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Article

Sustainable Education: Exploiting Students' Energy for Learning as a Renewable Resource

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Abstract: In this article, "sustainable education" is reconceptualized, drawing on the insight that education runs on the energy of students, teachers and all other stakeholders involved. Sustainable education systems are defined as systems in which students' natural energy for learning is renewed (rather than depleted) and no talent gets wasted. Students' energy for learning is geared towards the acquisition of crucial competences for the 21st century (including the competence to make their own lives work and to make life on the planet work), which they can deploy and further develop on a long-term, sustainable basis. For this to happen, education systems need to be built upon strong, up-to-date curricula and to design classroom activity based on cutting-edge knowledge on what drives human learning. To this end, school teams' joint energy for educating needs to be tapped and renewed, and assessment needs to be primarily used to further improve the quality of education.

Keywords: sustainable education; learning; 21st century skills; equity and excellence

1. Introduction

Like cars run on fuel, education runs on energy. It runs on the energy of students, teachers, administrators, parents and all others involved in educating. The balance we need to draw up is how much of that energy turns into actual learner development and how much into other things, like frustration, irritation, school dropout and failure. This may well be the pivotal question any education system, and any individual teacher, must answer. If the energy learners invest in classroom activity leads to successful learning, this, in turn, may release new energy for learning. In essence, learning fuels further learning [1–3]. From a socio-emotional perspective, if people's energy turns into successful

learning, this may enhance their self-confidence and social well-being and may motivate them to put effort in further learning. If people participate in activities they find worthwhile and learn new things from, their willingness to engage in similar activities in the future may grow. Cognitively, too, learning is a springboard for further learning: all of the knowledge, skills and attitudes that people successfully acquire can be used to confront new challenges, new ideas and new opinions. Concurrently, learning proceeds when what is new can be built upon what is already known [3]. That is how learning works and how the mind works.

Therefore, if energy invested into learning turns into actual development, then that successful learning experience may unleash new motivational, social, emotional and cognitive energy for learning. In this way, energy for learning becomes renewable energy. The wheel keeps on turning. If this happens on a regular and systematic basis, and for every single student in the education system, energy for learning is exploited in a sustainable way, rather than being depleted. Then, education becomes sustainable education.

As can be inferred from the above, the term "sustainable education" is reinterpreted in this article. Rather than focusing on the ways in which education systems may prepare young people to become the custodians of sustainable societies and environments (so, rather than focusing on education for sustainable development) [4–6], however noteworthy that goal may be in its own right, this article focuses on the extent to which education systems themselves satisfy the basic criteria of sustainable development (see also [7]).

2. A World-Wide Challenge

Many education systems around the world currently fail the test of sustainability [7–9]. In these systems, valuable proportions of energy, time and talent go to waste: an unacceptable proportion of students fail to realize their learning potential, leaving compulsory education without obtaining a degree or without developing competencies that are vital to their present and future lives [10–13]. Policy makers are quick to point out the economic cost of educational failure: for instance, students who do not graduate from secondary education run a higher risk of becoming unemployed or having to live on social welfare; conversely, students who hold a degree of higher education have been shown to contribute more, on average, to the gross national product of their country [14,15].

However, economic statistics are just the tip of the iceberg. Many of the students who are registered as dropouts or unqualified school-leavers are people of flesh and blood with broken dreams, shattered self-esteem and a lowered motivation to ever resume formal schooling again [15,16]. Many of them run a proportionally high risk of suffering from mental and physical pain in their later lives, to suffer from illness and life-threatening disease at an early age and to end up in criminality or poverty [9,15]. Many have developed crucial competences (such as functional literacy) at such low levels that their chances of achieving their full potential through lifelong learning have significantly decreased [17].

The stakes are high. Education prepares the next generation to become the workforce of the future and much more than that. Education prepares the next generation to become the guardians of our planet, the stewards of democracy and the peaceful co-existence among different peoples and races, the custodians of society, the inventors and explorers of the future, the caretakers of their own children. We cannot allow the energy, talent and time that fuel our education systems to be wasted. More than ever, the future of our planet depends on the future of our education systems. Below, we will draw on research

and recent theoretical publications to describe the features of education systems that meet the following three crucial criteria and hence might be termed sustainable education systems:

- No talent is wasted: education should work for every single student in the system, irrespective of the students' background;
- Energy for learning is renewed: the energy that students and teachers invest in education is maximally turned into learning and development, which produces new energy for learning;
- Crucial needs are addressed: students develop the competences that are crucial for their future lives and for the future of our planet.

3. Designing a Strong, 21st-Century Curriculum

Strong education systems are guided by a strong curriculum, which describes the crucial competences that students need to develop and sustain. Because the world has undergone such vast social, ecological, economic and political changes and faces such major threats, the curriculum of the 21st century will need to be different from the curriculum of the previous century [7,13,17–19].

Every era needs its own education. To fully live their present and future lives and to secure the future of our planet, students of the 21st century will need to learn to:

- Make knowledge work: Rather than merely accumulating facts and figures in their heads and memorizing specialist, decontextualized knowledge, young people need to learn how to use knowledge in flexible ways to solve complex problems in a wide range of situations and contexts. They will need to be able to "re-contextualize" the abstract knowledge they have acquired to cope with authentic, real-life challenges. Therefore, if the education of the 20th century was knowledge based, sustainable education for the 21st century will need to be solution oriented.
- Make communication and information work: Rather than absorbing information provided by a teacher or a handbook, young people need to learn how to find, critically evaluate, organize and use information for a wide variety of purposes. In addition, young people need to learn how to communicate in clear and coherent ways, to report and summarize findings (both orally and written), to share thoughts, to deliberate and join discussions in a civilized and rational way and to engage in open-minded and constructive dialogue. Therefore, if the education of the 20th century was transmission based, sustainable education for the 21st century needs to be communication oriented.
- Make their creative powers work: Rather than solving problems in one particular, predetermined and uniform way, young people will need to learn how to devise different solutions and adequately apply the most appropriate ones to the case at hand. Crucially, the next generation of adults will need to be able to come up with innovative solutions for the social, ecological, economic and political problems the current generation of adults fails to solve. From an early age on, creative, "out-of-the-box" thinking should be stimulated throughout the curriculum. Therefore, if the education of the 20th century was highly reproduction based, sustainable education for the 21st century will need to be innovation oriented.
- Make social relations work: Rather than merely striving for personal success (at the cost of others), young people need to be able to work and learn together with others, respect other viewpoints and cultures, work out compromises and solve social conflict in rational, nonviolent and civilized

ways. In view of the fact that intolerance underlies much current warfare and social injustice, young people should develop their own identity while fully respecting other people's identities and choices. Therefore, if the education of the 20th century strongly emphasized individual merit, sustainable education for the 21st century will need to take a social turn.

- Make technology work: In addition to using technology for personal, informal purposes, young people will need to develop high levels of functional literacy to critically cope with the overload of information that modern technology produces. They will need to learn how to put technology to adequate use to make their own and other people's lives richer, safer, easier, more peaceful and more worthwhile and, at the same time, secure the future of the planet on which we live. Therefore, if the education of the 20th century was low-tech, sustainable education for the 21st century will need to be multimodal and high-tech.
- Make change work: Rather than being afraid of change, young people will need to learn how to cope with sudden challenges and unexpected events in a flexible, creative, rational and well-considered way. Young people will need to develop the flexibility to adapt their behavior and decisions to new input and rapidly-changing contexts. Therefore, if the education of the 20th century was largely based on the transmission of established bodies of knowledge, sustainable education for the 21st century will need to strike a balance between the legacy of the past, the pace of change in the present and the needs of the future.
- Make their own learning work: In addition to learning how to meet immediate needs, young people will need to develop a wide range of learning strategies, attitudes and skills to sustain their own learning and development in the future; they will need to develop a high degree of confidence in their learning skills and the willingness and skills to aid others in furthering their development. Therefore, if the education of the 20th century was strongly focused on immediate performance targets, sustainable education for the 21st century will need to foster lifelong learning skills.
- Make their own lives work: Rather than merely dictating which path students should blindly follow, educators should foster students' ability to think independently and make their own decisions in a rational way. Rather than dictating what students should think, education should teach students how to think for themselves. Furthermore, education should enable students to explore who they are, to discover what their true talents and ambitions are, which of their limitations they can overcome (and how to do so) and which educational path is best suited to make the most of their learning.
- Make life on the planet work: If education should foster people's capability to take charge of their own lives and their own development, they should learn to do so without damaging others and their environment. Even more, they should learn how they can make a positive contribution to preserving the social and ecological diversity on this planet, enhancing equity among people of different ethnic, cultural and religious origins and solving the major problems this planet currently faces (amongst which are poverty, child abuse, global warming, species extinction, warfare and the depletion of the Earth's natural sources). This aim resonates strongly with the original meaning of the term "sustainable education" as coined by Sterling [4] and advocated within the field of education for sustainable development [5,20–24].

Foregrounding the above-mentioned competences as the key competences for 21st century education does not imply that core subject knowledge should no longer be taught or assume a peripheral position in the curriculum. However, in line with Sterling's views on sustainable education [25], it does mean that the teaching of core subjects should be profoundly revised and enriched: the above-mentioned key competences are not to be viewed as mere "add-ons" that can be taught in a piecemeal or fragmentary fashion (if there is some time left), but should rather be considered as the ultimate goals of core subject teaching and the main criteria against which the quality of core subject teaching should be measured. As Sterling [25] puts it, this requires that relation is systematically put back into learning and teaching: whether they take a math, history or technology class, learners should be sensitized and empowered to make the knowledge they acquire work by applying and relating it to authentic, real-world problems; while doing so, they should take into account the needs of others and the consequences of their decisions and findings for life on the planet and try to use their newly-acquired knowledge to creatively solve the major problems that local and global communities are currently facing. This means that the above-mentioned competences should not be treated as a list of items that needs to be ticked off, but rather be seen as a set of core competencies that should be integrated in the teaching of all subjects and in daily classroom practice on a systematic basis. Therefore, when it comes to defining the key goals of the curriculum, there is a red thread running through Sterling's seminal views on sustainable education, the views put forward in the field of education for sustainable development and the view on sustainable education that is presented in this article: rather than accumulating predigested bits of knowledge in their heads and reproducing it during quizzes, tests and exams, students should be empowered to think critically and creatively, make well-grounded, rational decisions and act in appropriate and relevant ways to address the problems that threaten their personal, local and global future.

4. Understanding Learning

To make education systems work optimally towards the above-mentioned learning goals and to do so for every single student in the system, we need to understand how learning works. We need to fully grasp what it is that turns students' energy into the development we envisage. Although much remains to be uncovered, there is much about learning processes that we have discovered over the past few decades [1–3].

For one, learning is about connecting. To learn, people need to be able to connect the new with what is already known. To a great extent, prior knowledge determines what can be learnt; the learning outcome of human activity heavily depends on the extent to which new information can be connected with what has already been acquired. Research into learning has tended to highlight the cognitive side of this basic insight. However, especially in compulsory education systems enlisting children and adolescents, the cognitive aspects of learning (and connecting) cannot be separated from other dimensions of learning. For young learners of flesh and blood, the cognitive aspects of learning are inextricably entwined with social, emotional and physical aspects [3]. Connections, then, may be hypothesized to be richer for learning and thus give rise to more sustainable energy-learning cycles, if they positively engage the learner's whole being. Therefore, in this line of reasoning, learning is facilitated if learners also connect socio-emotionally to what they aim to learn or need to learn and if learners socio-emotionally connect to the activity they are participating in and might learn from. In addition, learning will be enhanced if

learners are able or willing to connect to the person(s) with whom they are interacting and/or from whom they are learning [26]. In other words, the combination of socio-emotional, physical and cognitive engagement can top-up the energy unleashed for learning, and the learning experience, in turn, may feed the learner's socio-emotional, physical and cognitive well-being.

Secondly, learning is an active verb. Connecting (and thus learning) cannot be done for the learner; it is something the learner needs to do. For much of what people need to learn, especially for the development of complex competences, people need to engage in situated practice and to do so repeatedly. However, merely repeating a particular activity does not automatically result in deep-level learning. Much learning requires some degree of reflection on what we are doing. If we understand what we are doing (especially when we are doing, or supposed to be doing, new and complex things), our capacity to handle the new, modify and apply it in a wide range of situations and contexts may be largely enhanced. In this way, learners' natural powers to learn will turn into expert power.

The above implies that much learning requires effort and that learning also has a motivational aspect. If learners assign personal meaning to what is to be learnt or done, if they believe the new will make a positive difference in their lives, if they expect the learning or participating will matter in any way, if they can make educational aims their aims, they might be inclined to invest more energy in the activity. Ultimately, much of what does engage people in activities that might lead to learning boils down to some prospect of personal or social reward.

In sum, learning is about connecting, investing, and expecting. The three reinforce each other. If people can connect the new they encounter in the now to something they knew, did or felt in the past with a view to feeling or doing better in the future, then they are bound to invest energy in the ongoing activity, and the energy-learning wheel will start turning. This does not imply that learners need to be consciously aware of each of these conditions. There is quite a lot of investing, connecting and expecting that goes on at an unconscious level. Additionally, as mentioned above, if people are cognitively, socio-emotionally and physically engaged in connecting, investing and expecting, then the learning that comes out of it, and the new energy that the learning experience produces, may be largely enhanced. Conversely, the socially-disadvantaged child who cannot connect her prior knowledge and skills that she developed at home to the abstract subject-matter of the school curriculum, who feels that the teacher holds low expectations of her school achievement and who expects to do badly on the following tests, may find it increasingly hard to invest further mental and physical energy into studying and working hard at school. For this student, the energy-learning cycle may grind to a halt: the energy for learning this student has left may fail to be renewed.

5. Designing Learning-Oriented Education

Education systems work well if they work well for every single student in the system. That is, if they manage to keep the self-perpetuating energy-learning cycle of every single child going and if they make sure that every single child develops the crucial competences in the curriculum and realizes her full learning potential. However, how do successful education systems accomplish this? What do education systems that foster both equity and excellence actually do [27–31]?

- They challenge and trust learners: Teachers in successful education systems hold high expectations of every single student in the system and expose their students to challenging, meaningful content.

They are not discouraged by the temporary flaws, errors or mistakes that inherently belong to any process of learning (and which, if put to proper use, may actually be exploited to promote learning). Challenge is key to high-quality education, because, in essence, it is about inviting learners to stretch their muscles and continuously acquire new skills, knowledge and attitudes. Reviewing the research on what distinguishes expert teachers (whose students show higher-than-average learning gains year after year) and experienced teachers, Hattie [32] (pp. 33–34) concludes that "expert teachers do differ from experienced teachers, particularly in the degree of challenge that they present to students, and, most critically, in the depth to which students learn to process information."

- They activate and motivate learners: teachers cannot do the learning for their learners. Research into learning processes amply shows that to develop expertise (in whichever field), learners need to engage in much deliberate practice, during which they can learn by doing and by reflecting on what they are doing in an effort to improve their practice [3,31,33]. Rephrasing this insight in terms of sustainable education, this means that learners need to invest energy in their own learning process. As research into learning motivation indicates, energy for learning is boosted and activated if learners are exposed to tasks they consider valuable, challenging and doable and if they know that support (by a more competent partner) is provided should obstacles arise [3,34,35]. In addition, learners' energy for engaging in learning activities might further be boosted to the extent that teachers tailor content and support to their students' learning needs and allow their students to have a say in what learning content and learning activities are truly worthwhile.
- They contextualize learning: Activating students' energy for learning does not suffice. As mentioned in the Introduction, one of the key principles of sustainable education is that the energy that learners invest in learning activities should turn into successful learning experiences, so that their energy for learning gets renewed, and a virtuous cycle ensues. One of the key features of successful learning experiences is that new content can be linked by learners to their prior knowledge [1,3]. Therefore, in successful education systems, the substantial body of decontextualized knowledge students need to acquire is linked by teachers to numerous concrete, contextualized cases and examples and connected to students' prior experience; in a similar vein, students are invited to apply this knowledge to new cases in (semi-) authentic contexts and situations. Reviewing research on the impact of education on learning, three out of the five recommendations that Pashler *et al*. [36] make to teachers focus on using multiple ways of presenting challenging input (verbal, visual, digital, *etc*.) and designing multiple ways in which the student processes the input (problem-solving tasks, worked examples, hands-on exploration, *etc*.). Both inside and outside school, learners should be offered rich opportunities to re-contextualize their new knowledge to fully understand it, to make it come alive, to put it to societal use and to use it to enrich their own and other people's lives. Therefore, in sustainable education, bridges between the school and the outside world are constructed and maintained: opportunities for workplace learning, community learning and learning from the multimodal experiences that modern technology offers are fully exploited to allow the learners to establish rich connections between the abstract and the concrete, between academic knowledge and real life and between new knowledge and learners' prior knowledge.
- They socialize learning: In successful education systems, learners get ample opportunity to collaborate on tasks and learn together. The empirical evidence on the positive impact of

cooperative learning on students' development is robust [28,31,32]. In the process of collaborating, learners can support each other's learning and understanding of new content and, at the same time, learn how to work together, develop social skills and learn how to solve problems and settle disputes in a constructive way. In sustainable education systems, learning to work, learn and live together are fostered in an integrated way and become part of the school's daily life and assessment culture. School populations become learning communities where pupils develop and sustain rich and constructive relationships with more peers than just the pupils in their own class. In sum, for sustainable education, cooperative learning is of crucial importance, both in terms of enhancing successful learning experiences and in terms of fostering one of the key competences that students need to develop to fully live their present and future lives and to secure life on this planet.

- They differentiate*:* Today, many education systems require all students to acquire all subjects at the pace of their birthdays. However, the energy-learning cycle of every student has a distinctly personal touch. People differ in what exactly arouses their energy flow, in the prior knowledge they have built up, the interests they have, the way they learn and the pace at which they acquire different skills. As the research on evidence-based education amply indicates [28,31–33], successful education systems are characterized by a high degree of flexibility in the teaching methodologies, support systems and grouping formats they offer: students who are temporarily lagging behind are offered more intensive, or adaptive, support; students who are extremely fast are offered further challenges.

In view of the above, and in view of what we know about learning today, the education of the 21st century needs to increase the time devoted to holistic, interdisciplinary activity in which learners collaboratively work towards a challenging, meaningful outcome; in which they need to deal with different opinions and perspectives and with information coming from different sources; in which the explicit attention to elements of skill is embedded in holistic meaning-making activities; in which learners are provided with feedback on the quality of their work and the progress they are making; in which learners, while in the process of complex problem-solving, also learn how to solve problems, whether they be of a social, cognitive, affective or other nature. In essence, sustainable education systems systematically take the learning process of all learners as their true focus of attention. All activity is grounded in the energy-learning cycle and is set up to maximally feed it. Learning is at the core of the system, not the system itself.

6. The Open School

Walls, windows, doors and ceilings: that is of what a school building consists. In a metaphorical sense, the school of the previous century was dominated by its walls and ceilings. Students were sitting together in stable groups, based on attainment and separated from other groups by thick walls. Similarly, between the different courses of the curriculum (relating to different scientific disciplines), firm walls were erected. Annual learning development was kept within the vertical space bound by well-described floors and ceilings. Strong walls separated students from the environment outside the school.

Pursuing the metaphor, the sustainable school of the 21st century that attempts to put the above-mentioned pedagogical principles into daily practice may find itself dominated by windows and doors instead. Open doors allow students to move across physical and intellectual spaces to learn with

many others, to help their peers learn and to develop social skills while trying to work together with different types of students. Open doors allow for dynamic regrouping of students to create more opportunities for learners to learn at their own pace and for teachers to fine-tune their support to specific learner needs. If classroom doors and windows are opened on a more regular basis, students may get richer opportunities to apply knowledge and skills from different courses and disciplines to complex cases. Students of different strands and programs and with different talents, skills and prior knowledge can then be deliberately mixed to solve authentic problems demanding the expertise and creative ideas of highly complementary groups that are able to work together efficiently. Doors can be opened to the outside world, too: in that way, students may be challenged to apply their competences to authentic problems in an effort to make a valuable contribution to community life, to develop crucial competences in workplace learning and real-life contexts and to relate knowledge and skills they built up at home to their classroom work [37,38]. Parents will be invited on a regular basis to talk about their children's development and future prospects. Assessment will be geared towards the discovery of children's unique talents and interests, turning the school into a window of opportunity for every single child in the system.

A nice illustration of these principles can be found in a Flemish secondary school, where students in the vocational strand were asked to teach first-aid skills to students in the academic strand. The vocational students' self-competence was strongly boosted by this experience. Moreover, they developed social skills (explaining and teaching) and first-aid skills (the actual explaining helped them understand the content they were teaching even better) during this activity. Besides acquiring first-aid skills, the "academic" students learned to see their "vocational" peers in a different light. The example illustrates the way in which the principles and practices that are suggested in this section relate to the key principles of sustainable education. First, many of the measures that are suggested in this section have the potential of boosting students' positive energy for learning by being directly linked to the variables that have been shown to raise students' motivation to engage in learning activities: applying knowledge to cope with intrinsically interesting, authentic problems, engaging in joint project work with other people who are eager to pursue a common goal, receiving opportunities to boost self-confidence (e.g., by helping a peer or bringing in expertise the other does not possess) have all been empirically shown to be linked to enhanced learning motivation and task engagement [3,31,34,35]. Second, many of the measures that are suggested in this section raise the chance that the effort students put into learning will lead to successful learning. Peers providing each other with interactional support, contextual support that comes with making the learning environment more realistic and authentic and learners' efforts to try and explain newly-acquired knowledge to others have all been shown to be associated with enhanced development [3,31,33,36].

7. No Talent Is Wasted

The example above shows that the principles of holistic, cooperative learning may work out fine not only for the talented and gifted, but also for "less gifted", "socially disadvantaged" and "ethnic minority" students. Yet, for the latter groups of students, the bar is often lowered [11,39,40]. These students' engagement in shared, interdisciplinary project work calling for higher-order, creative and critical thinking is often put "on hold". Teacher expectations are lowered, and the students are invited to engage in less meaningful, powerful and motivating activities, over-emphasizing subskills or isolated elements.

As a result, the balance between the energy invested in teaching and the learning that comes out of it may be severely disturbed, much to the frustration of both learners and teachers involved. As was pointed out in Section 2, the social gap between pupils of low and high socio-economic backgrounds is one of the key factors that turns many of the education systems in the world today into relatively unsustainable systems. Rather than leading to successful learning experiences and being renewed as a result, the positive energy for learning of underachieving students slowly, but surely, gets depleted. These students are at risk of giving up school and giving up formal learning altogether [10,16]: they risk leaving school early without graduating and without developing a threshold level of the 21st century key competences that were described in Section 3; they are at risk of participating to a relatively minor extent in lifelong learning and realizing their full potential. As a result, valuable human energy, talent and time get wasted rather than turned into sustainable human development.

Therefore, at all levels of the educational system, from the macro-level of system organization to the micro-level of classroom teaching, practitioners have to make sure that all students receive high-level education of a challenging kind. Not a single student should be put on an energy-learning diet. At the system level, early tracking and streaming have been shown to raise the risk of lowered teacher expectations, curriculum reduction and social inequity. Therefore, all students should be offered comprehensive education, preferably up to the age of 14 [9]. At the local level, schools have to join forces with local communities and companies to offer students rich opportunities for workplace and community learning (in upper-secondary education and second-chance learning, this actually may become crucially important for the students for whom more traditional classroom approaches did not work). At the school level, approaches towards remedial teaching that focus on what students are not able to do may make students feel stigmatized, lowly competent and isolated from the mainstream group. If remedial teaching consists of little more than the mere repetition of the same content and the use of the same teaching procedures that failed to work in the first place, repetition may lose its learning potential. This is probably one of the reasons why the energy (and money) invested in making children repeat a grade often produces counterproductive effects [9,32]. Therefore, if remedial teaching is organized, it should be as motivating, interesting and meaningful as teaching in the mainstream and, at the same time, should be better adapted to the specific needs of the students involved.

8. Teachers Make the Crucial Difference

Teachers make the crucial difference [32,41,42]. There is no way of getting around this basic truth. In the end, it is not class size or money that does the trick. It is the teacher [29]. Reviewing his meta-analysis of thousands of studies on educational effectiveness, Hattie [32] (p. 169) concludes that "the major source of controllable variance relates to the teacher". This is because teachers are in a privileged position to keep the energy-learning cycle of every single student going. Teachers can motivate learners to engage in meaningful learning activities. They can provide feedback and interactional support tailored to individual learners' needs. They can scaffold reasoning and higher-order thinking. They can model expert performance. They can listen and show that they care. They can establish rich connections with learners and for learners and, in this way, support learners by turning their positive energy for learning into successful learning experiences.

What is more, teachers can do this on a daily, minute-to-minute basis and, so, can forge strong chains of support for every single one of their students. Teaching may be seen by many as a gift, but great teaching, the kind that boosts the energy learning cycle in every single student in the classroom, is a learned competence. The research on expert teachers shows that they engage in deliberate practice, which means that they do not just teach, but consciously reflect on the quality of their teaching and seek support from others in an continuous effort to improve their impact on their students' learning [32,33]. Being an expert teacher requires (amongst others) a broad repertoire of teaching formats and activities, an alert pair of eyes and ears to observe and analyze the quality of the learning process that different learners are engaging in, a high level of flexibility and skill to tailor support to students' present and future needs and sophisticated social skills to connect with learners of different backgrounds and character. Great teachers bring out the best in learners: their minute-to-minute decisions in the classroom are not lucky shots, they are the result of a balanced interplay between expert knowledge, skills and attitudes.

Therefore, teachers are learners, too. For teachers-as-learners, too, it is of crucial importance that the positive energy sources for learning they have (their professional motivation and dedication, their prior knowledge and skills) can be turned into successful learning and development. For teachers, too, it is crucially important that the energy for teaching they have does not burn out or go to waste. Therefore, teachers need to able to practice their profession in favorable working conditions. To foster their development, they need to be given ample opportunity to work together and deliberate with their colleagues, to participate in in-service training and coaching on the floor, to reflect, preferably together, on what they are doing in the classroom in an effort to enhance the impact of their teaching on students' learning.

In this respect, too, education will need to take a social turn [7,41,43]. Schools probably constitute the potentially most powerful learning communities in the world. Yet, for schools to become a truly powerful learning community, the available, and virtually inexhaustible, source of energy for leaning of the school team needs to be tapped. In many ways, the energy and expertise of the different teachers in the team must be regarded as highly complementary and treated as such: if teachers share ideas, prepare or give lessons together, discuss pupils' progress and together search for ways to optimally fine-tune instruction to the pupils' needs, better teaching and richer teacher development may come out as a result. The extensive research on what effective schools do more and better than less effective schools clearly indicates the crucial importance of collegiality among staff members, joint policy-making, joint staff development, co-teaching and joint deliberation on the impact of education on student development [44,32]. In this respect, Darling-Hammond [43] (p. 193) concludes that countries that have recently made the greatest progress in student achievement allow their teachers sufficient time "to plan cooperatively and engage in analyses of student learning, lesson study, action research, and observation of one another's classrooms that help them continually improve their practice."

Ultimately, there is very little that gives people more energy than working together on a worthy cause. Additionally, there is very little that drains people so much as fighting for a seemingly lost cause all on their own. The various members in a school team are all committed to the same worthy cause: fostering their students' development and well-being. Therefore, if team members combine their natural energy sources for teaching (*i.e.*, their motivation, dedication and expertise), teacher learning and development are bound to come out of it; this, in turn, will give teachers new energy for teaching and developing.

It should be noted, in this respect, that parents are not teachers. If parents are expected to do the kind of things at home that teachers are doing at school, education systems may become less equitable. Therefore, parents should primarily be asked, let alone required, to do the kinds of things that all parents are able to do. If necessary, they should be helped to raise their kids in material or financial ways, but above all, they should be listened to and consulted when it comes to designing the child's educational career, discussing their well-being, talents, limitations and worries. Parents and teachers are partners in the shared project of keeping the energy-learning cycle of their children running. What is more, as partners, they are highly complementary. Parents know and see things that teachers do not know and see, and *vice versa*. True dialogue and exchange between parents and teachers can make a big difference for children. Additionally, allowing parents to participate in that dialogue on an equal footing with teachers and administrators can make a big difference for the parents.

9. Broadening Assessment

The main goal of assessment in sustainable education is to improve education and to promote learning [45,46]. In meta-analyses on the impact of education on learning, formative assessment and feedback systematically rank amongst the most influential variables [28,32]. The research clearly indicates that assessment should primarily serve the purpose of finding out whether students' energy-learning cycle is running and, if not, which obstacles should be cleared. To do so, a broad repertoire of different assessment procedures and methods can be employed, enabling teachers to unravel whether students are activating energy for engaging in a learning activity and how they are coping with the learning task in an effort to turn their energy for learning into a successful learning experience. Building on their observation of students' learning process and output, teachers can then provide learners with feedback, preferably the kind of feedback that drives the learning process forward. Reviewing the extensive research on feedback, Hattie [32] concludes that feedback is most productive when it builds a connection between three crucial questions: where is the learner going (for which learning goals did the learner activate energy for learning), how is the learner going there (how is the learner coping with the task) and where to next (which kind of feedback and support could help the learner most at this particular stage to learn successfully). In sustainable education, then, assessment is crucially a matter of dialogue, aimed at using information about the learning experience in a joint effort to enrich it. Errors are welcomed: errors, in fact, can drive learning forward in a forceful way if they are treated as sources of information [32,33].

Hattie [32] further suggests that students should be taught how to critically and objectively self-assess their work (and their peers' work) and to draw conclusions on the efforts they need to make next. In that way, learners can become their own teachers and build up self-regulating skills. In terms of sustainable education, learners should ultimately learn to self-regulate their own energy-learning cycle.

In sustainable education, the curriculum is not dictated by what can be tested easily. Rather, assessment is dictated by what should be taught first and foremost. In line with the previous section, for school teams, assessment has an introspective dimension, in the sense that they use student results to analyze the quality of the education they offered, in an effort to identify aspects that can be, and should be, improved. Finally, in sustainable education, assessment also has a prospective dimension. School teams, students and their parents aim to identify what students are good at (and less good at), what they like to learn and what their ultimate learning ambitions are, in an effort to construct the most optimal

match between the students' ambitions and capabilities and their educational trajectory. Therefore, most probably, school teams should not test more, but should do more with the assessments that they carry out [41].

10. Implementing Sustainable Education

Following from the above, a wide range of measures promoting sustainable education, ranging from the macro-level of the education system to the micro-level of the school, could be listed. Amongst others, this list could include the following proposals:

- Introduce a weekly slot of four hours that is devoted to interdisciplinary, collaborative project work.
- Check whether the current curriculum gives top priority to competences that are vital to students' future lives and the future of the planet.
- Create more opportunities for children to develop creative thinking skills throughout the curriculum.
- Provide mentoring by experienced teachers to every beginning teacher during the first two years of their career.
- Provide more outdoor learning opportunities to all students.
- Enhance community life at school by increasing student influence on school policy, organizing peer tutoring and school projects across strands and age groups.
- Invest in the quality of pre-primary education by training nursery teachers to interact in a natural, rich way with children while they are playing and exploring the world around them.

Not all of the above-mentioned measures require extra money. Some primarily require the commitment of practitioners and policy makers, the joint effort of school teams and a fair degree of creativity and belief. Implementing such measures might sensitize many practitioners to reflect on the quality of education, but on the other hand, they might also do little more than scratching the surface of a system that remains otherwise unaltered. If schools raise the number of hours devoted to cooperative learning, but the summative assessment of students is exclusively based on individual tests, then students might still conclude that, ultimately, individual competition rules the world. If students participate in lesson activities that explicitly focus on fighting racism and fostering multicultural dialogue, while at the same time aggressive bullying in the playground is not tackled, students may decide that nice principles in the classroom have no bearing on real life. If the whole team attends an in-service training on complex problem-solving, but every teacher is left to their own devices when it comes to trying new ideas out in the classroom, the impact of the training on teacher development will be close to zero. If the school team purchases an expensive monitoring system for following up on students' development of key competences, but teachers lack the expertise to differentiate between learners, then the energy invested in the administration of the monitoring system may not pay off in terms of student development. Ultimately, making education more sustainable is a matter of optimizing school culture, not school structure.

11. Conclusions

In this article, the concept of sustainable education was reinterpreted and redefined as education in which:

- No energy for learning and talent is wasted: education should work for every single student in the system, irrespective of the students' background;
- Energy for learning is renewed: the energy that students and teachers invest in education is maximally turned into successful learning and development, which produces new energy for learning;
- Crucial needs are addressed: students develop the competences that are crucial for their future lives and for the future of our planet.

Young people have a strong, natural urge and huge sources of energy to learn. They learn in order to fulfill a wide range of social, physical, emotional, psychological needs. Their energy for learning is renewed every time their efforts to learn turn into successful learning, because successful learning provides learners with cognitive, physical, emotional and motivational sources for further learning. In the 21st century, young learners need to tap and continually renew their energy for learning in order to cope with the dramatic changes that are reshaping modern daily and societal life. Acquiring the basic skills of reading, writing and math no longer suffices [13]. To function in societal life and in the labor market, to enrich their personal lives and secure life on the planet, students need to acquire a wide variety of higher order, 21st century skills. Education systems have a huge responsibility and great potential to make this happen. They will be successful to the extent that they can tap students' energy for learning, help learners to build up successful learning experiences and keep their energy-learning cycle running. Drawing on the extensive research on learning and development and on their own energy for learning, school teams can make a crucial difference in students' school careers and their future existence.

The implementation of sustainable education will require substantial government support: first, in terms of taking the necessary steps to instigate and organize the reframing of curricula and key objectives of educational systems in their countries; second, in terms of supporting school teams and individual teachers to further develop their professional expertise. As the above-mentioned research made abundantly clear, investing in teachers' and school teams' motivation and competence will be key to pursuing the three main ambitions that define sustainable education mentioned above. As a corollary, much more classroom-based research is needed to identify what expert teachers and expert teams do in terms of sustainably promoting the key competences of the 21st century with all of their students, irrespective of their social, cultural or ethnic background.

The aim of this article was not to advocate change merely for the sake of change. What we need to do in education is to sustain what goes well and to fight what goes wrong. We need to fight the loss of human talent and potential, the loss of energy for learning, the loss of dignity and pride, the loss of precious time to foster development in crucial domains. Education can be a powerful engine of opportunity for all students, and it is the energy of students and teachers that keeps the engine running.

Conflicts of Interest

The author declares no conflict of interest.

References

1. Bransford, J.; Brown, A.; Cocking, R. *How People Learn: Brain, Mind, Experience, and School*; National Academy Press: Washington, DC, USA, 1999.
2. Dumont, H., Istance, D., Benavides, F., Eds. *The Nature of Learning. Using Research to Inspire Practice*; OECD: Paris, France, 2010.
3. Hattie, J.; Yates, G. *Visible Learning and the Science of How We Learn*; Routledge: New York, NY, USA, 2014.
4. Sterling, S. *Sustainable Education: Re-Visioning Learning and Change*; Schumacher: Bristol, UK, 2001.
5. Tilbury, D. *Education for Sustainable Development: An Expert Review of Processes and Learning*; UNESCO: Paris, France, 2011.
6. Wade, R. Education for sustainability. Challenges and opportunities. *Policy Pract. Dev. Educ. Rev.* **2008**, *6*, 30–48.
7. Van den Branden, K. Sustainable education: basic principles and strategic recommendations. *School Eff. School Improv.* **2012**, *23*, 285–304.
8. Condron, D. Affluence, Inequality, and Educational Achievement: A Structural Analysis of 97 Jurisdictions across the Globe. *Sociol. Spectr.* **2013**, *1*, 73–97.
9. OECD. *Equity and Quality in Education: Supporting Disadvantaged Students and Schools*; OECD: Paris, France, 2012.
10. Curtis, D.; McMillan, J. *School Non-Completers: Profiles and Initial Destinations*; Australian Council for Educational Research: Camberwell, UK, 2008.
11. Gamoran, A.; Long, D. *Equality of Educational Opportunity: An 40-Year Retrospective*; WCER Working Paper No. 2006-9; Wisconsin Centre for Education Research: Madison, WI, USA, 2006.
12. Van den Branden, K., van Avermaet, P., van Houtte, M., Eds. *Equity and Excellence in Education. Towards Maximal Learning Opportunities for All Students*; Routledge: New York, NY, USA, 2010.
13. Wagner, T. *The Global Achievement Gap*; Basic Books: New York, NY, USA, 2008.
14. Baum, S.; Payea, K. Education pays. *The Benefits of Higher Education for Individuals and Society*; The College Board: New York, NY, USA, 2004.
15. Belfield, C.; Levin, H. *The Price We Pay. Economic and Social Consequences of Inadequate Education*; The Brookings Institution: Washington, DC, USA, 2007.
16. Byrne, D.; Smyth, E. *No Way Back. The Dynamics of Early School Leaving*; Liffey Press: Dublin, Ireland, 2010.
17. OECD. *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*; OECD Publishing: Paris, France, 2013. Available online: http://dx.doi.org/10.1787/9789264204256-en (accessed on 10 April 2015).
18. Marzano, R.; Heflebower, T. *Teaching and Assessing 21st Century Skills*; Hawker Brownlow Education: Cheltenham, UK, 2011.
19. Partnership for 21st Century Skills. P21 Framework Definitions. Available online: http://www.p21.org/our-work/p21-framework (accessed on 12 January 2015).
20. Gadotti, M. What We Need to Learn to Save the Planet. *JESD* **2008**, *2*, 21–30.
21. Huckle, J.; Sterling, S. *Education for Sustainability*; Earthscan: London, UK, 2006.

22. Lang, J. *How to Succeed with Education for Sustainability*; Curriculum Corporation: Carlton, OR, USA, 2007.
23. Martens, P.; Roorda, N.; Cörvers, R. Sustainability, Science, and Higher Education. The Need for New Paradigms. *Sustain. J. Record* **2010**, *3*, 294–303.
24. UNESCO. *Contributing to A More Sustainable Future: Quality Education, Life Skills, and Education for Sustainable Development*; UNESCO: Paris, France, 2005.
25. Sterling, S. Sustainable education—Towards a deep learning response to unsustainability. *Policy Pract.: A Dev. Educ. Rev.* **2008**, *6*, 63–68.
26. Cornelius-White, J. Learner-centered teacher-student relationships are effective: A meta-analysis. *Rev. Educ. Res.* **2007**, *77*, 113–143.
27. Creemers, B.; Kyriakides, L. *The Dynamics of Educational Effectiveness: A Contribution to Policy, Practice and Theory in Contemporary Schools*; Routledge: London, UK, 2008.
28. Marzano, R. *What Works in Schools: Translating Research into Action*; Association for Supervision and Curriculum Development: Alexandria, VA, USA, 2003.
29. McKinsey and Company. *How the World's Best-Performing School Systems Come out on Top*; McKinsey and Company: London, UK, 2010.
30. Mourshed, M.; Chijoke, C.; Barber, M. *How the World's Most Improved School Systems Keep Getting Better*; McKinsey and Company: London, UK, 2010.
31. Petty, G. *Evidence-Based Teaching: A Practical Approach*; Nelson Thornes: Cheltenham, UK, 2009.
32. Hattie, J. *Visible Learning: A Synthesis of over 800 Meta-Analyses Relating to Achievement*; Routledge: New York, NY, USA, 2009.
33. Willingham, D. *Why Don't Students Like Schools?* Jossey-Bass: San Fransisco, CA, USA, 2009.
34. Dweck, C. *Mindset: The New Psychology of Success*; Ballantine Books: New York, NY, USA, 2006.
35. Ryan, R.; Deci, E. The "what" and "how" of goal pursuits: Human needs and the self-determination of behavior. *Psychol. Inq.* **2000**, *11*, 227–268.
36. Pashler, H.; Bain, P.; Bottge, B.; Graesser, A.; Koedinger, K.; McDaniel, M.; Metcalfe, J. *Organizing Instruction and Study to Improve Student Learning*; National Center for Education Research, Institute of Education Sciences: Washington, DC, USA, 2007.
37. Dewey, J. *Experience and Education*; Collier-MacMillan Canada Ltd.: Toronto, ON, Canada, 1938.
38. Gray, P. Free to learn. In *Why Unleashing the Instinct to Play Will Make Our Children Happier, More Self-Reliant, and Better Students for Life*; Basic Books: New York, NY, USA, 2013.
39. Black, L. Differential participation in whole-class discussions and the construction of marginalised identities. *J. Educ. Enq.* **2004**, *5*, 34–54.
40. Jaspaert, K.; van den Branden, K. Literacy for all. In *Equity and Excellence in Education: Towards Maximal Learning Opportunities for all*; Van den Branden, K., van Houtte, M., van Avermaet, P., Eds.; Routledge: New York, NY, USA, 2011; pp. 215–235.
41. Fullan, M. Choosing the wrong drivers for whole system reform. Melbourne: Centre for Strategic Education. Available online: http://edsource.org/wp-content/uploads/Fullan-Wrong-Drivers1.pdf (accessed on 20 October 2014).
42. Hanushek, E. The difference is great teachers. In *Waiting for Superman. How We Can Save America's Failing Public Schools*; Weber, K., Ed.; Public Affairs: New York, NY, USA, 2010; pp. 81–100.

43. Darling-Hammond, L. *The Flat World and Education: How America's Commitment to Equity will Determine Our Future*; Teachers College Press: New York, NY, USA, 2010.
44. Gray, J.; Hopkins, D.; Reynolds, D.; Wilcox, B.; Farrell, S.; Jesson, D. *Improving Schools: Performance and Potential*; Open University Press: Buckingham, UK, 1999.
45. Hattie, J.; Timperley, H. The power of feedback. *Rev. Educ. Res.* **2007**, *77*, 81–112.
46. Timperley, H. *Using Student Assessment for Professional Learning: Focusing on Students' Outcomes to Identify Teachers' Needs. Paper no. 21*; Department of Education and Early Childhood Development: Melbourne, Australia, 2011. Available online: http://www.education.vic.gov.au/Documents/about/research/timperleyassessment.pdf (accessed on 12 February 2015).