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# *Improving Sustainability: What Can Education Learn From Other Complex Systems?*

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*This article is concerned with the causes of unsustainability in complex systems, and what educators can learn from such a study. It argues that there are a number of similar stressors in many complex systems. The systems chosen to illustrate this argument are the educational, the environmental, and the financial, and the stressors described are the excessive exploitation of resources and the introduction of pollutive substances, practices or ideas. Such stressors, it is argued, lead to crisis points in all three systems, as actors within them are increasingly unable to adapt to the rapid changes they cause. Finally, because these systems share similar characteristics, this article argues that educators can learn much from the existence of similar remediations.*

*Keywords: educational leadership; sustainability; systems thinking*

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Mencken said that to every complex problem there existed a solution which was neat and simple and wrong (see Lloyd & Mitchinson, 2008). This could be a preface to many of the problems of the 20th and 21st centuries; faced by challenges in a variety of areas, many "solutions" have created more serious problems instead. Pesticides created to raise crop yields have killed off natural predators and much other wildlife (Carson, 1962). The use of antibiotics has led to the evolution of microbes highly resistant to them, and even more threatening to human life (Drlica & Perlin, 2011). Managerial systems designed to standardize practice in order to raise productivity have led to reductions in creativity and morale (Kanter, 1983). Finally, attempts to control and engineer more effective educational systems through high-stakes testing and punitive accountability have led to increasing numbers of teachers wishing to leave the profession, and lessons devoid of creativity and enjoyment (Bangs, MacBeath, & Galton, 2011). A key part of the reason for the creation of such problems, this article will argue, lies in the desire for neat and simple solutions which work now, rather than recognizing that for solutions to work now, but more importantly to work well into the future — to create ones that are sustainable — one needs to recognize the complexity of the challenges faced. Developing and maintaining sustainable systems has thus become a major concern in many different areas of activity. This article will also argue that a comparison of a number of such systems suggests that they have rather more in common than is normally recognized. A comparison of the causes of different systems' unsustainability then may be a highly valuable exercise for educators, as such a comparison may also suggest new forms of remediations.

This article compares educational with environmental and financial systems. This choice is driven by four different considerations, all of which are seen as necessary for their selection, but none on its own as being sufficient. A first reason is driven by theory, and particularly by the burgeoning literature on complexity theory and its applications to systems. This article suggests that all three systems are complex in

similar ways, and therefore need a similar kind of understanding of the consequences of actions made within complex systems.

A second reason lies in an observational literature suggesting that all three systems seem to be stressed in significantly similar ways. The two main "stressors" discussed in this article which seem to be common to all three are: (a) the excessive exploitation of resources; and (b) the introduction of pollutive substances, practices, or ideas. These stressors, it is argued, lead to similar crisis points, where actors within these systems find it increasingly difficult to adapt to rapid change. Such an examination may then suggest not only that they become unsustainable in a similar manner, but that there also may be similar remediations.

A third reason is based on social and ethical considerations: how these systems are treated has major social and ethical impacts upon the actors within the systems, and as all three contain actors (living creatures) whom many would see as having claims to moral rights, this article argues that if social and ethical considerations are part of the conceptual schema within which an examination of sustainability is placed, then these three systems are strong exemplars.

A final reason lies in that there is evidence to suggest that all three systems have been adversely affected by the dominant economic theory and practice over the last thirty to forty years — that of neo-liberal economics, and its attendant social practice of consumption. An understanding of the similarities in such causation may also suggest similar remediations.

## Theoretical Considerations: Understanding Complexity

So to begin with the first of these reasons for comparability, that of complexity theory, it will be argued that the notion of complexity is pivotal to the theoretical underpinnings of this article. Johnson (2009) and Mitchell (2009) both provided overviews of the characteristics of complex systems, suggesting a number of commonalities between environmental, financial, and educational systems. Thus each of them has many actors:

- Who constantly interact;
- Whose behavior is influenced by memory of previous events or feedback from other systemic elements;
- Who can and do adapt their behavior in the light of what they have learnt;
- Who are influenced by, and themselves influence, the environments they inhabit.

In all three systems, then, the collective actions of large numbers of individual agents give rise to complex, changing, and unpredictable patterns of behavior. In environmental systems, for example, the destruction of a species is hardly ever simple and linear. As Wilson (2003) cautioned, it can be caused by one, or a combination, of the following factors: habitat destruction, invasive species, pollution, population increase, and overharvesting. Furthermore, the importance of any one of these causes will depend upon the nature of the particular species, the type of ecosystem within which they live, and their unique interactions with the different threats. In similar manner, when economic theorists fail to appreciate the complex of rationality, emotions and values which contribute to most economic decision making, and instead simplistically describe human actors as self-interested, rational calculating machines, they under-describe, and so mis-describe real human behavior in a marketplace (Greider, 2004). Finally, as Hoyle and Wallace (2005) argued, an essential aspect of educational leadership practice lies in working with not one stakeholder, but with a whole variety, and also appreciating that these stakeholders do not necessarily agree on a school's purposes. In such circumstances, much of the art of leadership lies in the balancing of these different interests, and if policymakers fail to understand that the job is one suffused with this complexity, simplistic policies will likely be fashioned which do not help leaders to address the complexity of their job, and are indeed likely to push the role toward unsustainability.

Plsek and Greenhalgh (2001) then summed up this situation when they argue that each complex system comprises a collection of agents

who are interconnected to such an extent that "one agent's actions changes the context for other agents" (p. 625), and that therefore their actions will not always be predictable. Because of this, the systems within which such agents exist will necessarily evolve in unexpected and complicated ways, and without any central direction. A second consequence is that in such systems, as all weather forecasters know, certainty rapidly diminishes the further into the future one tries to predict behavior. It follows that any suggestions for system sustainability, including educational sustainability, need to be couched in such understandings if problems are to be properly framed and addressed.

## Observational Considerations: Toward Unsustainability

If complexity theory suggests a similarity between the three systems, so does the observation of how they each progress toward an unsustainable state. To explain this, a broad environmental literature is examined first, then financial systems, and finally that from education. Environmental literature provides a rich and vivid picture of the effects of humanity on the environment as it moved from hunter gathering, to farming, to industrialization, and many commentators (e.g., Lovelock, 2006; Meadows, Randers, & Meadows, 2004; Rees, 2004; World Wildlife Fund, 2008) now claim that as it did so it progressively over-exploited this environment, and some (e.g., Diamond, 2005; Fagan, 2004) argued that it was the primary cause of the downfall of a number of ancient civilizations. It thus provides many examples of the first stressor for other systems to reflect upon.

### *Stressor One: When a System's Resources Are Over-extracted or Damaged*

There are many indicators of unsustainable environmental resource extraction. Diamond (2005) detailed how current deforestation in the developing world was replicated in the developed world in its earlier

industrialization phase. Wilson (2003) documented how fisheries in the North Atlantic, the Black Sea, and parts of the Caribbean have collapsed over the last few decades, while both Klare (2008) and Smith (2011) described how increasing demands for fresh water by industry, agriculture, and expanding populations has led to the over-exploitation of "fossil" water. Both Strahan (2007) and Holmgren (2009) argues the extraction of oil has peaked, while Smith (2011) suggested that filling this energy gap until renewable energy sources are sufficiently developed will mean the extensive utilization of dirty energy sources like coal, or the increased use of nuclear power, with the long-term problem of safeguarding its waste.

The damage to this system is seen in the effect on the planet's species. Wilson (2003) argued that the sixth great species extinction of this planet is currently underway, but this time due to human activity. He suggests that if humanity continues its present activities, "at least a fifth of species of plant and animals will be gone or committed to extinction by 2030, and half by the end of the century" (p. 102).

Financial resources can also be extracted beyond safe limits. To appreciate this, one needs to recognize that the basic principles of banking rest on the relatively simple idea that banks borrow money from savers at a rate below the rate at which they then pass it on to their borrowers. Crucial to this process is their ability to assess the borrower's ability to pay back the loan; otherwise, of course, they place themselves in a precarious position of having insufficient reserves, and therefore placing themselves in an unsustainable financial position. The global financial crisis of 2007–2008 was in large part caused by the breaking of this fundamental rule (Cable, 2010; Harvey, 2010; Heinberg, 2011). The liberalization of banking regulations internationally, but particularly in countries like the United States (U.S.) and the United Kingdom (U.K.), led a number of banks to move from a conservative approach to lending, to one in which money was lent to "sub-prime" borrowers — those who had little or no equity, and therefore were highly unlikely to be able to re-pay the debt. This error was compounded by the abrogation of the Basel rules (Brummer, 2009), the internationally accepted

banking code requiring banks to retain 8% of capital in reserve against the risk of defaulting loans. They avoided this obligation through inventing extremely risky ways of holding less capital, called "credit default swaps." Such risky lending was compounded by the banking practice of bundling of these loans into packages, called "collateralized debt obligations" (or CDOs for short; Brummer, 2009), the risk content of which became impossible to judge. These behaviors led not only to extremely heavy financial resource extraction, but to a bank's inability to judge the quality not only of its own loans, but of those of other banks as well. The result was that much of their own financial resource was damaged, but so was that of others, resulting both in huge financial losses, and an unwillingness to lend to each other. The system consequently had to be bailed out by national governments to the tune of hundreds of billions of dollars: a very good example then of how excessive resource extraction can lead to severe damage and system malfunction.

In education, many kinds of resources can be over-extracted or damaged, including the financial, the intellectual, and the physical. The principal resource to be addressed in this article is the human kind — those individuals employed to "produce" satisfactory results — whether this is interpreted as satisfactory examination scores, or in implementing policies. A strong literature has developed over the last three decades documenting how this human resource in many parts of the world has been placed under increasing pressure through a form of management based upon the creation of low-trust/high-accountability/high-stakes testing regimes, with the intention of extracting more work from these "human resources" (Bottery, Ngai, Wong, & Wong, 2008; Gronn, 2003; Levin, 2003; Wright, 2011). The demand for increased worker flexibility — numerical, temporal, functional, and locational — have all been seen in education, resulting in what Brown and Lauder (2001) called the "democratisation of insecurity." The development of "bastard" forms of leadership of educational organizations (Wright, 2001) has also been combined with a steady increase in the number of "greedy organisations" (Gronn, 2003) which attempt the extraction of more time,

more personal commitment and loyalty from its resources. The initiatives, the rush of policies, and the kind of management favored in delivering these, can combine to produce what Galton and Macbeath (2008) described as "initiative overload," leading to issues of increased stress, earlier retirement, and less individuals wanting to take up leadership positions (e.g., Levin, 2003; Rhodes & Brundrett, 2009).

This educational example then replicates the extraction and damage caused to environmental and financial systems. Currently a principal causation in all three of these systems lies in the influence of core assumptions of neo-liberal financial theory, and the attendant social practice of consumption. Thus, in terms of the environment, Greider (2004) pointed out that neo-liberal thinking does not regard ecological damage as a cost, but rather as an addition to a country's GDP in the costing of the action needed to clean up such damage. A second assumption is that firms should be rewarded if they manage to push such costs onto someone else, thus encouraging firms to manufacture products without taking responsibility for the environmental effects of such products. As Brunner suggested, such assumptions lead to "irresponsibility developed into a system" (cited in Greider, 2004, p. 35).

In financial systems, as Bakan (2004) and Jackson (2009) argued, when economic growth is taken as the principal measure of financial performance, and the prevailing philosophy views the state as no more than an umpire in the action of markets, then steers and curbs on financial transactions are highly likely to be reduced, riskier gambles taken, and the possibility of financial collapse heightened. Finally, when educators are seen less as resourceful humans, engaged in dyadic educational relationships with their pupils, to be treated with respect and dignity, but more as human resources, as interchangeable and expendable means to ends, then systems of low trust and high accountability which extract the maximum from such a resource with little thought to the effects on that "resource" other than problems of their replaceability are much more likely to be set in place. In all three cases, then, the threat of the excessive extraction of a fundamental

resource seems to be driven largely by the current dominant economic model and its attendant practices.

### *The Pollution of Normal Functioning and Stressor 2*

However, not only will the excessive extraction of resources threaten the sustainability of a system, its viability will also be threatened when substances or practices are introduced which undermine or pollute normal functioning. This then is stressor 2: the introduction of inappropriate ideas, practices or substances into a system. In environmental terms, this stressor is seen in both the introduction of invasive non-native species, as well as in general pollution activities. The introduction, deliberately or accidentally, of invasive species can lead to the devastation of native species as they have no natural protection. The introduction of rats, for example, may have been an accidental consequence of human expansion globally, but was the major if unintended contributory factor to the extinction of the New Zealand moa, and the Mauritian dodo. Moreover, as pointed out above, the introduction of a species is hardly ever a micro-event, as the extinction of one species normally has consequences for other species because of their complex inter-linkages within an ecosystem. Wilson (2003), for instance, described how the introduction of the African big-headed ant onto the Hawaiian Islands not only exterminated the majority of native insects in the lowlands, but in so doing, prevented the pollination of plants by native species, and thus led to the extinction of other dependent animals and plants species (p. 38). However, human pollutive activity has been at least as stressful on environmental systems. The advent of the industrial revolution led to widespread and intensified forms of pollution, from the burning of fossil fuels, and chemical and oil spillages, to more recent nuclear and synthetic chemical leaks, which led to increases in stillbirths and cancers.

In the financial world, the terms “toxic assets” and “toxic debts” (Lanchester, 2010) have been used to describe the effects of excessive and inappropriate lending in the banking sector. Generated in large part

by the uncritical adoption of neo-liberal economic practices, they were toxic because the loans were lent to individuals who were in no position to pay them back, and when the house market ceased to be one of rising prices, banks could no longer secure such loans against the value of the homes. Then, when large numbers of banks defaulted and a sudden glut of housing came on the market, house prices dropped rapidly, and these "assets" suddenly became toxic "debts."

The problem, however, did not end there. While defaulting led to serious weaknesses in the banks' finances, further "pollution" to the system occurred, because, as noted above, these loans had been packaged as "unpickable" CDOs, and then sold on to other institutions. The result was that the creation of these pollutive practices (the imprudent lending of mortgages) and the creation of inter-organizational toxic loans damaged an essential element of the system — the trust between financial institutions, and led to its near collapse.

In education, the most toxic form of damage has probably been through the importation of non-educational ideas. While the consideration of ideas and practices from other sectors can be a valuable stimulus to new thinking, the introduction of ideas or practices which run against the basic principles of a system should be treated with extreme caution. If one accepts that values like communal and public good, care, equity, and trust are core to good educational practice, then the fact that they have been increasingly downplayed through the introduction of other — largely economic values, particularly those efficiency, effectiveness and private interest — should be a real cause for concern. Thus for example, Barber (1984) argued that core values of citizenship like the pursuit of community and public good have increasingly been replaced by ones of individual consumerism. In the process, the idea of education as based on a collective action for the public good has been replaced by the notion of individual and organizational competition for private gain (Grace, 1994). In the process, information has increasingly been seen not as an open process enabling public and community action, but more as a commodity to be used for individual and competitive advantage. In like manner, the concept

of trust has been used by Fukuyama (1996) to argue its value as a predictor of economic success, rather than as a foundational social and educational relationship attribute. As evidence continues to amass of the increasing wealth disparities over the last 20 years (Facer, 2011), it is clear that the priority of the equity of need has been supplanted by the priority of individual choice. If such key educational values are then subverted by the introduction of other values and practices, educational sustainability is very likely to be threatened.

## Reaching Crisis Point

Complex systems tend to be very resilient and capable of absorbing many kinds of stressors. However, when changes within a system occur very rapidly and/or very widely, actors within this system may not be capable of adapting sufficiently quickly. A crisis situation may then develop leading to system collapse, unless different attitudes and remediative actions are adopted. A recent environmental example is the growing concern that global temperatures may be changing too quickly for species to be able to adapt. The possibility of climate change which is rapid, unpredictable and extreme is now supported by archaeological evidence from the collapse of previous civilizations (Diamond, 2005), from pollen samples from ice core extractions (Kunzig & Broecker, 2008), and from fossil and geological evidence that rapid climate change has been a principal or contributory cause in all five previous great species extinction (Benton, 2003; Ward, 2008). A number of commentators (e.g., Intergovernmental Panel on Climate Change, 2007; Lynas, 2008; Stern, 2006; Wilson, 2003) all argued that a similar event may happen this century, and given the complex and interdependent nature of most natural environmental systems, if this were to happen, the extinction of single species could have enormous ramifications for entire ecosystems.

Actors in financial systems also find it hard to react sufficiently quickly to rapid change. Thus when banks get into financial difficulties, and if individuals are not quick enough in withdrawing their money,

they may suffer heavy financial losses. While this kind of event has clear parallels with that of natural systems, it is made more complex, as Wallace and Fertig (2007) pointed out, by the fact that human beings can anticipate and "frame" scenarios, and then adopt behavior to deal with these situations. While this ability may sometimes be an advantage, it can also have the unfortunate effect of producing the situation feared. For example, unfounded rumors about a bank's financial health may lead to a run on its reserves, and may produce the kind of self-fulfilling prophecy seen in the Northern Rock Bank crisis of 2007, when customers withdrew £1 billion in a single day on the basis of reports of the bank's inability to borrow money to repay other loans, even though, as Brummer (2009) argued, Northern Rock's problems appear to have been short-term and resolvable. Such financial panics generated by suspicions, hearsay, and unfounded rumors are well documented in investment markets as well, as rumors about the ill-health of a stock can provoke the selling of that stock, and irrespective of the truth of such rumors, make the suspicion a reality. When this happens, some actors may move rapidly enough to save their own position, but others less speedy may be ruined.

Similar parallel situations occur in education and lead to a lack of adaptive behavior by its actors. The effects of educational policies in many parts of the world over the last three decades on those working in education have been well documented above. These policies share a number of characteristics — a lack of trust and consultation of professionals, increased systematic and high-stakes testing, as well as a punitive accountability, all tending to lead to a compliance culture. Moreover, they tend to be framed within a policy climate which Bangs et al. (2011) described as "quick wins for political purposes" (p. 17) — the drive to produce results in sufficient time for the next election. Policy time frames generated by short-term political demands rather than educational requirements may leave insufficient time for proper conceptualization and to permit local modification (Fullan, 1991), or to synchronize with the personal survival systems built by those "street-level bureaucrats" (Lipsky, 1980) who work at the frontline of practice.

Such "fast" policies then are likely to be poorly framed, generate a more than usual amount of policy failure, and lead to increased stress and lowered morale of implementers, as these actors find it increasingly difficult to adapt their values and practices sufficiently quickly. System sustainability — in terms of both the adaptability of the actors in the system, as in the quality of policy impact — is threatened. It is significant and highly problematic that Gillian Shepherd, former English Secretary of State for Education, should say that "if the Conservatives had known they were going to be in [power] for eighteen years … the whole of the reforms would have been completely different" (cited in Bangs et al., 2011, p. 48). Even some of those forced to march to the election beat, then, seem to recognize the poor quality of policy this can generate.

Moreover, Merton (1952) pointed out over half a century ago that creating a compliance culture, impacted by the constant influx of policies, produces the very real danger that individuals will learn to do little more than conform, leading to a lack of reflection about the policy purposes, and of how one might thoughtfully adapt to present concerns and future dangers. The long-term effect then can be, as Lauder, Jamieson, and Wikeley (1998) argued, to create "a trained incapacity to think openly and critically about problems that will confront us in ten or twenty years' time" (p. 51) — a very good description of the danger of reaching a crisis point where actors are incapable of recognizing and adapting sufficiently quickly to potentially damaging change.

## What Can Education Learn From Such Comparisons?

The three systems considered share some of the same kinds of threats to their sustainability. They also exhibit similar symptoms when crisis points arise. Sharing similar characteristics as they do, the ability to learn from how each copes with such threats and crisis points would then be very useful. A first step in this process would be an examination of the changes needed to increase system sustainability. This article argued for six such changes. Educators must move:

1. From simplistic and linear understandings to ones based on complexity and non-linearity.
2. From seeing most problems as tame to seeing many as wicked.
3. From believing in your certainty to embracing provisionality.
4. From efficiency and consumption as the major criteria for resource usage to sufficiency as the major criterion.
5. From a conception of well-being based on resource consumption to one based on how well resources are nurtured and maintained.
6. From a reduced focus on short-term visions in education for short-term gains to the greater adoption of longer-term visions for the benefit of future generations

## *From Understanding Education as a Simple System With Simple and Linear Processes to One Based on Complexity and Non-linearity*

This article has argued that a number of systems are much more complex than normally recognized, containing as they do agents who not only interact with each other, but also with their environments. Such systems then can never fully predictable, with the actions of one agent very likely changing the contexts of others. Examples of this have been described for environmental ecosystems, where the impact of new species introduction is never entirely predictable; for financial systems, when the independent decisions of large numbers of individuals can bring down multinational institutions; and for education, where a proper understanding of the stresses and complexities of educational leadership involves recognizing the diversity of stakeholders and their values to which leaders must respond. A properly complex understanding of such educational work would then lead to programs of personal development less concerned with developing the skills and competencies needed to deliver particular policy packages, and more to do with acknowledging and helping leaders to accept the diversity of the job. Such knowledge and acceptance of a better conceptualization of the role would likely help develop the resilience needed to keep working in a role where some

problems may never be ultimately resolvable. Such an approach would not actually reduce the complexity of the job, but would likely help reduce the pressure through the lessening of a guilt which can attach itself to those who do not achieve what they are constantly told they can and should achieve.

## *From Seeing Most Problems as Tame to Seeing Many as Wicked*

When such complexity is not recognized, the result almost inevitably is the adoption of what Bore and Wright (2009) described as "tame" solutions to "tame" problems. Such "problems" tend to be easy to describe, and easy to understand, even as they under-describe the reality of the difficulty faced. The result of such tame interpretations of problems is likely to lead to the adoption of solutions with similar characteristics — neat, simple, linear, and short-term. So, for example, if success is defined as the performance of measurable behavioral demonstrations of competence, or the achievement of raw attainment scores, such a definition fails to understand the complex histories of causations, interactions, interests, personalities, and other events within particular contexts which are required to produce such demonstrations, such scores, and thereby radically under-describes the kinds of work that individuals may have had to put in to achieve these, and much worse, the work that individuals may have put in but which failed to reach the stipulated criteria because of events beyond their influence and control. These are, then, not "tame" problems at all, but rather complex, non-linear, long-term "wicked" issues, which need as much thought in their framing as problems, as are the similarly complex solutions needing to be sought. In sum, if a problem is under-described, the result is highly likely to be the long-term unsustainability of the solution, of the actors asked to achieve results, and therefore the unsustainability of the system itself.

Those working in education systems, then, particularly if they have worked in compliance regimes wedded to "tame" problems and

solutions, may well need help in distinguishing between these two types of problem, and of the dangers and consequences of adopting simplistic definitions. However, understanding that a problem is wicked, and then correctly adopting appropriately wicked solutions, will not guarantee success. Some wicked problems may never be ultimately amenable to any final solution, and this may be as frustrating in its own way as inappropriate tame definitions of problems and solutions. However such understanding and acceptance is essential if individuals are not to burn themselves out in striving for the unattainable. The recognition of the "wicked" then suggests that recognizing and accepting a lack of understanding may be a strength, for asserting certainty when there is none can be dangerous and damaging.

## *From Believing in Your Certainty to Embracing Provisionality*

So complex situations and problems may not always be fully understood: there will be times when what is known is no more than fragments of the problem, and also times when only in retrospect are the reasons for an event understood — and sometimes not even then. To paraphrase Rumsfeld (2002), there will be "known knowns" (things we know that we know), "known unknowns" (things we know that we don't know); but there will also be unknown unknowns (things we don't know that we don't know). Many decisions are made in situations of contextual complexity, by actors limited in their ability to know all the factors involved. This then needs to become the epistemological basis for one's view of what one can know. This was elegantly expressed by Popper (1959/1982, p. 111) when describing the empirical base of science, as he argued that there is nothing final or absolute about it, for science doesn't rest upon some "solid bedrock," but instead is rather like a building built on a "swamp" and piles are driven down into this swamp, not to provide any final foundation, but only until we are confident that these piles will "carry the structure, at least for the time being."

*At least for the time being* … this may then be our best attempt so far, but it needs to be accepted as being necessarily based upon only a

provisional judgment, and failure to adopt such an attitude puts pressure on professionals working in policy contexts where they are increasingly expected to solve problems which are not amenable to final solutions. A greater embrace of provisionality may then make educational practice more sustainable. By removing from them the requirement of having to be the undisputed expert, of having to provide definitive solutions when no finality may be achievable, it prevents the temptation to assign an impossible finality. It may in the process create more sustainable systems by limiting the tendency of external inspection systems of punishing the innocent.

## *From Efficiency and Consumption as the Major Criteria for Educational Resource Usage to Sufficiency as the Major Criterion*

Such certainty of judgments has historically been accomplished by a failure to recognize human impact on the planet. Boulding (1968/1989) described how the human race has historically indulged in what he calls a "cowboy" approach to economic practice, which assumes an inexhaustible supply of resources for human beings to consume, and always enough new land to leave any pollution behind. Such an attitude might have been understandable when the global population was small, but humanity now lives on a spaceship world, "crew" of a world with exhaustible resources, where:

> the measure of well-being is not how fast the crew is able to consume its limited stores, but rather how effective the crew members are in maintaining their shared resource stocks, and the life-support system on which they all depend. (Boulding, 1968/1989, p. 136)

Commentators like Meadows et al. (2004) and the World Wildlife Fund (2008) argued that humanity has been in unsustainable territory since the 1980s, and Princen (2005) therefore suggested the need for a greater embrace of what he calls an "imperative" concept of sufficiency, where the prevention of damage to a system takes higher priority than

the need to extract its resources. This position is underpinned by three different kinds of arguments, all of which transfer well to education.

A first is *epistemological*, in that if we are unable to fully predict the long-term consequences of our actions, then any resource extraction needs to be treated with caution, for as the Rio Declaration (1992) suggested in its precautionary principle: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (cited in Garvey, 2008, p. 97).

In the financial world, this is also the point of the Basel rules — to ensure there is sufficient reserve capital to guard against defaulting loans. Finally, in education, the mounting educational evidence on individual and system stressors described above could reasonably be interpreted as excessive demand on the human resource, damaging not only to the sustainability of those within the system, but to the system itself. A similar educational precautionary principle might therefore be considered — one which argued that if there is danger of serious damage to those in the system from excessively fast or over-demanding policies, then lack of certainty as to the extent of such damage should not be a reason for failing to take measures to prevent further damage.

However, this also points to a problem so far unresolved. The environmental literature is well grounded in the list of criteria by which a system would be classed as being in an unsustainable state (see, e.g., Walker & Salt, 2006). Similarly, and particularly after the latest financial meltdown, most financial writers could supply a similar list. Yet in education there is a lack of consensus. This stems in part from the differences in opinion over what is valued and what is thought of as bearable. Perhaps more importantly though there is no agreed list of criteria for unsustainability and how the evidence from such a list would be interpreted. Until this happens, an educational precautionary principle is likely to have limited support.

A second *practical* argument for a position of imperative sufficiency follows from the first, but clearly suffers similar limitations.

This argues that if there is a genuine threat to systemic stability, then an imperative version of sufficiency is the only sensible stance to take. Educationally, this would argue that when there was sufficiently strong evidence that the demands made on its "human resources" were so onerous that both they and overall system stability was threatened, then the adoption of an imperative version would be a sensible, practical move.

Finally, there are strong *ethical* reasons for adopting an imperative version. One argument here suggests that the natural environment is not simply a means to the end of human consumption; there is a strong tradition of *ethical* argument (see Singer, 2006) that other species have rights to existence irrespective of their usefulness to human beings; an imperative version of sufficiency is therefore brought into force simply by their existence and their needs. However, even if one were to reject the rights of other species, consideration would still need to be given to the notion of intra-generational equality — access to resources by people of different levels of wealth, and from different parts of the world (Chang, 2008); and some would argue (see Partridge, 2003) that one also needs to consider *inter*-generational equality — the resource access needed by future generations. The consideration of the rights of other species, the fairer distribution of resources currently, and the saving of resources for future generations' needs, together make a strong trio of arguments for a much more precautionary attitude to current resources.

Such arguments can also be deployed educationally, in that it can be argued that education is not simply a matter of economic supply and demand, where government and/or consumers decide on what is needed, and trained human resources supply those needs. An ethical, and inherently educational, position would instead argue that educators should be viewed as resourceful humans engaged in a meeting and development of minds, and there should be as much concern for them as for their students. They then have worth and value in their own right, and an imperative version of sufficiency in education would better recognize such existences and needs.

### *From a Conception of Well-being Based on Resource Consumption to One Based on How Well Resources Are Nurtured and Maintained*

Such a notion of sufficiency also suggests that human well-being should be measured, not by how fast resources can be consumed, but by how well they are nurtured and maintained. Such a change would have major effects upon societal and educational views, for it suggests the need for a major change in what is currently regarded as the principal source of well-being — the ability to consume. As Princen (2005) put it, the attitude tends to be that "goods are good, so more goods are better" (p. 24). However, while a degree of consumption will always be essential for physical well-being, there is now a strong literature showing that consumption satisfies only up to a certain point, and that while the GDP of countries like the U.S. and the U.K. has risen consistently since the 1950s, other measures like the General Progress Indicator (GPI) have remained static or actually fallen (Bok, 2010; Haidt, 2006; Hamilton, 2004; Layard, 2006). Beyond a certain point, then, consumption does not produce better overall well-being. Instead, writers like Seligman (2011), Diener and Biswas-Diener (2008) and Layard (2006), all suggested that a sense of genuine long-term well-being comes from very different factors, like the satisfaction derived from striving for personally fulfilling accomplishments, the nurturing of engaging and meaningful relationships, and physical and mental health. The message seems clear: individuals (and their societies) would likely be healthier and more fulfilled if instead of seeking to increase economic growth and consumption, they spent more time nourishing their social connectedness. Perhaps as importantly it also suggests that reducing one's material standard of living is *not* necessarily a prescription for poverty, but a call to reassess what kind of resources are ultimately needed to nurture the relationships and the living space upon which humanity ultimately depends.

### *From a Reduced Focus on Short-term Visions in Education for Short-term Gains to the Greater Adoption of Longer-term Visions for the Benefit of Future Generations*

Such changes in perception lead necessarily to changes in perceptions of time scale. When the dominant societal motif is consumption, and normally immediate consumption financed by credit, societal focus will inevitably be on the short term. A focus on resource maintenance, however, requires a review of the current condition of these resources, but perhaps more importantly projections of their likely condition in the future. This is perhaps the seminal point of the most quoted definition of sustainable development, that from the Brundtland report which argued that sustainability is achieved when meeting "the needs of the present without compromising the ability of future generations to meet their needs" (World Commission On Environment and Development, 1987, "From One Earth to One World," para. 27).

Such future focus is also picked up in the discourse on educational sustainability (most notably in the form of leadership sustainability). Derived from the earlier environmental discourse, writers like Hargreaves and Fink (2006) argued that "educational reform in recent years has sacrificed depth of learning to the achievement of standardised testing," and that this has prevented the ability "to plan for a more sustainable future" (p. 694). The future focus also picks up Lauder et al.'s (1998) concern that a vigorous pursuit of a compliance and accountability culture can lead to practitioners developing a "trained incapacity" to critically consider future challenges, in education and in the wider society.

In an age when global resources currently need to supply the needs of 7 billion people, but will probably need to supply 10 billion by mid-century, the need to think of not only intra-generational equality but also inter-generational equality requires educators to facilitate views of society, population, resources and the environment which recognize as perhaps never before, that those in the present need to consider the needs of those yet to be born.

## Conclusions

When the resources of a system are overused, or when damaging values, practices or materials are introduced, it is unsurprising if those within the system find it hard to function. A crisis point may then be reached where unless different attitudes and remediative actions are taken, those within the system may not be able to cope. When educators have to respond to fast policies, and are expected to deliver on problems which are not capable of swift and simple solution, they may find themselves unable to address in a sustainable way the complexities of situations to the degree demanded by the nature of the challenge. Where insufficient time is available to take an overview position and reflect on the deeper and longer-term effects of such stressors, the likelihood of such stressors leading to breaking point is strengthened.

This article has suggested that one area of remediation lies in the need for a greater appreciation of the complexity of many problems and their solutions, and through this the appreciation of the potentially damaging adoption of "tame" rather than "wicked" solutions. A second area of remediation lies in the replacement of a culture built on the fast and unsustainable consumption of its resources with the recognition of the need for a greater degree of sufficiency and resource maintenance. Both approaches help address issues of environmental, financial, and educational sustainability, and raise fundamental questions about the nature of personal and societal well-being.

Finally, this article urges for educational policies and practices which go deeper, wider and further than most currently in enhancing sustainability. They need to be deeper in terms of our understanding of the complex nature of the world we live in. They need to be wider in terms of what they imply for the wider society beyond education. Also, they need to go further in thinking beyond the needs of present generations to consider the needs of those in the future. As the Buddhist saying goes: we have not inherited the world from our ancestors; we have borrowed it from our children. In what condition will we return it?

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