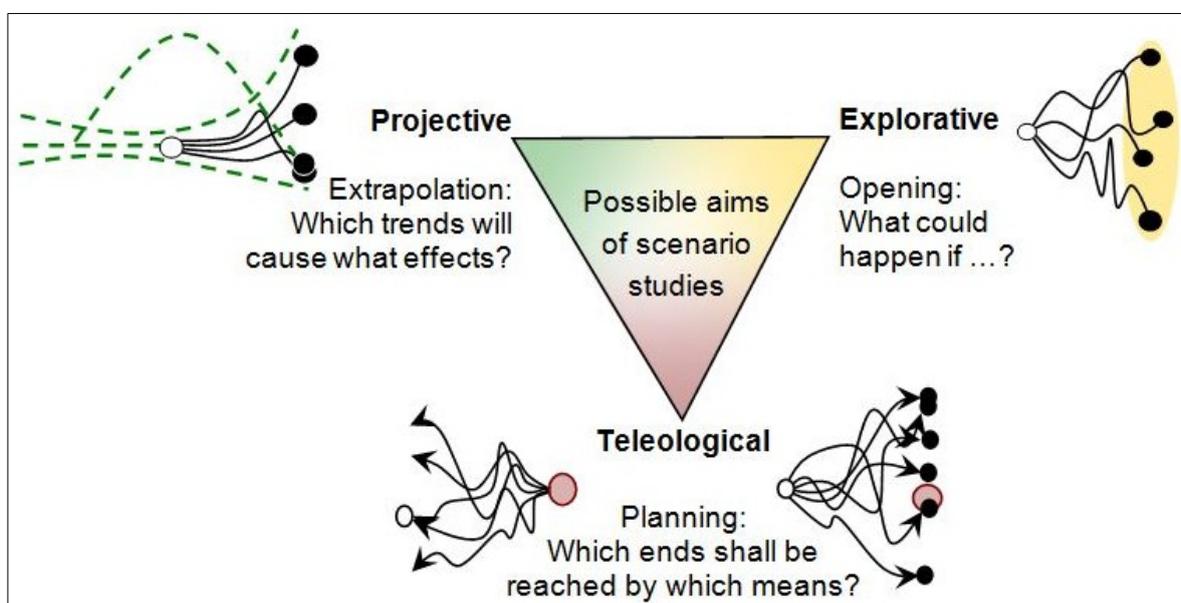
The teleological ideal type (2): This type focuses on aims, desires and values [48], a typical example of which is given in [49]. Means are identified according to their potential for contributing to the aims. Two forms can be distinguished: one form works backwards from a desired future state to identify development paths that might lead up to it from the present (backcasting; see [50]). The other form starts in the present and runs through many different courses of action trying to find a path to the desired future state (strategic gaming) and optimising the strategies by a process of trial-and-error. This type shows an inverse temporal structure: To achieve a state of *y* in the future, *x* has to be done today. Strong forms also reflect on and revise the aim and include it in the evaluation, while weaker forms are primarily instrumentalist; they only search for means without questioning the ends. The teleological ideal type of scenario method comes closest to its historical beginnings in military strategy development.

The explorative ideal type (3): This experimental type is used to open up and analyse the “space” of possible futures. Present decisions and actions are analysed as the main driving force, each opening up different pathways into the future (and closing others). Assumptions regarding causal mechanisms in socio-technical systems are necessary as well, not to give a prognosis of the future, but to establish different futures as the result of different actions or unexpected system changes (“wild cards” [51]). This type aims at broadening the spectrum of possible actions in an open future. The explorative type is based on a causal structure: if we do *x* today, we will reach the state of *y* in the future. Starting from the present, a space of possible futures is opened and can be analysed as more or less desired

alternatives. In a descriptive form of this type, assessment of the options is not part of the method itself, it is externalised. In a normative form, value judgements are a central element of the method and can be assessed and reconsidered in the process as well, for example as shown in [52].

These three ideal types describe corner points of the whole spectrum of different aims underlying the scenario method (Figure 3). Real scenario studies in most cases combine these types, marking different areas in the triangle, not just the corners. The most common combination involves the inclusion of one projective scenario as a reference (often called “trend” or “business-as-usual”) in a study having an overall explorative or teleological structure. Teleological studies can combine the search for feasible strategies for a given goal with an (explorative) test of the robustness of this strategy in different circumstances. Projective studies can describe future developments without intending to predict the future, but to criticise current developments, as in the well-known report “The Limits to Growth” to the Club of Rome [36], hereby adding a teleological element.

Figure 3. Three ideal types of the scenario method open up a triangle of possible aims for scenario studies.



After this reconstructive step, it can be shown that the scenario method truly relates to all four aspects of the common ground between sustainability and education. *Future orientation* constitutes the very basis of the method, as has been shown by the typology of the method’s underlying aims. The scenario method is used to analyse issues regarding the future, originally based on the paradigm that one can model the future as a system and thereby predict or steer it [53]. This futurological idea has subsequently been replaced by the aim of reorganising present thinking about the future to derive arguments for today’s decisions [54]. The scenario method treats *normativity as part of rationality*: It aims at enabling a rational discourse on possible futures, always combining predictive and normative arguments about the future. Value judgements are seen not as external to but rather as a crucial element of rational thinking, making it possible to derive suggestions on how to act. Sustainability provides a normative background that one can explicitly cite, interpret in various ways or criticise by using the scenario method. The scenario method adopts a *global perspective*, even when very specific

and small-scale issues are tackled. The global perspective only requires ensuring that none of the reductions—in time, space, or in the aspects to be discussed—thwarts the correct analysis of the issues at stake. The use of the scenario method mainly involves precise theoretical work; nevertheless, it is a method *engaged in practice*, often in an advisory setting: public or private research institutions offer advice in the form of scenario studies for political or other players. Although scenario studies are claimed to be relevant for decisions, they are not the decision itself. This distinction of roles offers another valuable aspect that can be modelled didactically and used to clarify the interplay of sustainability science and decision making. The direct link between the scenario method and all four aspects shared by sustainability and education suggests that it has high potential for HES.

In educational contexts, the scenario method is intensely discussed mainly with regard to the specific issues that can be addressed with it, e.g., biotechnology [55], emergency management [56], or regional development [57]. Furthermore, it is discussed as a technique to help students develop specific practical competencies, for instance in health care [58] or as librarians [59]. In this context, the scenarios primarily offer realistic pictures of future professional situations, and the scenario methodology is not taught as such. Finally, there are courses that teach the scenario method itself, for example as part of future studies (an empirical overview is given in [60]). The discussions are not usually about analysing the potential offered by the scenario method; they treat the method either as a didactical means for other, predefined ends or as an end in itself. The question of what *can* be achieved *with* the method is scarcely considered.

According to our reconstruction, the educational potential of the scenario method lies at its very core: systematic consideration of the future following a strategy of combining teleological, explorative and projective elements. Being able to tackle the future—one's own, that of society or of mankind—is one of the most fundamental educational aims. The educational nature of the scenario method, as it has been brought to light in the didactical reconstruction, can consequently be turned into an educational aim to be addressed with the scenario method. The scenario method can be used to foster the ability to think about the future in different ways and to recognise, choose and evaluate specific ways. This is at the same time an essential prerequisite for contributing to sustainable development. It requires the ability to step back and assume a critical perspective with regard to one's own thinking and the scenario method as a thinking technique.

4.3. Adapting the Scenario Method for Higher Education

As stated above, the search for teaching formats is the last step in the didactical reconstruction. An adequate teaching format for the use of the scenario method would typically be a simulation game [58]. This format combines intense phases of active project work with phases of theoretical input and reflection, using a method-based didactical approach as a bridge from sustainability sciences to sustainability practice. It can be seen as an intermediate format between case study teaching and theory-oriented courses (see Table 1).

Table 1. Comparison between three fundamental approaches to HES.

	Case study oriented	Method oriented	Theory oriented
Teaching formats	Projects, prepared projects, “service learning”	Simulation games, exercises, contributions to sustainability research	Lectures seminars
Link to reality	Real cases, possibly for real use	Realistic (or real) problems or cases	Abstract examples that might be real or not
Link to sustainability theory	Application of singular theoretical elements	Understanding the practical potentials and shortcomings of sustainability sciences	Broad and critical understanding of sustainability and the role of science therein
Groups	Whole group as one team or smaller teams working alongside each other	Small groups working alongside each other, plenary introduction and reflection	Individual students
Competence field	Coping with real-world problems	Applying methods, methodological reflection	Theoretical reflection

Beyond this point, an adaptation of the scenario method on a general scale is hardly feasible; the specific teaching and learning context to which the method is meant to contribute has to be taken into account. The points outlined below were relevant in the development of interdisciplinary courses on technology assessment for engineering students at Darmstadt University of Applied Sciences, mostly in their first year.

We offered a broad spectrum and choice of technological examples (concentrated solar power, neuro-enhancement, geothermal energy or care robotics) to trigger students’ interest, give them a new perspective on their own (engineering) science and show the similarities and differences between different approaches the method is used for. To fit the scenario method into a course within a usual curriculum structure (15 weeks, course duration 90 min), it is necessary to choose a simple and flexible variant of the scenario method. We used a “morphological analysis” [41] as a procedure to construct a model and develop a promising set of scenarios to work on. An additional quality is that it shows very clearly the formality and possible technocratic bias the scenario method carries. Our experience with this form has been good, but other modelling approaches have similar qualities [61,62], as long as the procedures are transparent and not, for example, hidden behind modelling software. Using models of reduced complexity seems crucial for an understanding of the method’s qualities and shortcomings, which are difficult to identify in ‘up to date’ computer-based models.

While case studies usually start with a clear group of addressees and a given problem to work on (even though sustainability problems are usually ill-posed problems), simulation games offer the possibility to vary both the question and the addressees between the project teams or even to treat the addressees as secondary: this approach—albeit unrealistic—gives students the opportunity to frame the question purely for the planned use of the scenario method, forcing them into intense methodological reflection instead of performing the research question by a specific addressee. The variation of addressees and research questions can be used systematically by comparing the results of the different

scenario studies produced by different teams in the same course. This proves to be an interesting approach especially when working with larger groups.

One of the crucial steps in producing a scenario study is to formulate scenarios in such a way that they are similar enough to be analysed together, but different enough to see the specific properties of each—usually this takes a number of recursive loops. One way to organise the integration of different scenarios is to personalise this step: the whole group decides on the structure of each scenario, each student writes one of them, the group tries to integrate the scenarios and determines necessary changes for the next individual round.

Finally, the scenario method can be used to relate the students' own future life world to the otherwise distant, scientific future. This can be achieved with small exercises to get used to the method (e.g., work-life balance), or with topics impacting their future directly (care robotics). Ideally, this should help them to consider their own life, to treat it as a project from a subject perspective.

5. Conclusions

The scenario method—based upon its didactical reconstruction—proves to be an excellent way to initiate educational processes regarding socio-technological futures. It offers high potential for HES, contributing both to sustainability and education, by focusing on the aspects they have in common: *future orientation*, which lies at the core of the scenario method. The method provides a medium of reflection to clarify ideas, plans, and expectations for the future, making it possible to consider whether the futures described are consistent, realistic, and desirable. Students can learn to question and to formulate aims and goals—in Kant's words: the possible better future state of mankind. The use of the scenario method also shows how *normativity is part of rationality* in all major and minor decisions that have to be made from the first project steps on, and how value judgements predefine the possible results to be drawn from the study. Value reflection is indispensable; normativity is a part of the rational procedure, not an add-on or a flaw. The choice to be made between the different ideal types of the scenario method is a typical example of such decisions. The scenario method, thus, offers an insight into critical reflection and shows that care must be exercised when working with the interwoven patterns of analysis and value judgements. This is particularly important for pressing societal issues, which are often considered to be addressable as neutral topics far removed from the sphere of values, such as technology. The scenario method contributes to an understanding of science and technology as part of socio-technical systems, with their ill-defined elements and changing boundaries. The differences to be observed in possible perspectives on the same technology, different methodological approaches and different types of results—all within the scenario method—show the absurdity of a positivistic idea of technology and technology studies. Technology is conceived of a phenomenon that is always to be interpreted, contextualised. Peter Euler characterises this as “technological reason” [11]. Working with the scenario method enables students to take on a *global perspective*, but does not lead them to an ultimately distanced perspective. On the contrary, it helps them focus on one concrete issue while bearing the whole context in mind. The global perspective should contribute to a careful, self-critical and reflexive perspective: Thinking about the future is crucial for sustainable development, but there is no guarantee that these thoughts are true, sensible, or capable of guiding decisions in the right direction. Studying sustainability actively by using a method

from sustainability sciences offers an excellent basis for future contributions to sustainable development. Even if the teaching format is not a real project itself (in the sense of a scientific enterprise or a contribution to life world problems), it prepares for and substantiates sustainability science that is *theory engaged in practice*.

Besides these fundamental links that we identified at the beginning, one further aspect can be added: By using HES as a link between sustainability sciences and educational sciences, the normative basis of education could be enriched, and the methodological discussion of sustainability science could benefit from an educational perspective: Didactical methodology could be developed as another aspect of the common ground between sustainability and education. However, combining methodology and didactics of sustainability needs further conceptual work, for which at least a minimal fundament in philosophy and pedagogy is necessary. Taking the scenario method as an example, we have tried to establish a strategy as to how one can derive specific didactical settings from fundamental aspects of education and sustainability. Presumably, many other methods from sustainability sciences carry educational potential for various contexts, both in professional training and general education—a potential which is yet to be explored.

Author Contributions

Richard Beecroft and Jan C. Schmidt contributed equally to all sections of this paper.

Conflicts of Interest

The authors declare no conflict of interest.

References and Notes

1. In this way we can avoid treating education (German: *Bildung*) as a mere instrument for sustainability, as often happens, for example in the UN Decade 2005–2014 “Education for Sustainable Development”.
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10. Even though education requires teaching and learning, it cannot be reduced to those elements, neither can it be described purely idealistically as the introduction to a culture, because it also provides the basis for the material reproduction of modern societies, for example through the technological use of natural resources [11]. The materialist view on education is not the only one to be found in philosophy of education, but it is one that explicitly includes an understanding of the relationship between humans and nature [12], which is crucial for HES.
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16. This view is in line with those of discourse theorists such as Jürgen Habermas and Karl Otto Apel.
17. The works of Johann Amos Comenius, an educational philosopher in the early phase of the Enlightenment, root such ideas of equality deeply in the notion of education itself: “omnes omnia omnino”—teaching everything to all with respect to the whole—is the often forgotten core of all modern concepts of “general knowledge” [18].
18. Comenius, J.A. *Große Didaktik. Die vollständige Kunst, alle Menschen alles zu lehren*, 10th ed.; Flittner, A., Ed.; translated; Klett Cotta: Stuttgart, Germany, 2007.
19. One important and highly formalised contribution of educational theory to the practical field is teacher training, a system with no equivalent in sustainability sciences.
20. The programme we are working for offers for almost all B.A. and M.A. students at Darmstadt University of Applied Sciences about one hundred courses per term in which sustainability is an overarching issue for the whole programme and an explicit focus of a large number of courses. Its status as an extensive electives programme concurs with an understanding of sustainable development as a dynamic to which various players need to contribute. The work of a few sustainability experts is not enough, nor is a change in everyone’s attitude; systematic transformations are required in various fields. To foster these changes, the specialists in their respective fields need specific competencies. Because most study programmes in DUAS are engineering courses or otherwise technology-related, the field of sustainability sciences we emphasise the most is technology assessment [www.suk.h-da.de] See also: [21].
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22. A typical example is Michael Jischa's argumentation on how to sensibilise engineering students by means of a theoretical lecture on sustainability to prepare them for active case study courses; see [23].
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