

Higher Education for a Sustainable World

Dr John Blewitt
Director of Lifelong Learning
Aston University

Abstract

Purpose: This article explores the nature and purpose of higher education in the 21st century focussing on how it can help fashion a green knowledge based economy by developing approaches to learning and teaching that are social, networked and ecologically sensitive.

Design/methodology/approach: a discursive analysis of the skills and knowledge requirements of an emerging green knowledge based economy using a range of policy focussed and academic research literature

Findings: The business opportunities that are emerging as a more sustainable world is developed requires the knowledge and skills that can capture and move then forward but in a complex and uncertain worlds learning needs to non linear, creative and emergent.

Practical implications: Sustainable learning and the attributes graduates will need to exhibit are prefigured in the activities and learning characterising the work and play facilitated by new media technologies.

Social implications : greater emphasis is required in higher learning understood as the capability to learn, adapt and direct sustainable change requires interprofessional co-operation that must utilise the potential of new media technologies to enhance social learning and collective intelligence

Originality/value: the practical relationship between low carbon economic development, social sustainability and higher education learning is based on both normative criteria and actual and emerging projections in economic, technological and skills needs

Keywords: sustainability, skills, economy, learning, new media

Classification: general review

Introduction

For some years Higher Education has been refashioned in the image of business with a growing emphasis on knowledge exchange, knowledge innovation, knowledge transfer and partnership working with the private sector on a range of initiatives designed to stimulate economic development and, in the last year or so, green growth (Damaud, 2001; OECD, 2009). Partnerships, professional networks, education and training are some major vehicles for this development as the OECD has recently stated (2009, p.29):

‘Education and training programmes are essential for developing the human capital needed to deliver eco-innovative solutions and create a potential labour force for “green jobs”. A number of countries have taken measures to mainstream environmental education in the school curricula or vocational training. A few countries have also started to focus on creating specific skills and a knowledgeable workforce for emerging environmental industries’.

Universities are, and have been, significant drivers of regional economic development (Premus, Sanders and Jain, 2003; Woollard, 2007; Drucker & Goldstein 2007) although some academic staff within the new corporate or entrepreneurial university are finding it difficult to adjust. This is sometimes because of deep seated philosophical objections or even anti business prejudice but often it is due to the prospect of working outside established comfort zones (Martinelli, 2008). However, as Abreu et al (2009) have demonstrated engineers and material scientists seem more at ease with HE working closely with and serving the needs of the economy than those working in the Arts and Humanities. 40% of all academics are currently interacting with the private sector. The percentage of engineering academics is around 75%, Social Scientists 40%, and Arts and Humanities staff around 30%.

For some critics the sale of knowledge production is undermining the university's historical purpose of fashioning a civilised society where social needs should take priority over individual or vulgar commercial ones. The university of the 21st century seems to be increasingly adapting itself to a 'user-pays' type student, or 'customer', where increased competition between organisations, academic staff and students runs parallel with the need to co-operate, collaborate and network. Indeed, it could be argued that a new institutional meritocracy is emerging. As the knowledge economy becomes a reality quality assurance and other regulatory procedures are both monitoring and benchmarking academic standards while facilitating a status distinction between the research intensive and teacher led, the selective and the recruiting, and the private and public university (although the latter has yet to properly develop in the UK). In addition, HE responsiveness to new economic and environmental, low carbon, imperatives is certainly encouraging a need for flexibility and adaptability, new multi disciplinary and transdisciplinary research approaches and new pedagogies that embrace the affordances of new media/new learning ecologies. Thus Denham (2005, p.25) concludes that the challenges facing the 21st century university are basically fourfold, namely:

- Being everything to everybody.
- Sacrificing academic freedom.
- Reinventing itself continually in a continuing state of institutional anxiety.
- Losing sight of the traditional knowledge for knowledge sake rationale.

The UK Government is, however, quite unmoved. Its *Higher Ambitions* proposals (BIS, 2009, p.2) all relate to a utilitarian and still largely economic worldview:

'In a knowledge economy, universities are the most important mechanism we have for generating and preserving, disseminating, and transforming knowledge into wider social and economic benefits'.

The Green Knowledge Society

If knowledge has traditionally been the business of education, it is quite also quite clearly the business of business. Nico Stehr has written extensively about knowledge and the emergence of knowledge societies. For Stehr (2002, p.43), knowledge is a 'capacity for action' and comes in three forms: meaningful knowledge affecting mainly the social consciousness of members of society; productive knowledge such as scientific work

converted into ways of directly appropriating natural phenomena; and, action knowledge in which knowledge is an immediate productive force. Information can lead to knowledge but information travels more easily and is less likely to be situated or restricted to specific groups, individuals or organisations meaning that the acquisition of knowledge is decidedly complex. Stehr (2002, p.62) writes:

‘The ‘transfer’ of knowledge is part of a learning and discovery process that is not necessarily confined to individual learning. Knowledge is not a reliable ‘commodity’. It tends to be fragile and demanding, and it has built-in insecurities’.

Formal education and training is extremely important but learning takes place in a variety of settings and spaces involving a broad compass of emotional and cognitive experiences that occur throughout life. Climate change too is both an economic and an emotional imperative and is beginning to shape skills development, skills demand and skills requirements in a belated attempt to grapple with the destructiveness of our culture’s unsustainable practices. Environmental technologies, bioscience and green energy have been identified by Government departments, labour organisations and think tanks as necessary for the environmental sustainability of future areas of economic growth and regeneration (BERR, 2009; TUC, 2009). Selwyn and Levett (2006) of the UK Centre for Economic and Environmental Development have forecast that the UK market for environmental goods and services will grow from £25 billion in 2005 to £34 billion in 2010 (42% growth from 2005) and conceivably to £46 billion by 2015. A report by EEF, the manufacturer’s organisation, and the consultancy Deloitte (2008) noted that businesses have much to do if they are to realise the commercial opportunities being presented by an emerging low-carbon economy. Business needs to be creative in thinking about and developing new products and markets. Some are already there. IBM offers an energy-management service to data centre clients who want to reduce energy costs and Xerox’s Managed Print Services helps clients to optimise energy use and reduce printing costs. Through its Fleet Solutions programme, Michelin provides tyre-maintenance services according to kilometres driven. Manufacturers must not neglect the service opportunities associated with the low-carbon economy particularly given the contribution that services can make to profitability and the general tendency for manufacturing, services and knowledge to morph into one another (Brinkley, 2008; 2009).

Consequently, money is to be made from protecting rather than trashing the environment and many new technologies and technical skills, including those related to ICT, are beginning to rehumanise workforce development after decades of ‘Fordist’ work practices. New learning and development, pivotal in a green knowledge economy, requires a considerable degree of participation and engagement, autonomy and trust, co-operation and collaboration between professions, trades, academic disciplines and various communities of practice. The dematerialisation of the economy has been apparent for some time as knowledge workers have replaced more traditional occupations (Wernick et al, 1996). Knowledge has also loosened the bonds between the material dependence of an individual and his/her occupational status or occupational role leading to a relative emancipation from the labour market. After all, many people do seem to be re-evaluating what for them constitutes personal and household wealth, social well-being and meaning. Further afield, Paul Hawken, Amory and Hunter Lovins (1999), Bill McKibben (2007), Lester Brown (2006) and others have argued dematerialisation and immaterialisation can enhance the lifestyles and well-being of those living in the wealthy countries without being detrimental to the social and economic development of other nations. Immaterialisation leads to the replacement of material things we once valued with immaterial ones - social relationships, friendship networks, information services and so on. New media and other

smart technologies are instrumental in promoting a green, knowledge based economy (GeSI, 2008; SCF Associates, 2009) and although job creation in hi tech areas will not compensate for job losses in the old industrial sectors, our future economic dependence on green knowledge is clear as economic growth and full employment long predicated on cheap and abundant fossil fuels, a stable climate and abundant and inexhaustible natural resources depletion, is not an option. New thinking, new learning and new business models urgently have to be made real and put into practice.

Two recent reports have outlined how 'a green new deal' could create prosperity without growth placing significant demands on formal education and lifelong learning to serve eco-system needs rather than conventional economic growth and productivity. The Green New Deal Group (2008, p.38-39) writes:

'There will be a need for a training, education, research and development programme for the 'carbon army' of workers needed to bring about a low-carbon future. To reduce carbon dramatically will require expertise ranging from energy analysis, design and production of hi-tech renewable alternatives, large-scale engineering projects such as combined heat and power, and offshore wind at the high skilled end; through to medium and unskilled work making every building energy tight, and fitting more efficient energy systems in homes, offices and factories'.

Tim Jackson, Economics Commissioner with the UK Sustainable Development Commission, goes further (Jackson, 2009). Growth, he writes, was once the dynamo of industrialisation but growth has been the ultimate cause of the recent credit crunch and economic downturn. Although some economists argue that growth can continue if we become more resource efficient this would be to conflate the *relative* with the *absolute* decoupling of the economy from processes of material consumption. For example, global carbon intensity has fallen from one kilo per dollar of economic activity to just under 770 grams per dollar but there is little evidence that the global economy has witnessed a reduction in resource throughput. The world is using more energy and producing more 'stuff'. With the global population rising and with social aspirations following suit, the need to stabilise and drastically reduce carbon emissions to limit global temperature rise and arrest resource depletion is obvious but, for this to occur, Jackson estimates that by 2050 global carbon intensity must be around 6 grams per dollar of economic output, that is, 130 times lower than it is today.

Education for Sustainable Development

A new gradueness as well as a new approach to university education is therefore required. The International Association of Universities (IAU, 2006) acknowledge that universities have not been producing graduates with the skills, motivation and knowledge necessary to promote sustainability. Despite some considerable advances in Education for Sustainable Development (ESD) in various places there has been no curriculum mainstreaming of sustainability as there has been with equal opportunities. This is partly due to a lack of knowledge and to some extent a suspicion that sustainability and, its sister concept sustainable development, are inexact, unscientific and too controversial to be operationalised effectively. The theory and practice ESD is not always easy to grasp. It relates to the social, economic, cultural, ethical and spiritual dimensions, will differ according to time, place and culture and, in curriculum terms, invites a transdisciplinary, systemic and holistic approach that addresses value, attitudinal, affective, skill and knowledge development. Wals and Jickling (2002, p.228-229) write,

‘Integrating aspects of sustainability cannot be realized without thinking very critically about the re-structuring of didactical arrangements. This re-orientation requires ample opportunity for staff members and students to embark on new ways of teaching and learning. For this to happen they have to be given the opportunity to re-learn their way of teaching and learning and to re-think and to re-shape their mutual relationships. These new didactical arrangements pre-suppose a problem orientation, experiential learning and lifelong learning’.

Helpfully, as part of the Decade for Education for Sustainable Development which we are now over half way through, UNESCO (2005) has identified a number of key ESD characteristics. ESD:

- is based on the principles and values that underlie sustainable development.
- deals with the well-being of all three realms of sustainability – environment, society, and economy.
- promotes life-long learning.
- is *locally relevant* and *culturally appropriate*.
- is based on local needs, perceptions, and conditions, but acknowledges that fulfilling local needs often has international effects and consequences.
- engages formal, non-formal, and informal education.
- accommodates the evolving nature of the concept of sustainability.
- addresses content, context, global issues, and local priorities.
- builds civil capacity for community-based decision-making, social tolerance, environmental stewardship, adaptable workforce, and quality of life.
- is interdisciplinary. No one discipline can claim ESD for its own, but all disciplines can contribute to ESD.
- uses a variety of pedagogical techniques that promote participatory learning and higher-order thinking skills.

David Selby (2007) stresses the urgency of our global predicament seeing the role of higher education as needing to prepare us for contraction. Climate change, excessive resource use and overpopulation requires formal and informal education to help nurture alternative and localised conceptions of the ‘good life’ together with more holistic ways of mediating and interpreting reality. Learning in higher education needs a keener appreciation of complexity such as the multiple ramifications and reverberations of human action. Selby also recognises the inherent complacency or lack of engagement in the view that the academy exists only for disinterested contemplation and reflection. Higher education certainly needs to offer learners this space but overall the sector needs to do more than monitor the demise of yet another human civilization. Higher Education must

therefore be focussed on more than simply delivering employability or servicing the business as usual economy. It must encompass: a civil component – community engagement going beyond encouraging student and staff volunteering; a political component – skills of decision making, leadership, conflict negotiation and values/moral education; and, our rights and obligations to other people, other species and the planet as a whole. It needs to be more ecocentric. Graduates need to prioritise actions, balance environmental social and economic costs and benefits, understand the needs and perspectives of others and, through both a generic understanding of sustainability and through their own disciplinary knowledge and expertise, be able to work in an inter-professional and intercultural manner. For Clugston and Calder (1999), one way of developing a sustainability curriculum in higher education is to develop learning around the key concepts of sustainability rather than a set of concepts located within each traditional disciplinary area. This needs to be married to a transdisciplinarity and Mode 2 knowledge (Gibbons et al,1993) which, as Harloe & Perry (2005) discuss, is key to higher education successfully engaging with a diverse range of intellectual, economic and social interests where both knowledge creation activities and research findings are disseminated interactively, in real and virtual time, and where research groups are networked globally with participants from a range of public, private and third sector institutions.

Mode 2 knowledge generation and sustainable development also requires a reflexive approach to evaluating the purpose, effectiveness and value of research practice. It means that peer review is likely to take second place to a much broader constituency of knowledge creators and evaluators enabling collective knowledge and collective intelligence to emerge and culturally take root. The old academic silos, professional demarcation lines and disciplinary mentalities are already blurring and in some cases disappearing. A practical example of this can be found in the field of eco innovation and sustainable manufacturing. The OECD (2009) have noted that although many eco innovations rely largely on technological developments and advancements, the intervention of inter-sectoral research and multi stakeholder networks have been extremely important in stimulating technological change and systemic innovations within many business organisations. In the context of building a more sustainable society and a greener, low carbon enterprise economy, new productive relationships need to be formed and a new knowledge and understanding, with a capacity to synthesise and extrapolate as well as focus tightly, needs to be nurtured in those learning organisations that call themselves universities. Indeed, in many ways, knowledge and understanding is far more important than the relentless and exponential increase in data and information and its dissemination. It needs to be made sense of and that is sometimes too clearly lacking as the academic and political adventures within climate science have recently demonstrated.

In the less glamorous sphere of technical and vocational education and training (TVET) many countries have for too long considered the supply of skilled labour to industry with its main purpose to boost productivity and facilitate economic growth, irrespective of the environmental consequences, as its core rationale. The needs of learners and the ecosystems have been subordinated to those of industry. Employer led training prioritises skill development relevant to the firm or sector rather than general employability or more social and personal learning and development. This means that TVET may produce “work ready” people who may not have the capabilities necessary for working in a world that is rapidly changing, uncertain, interconnected and ecologically precarious. TVET tends to be about the now. It looks towards the future by peering in to the rear view mirror. However, as Fien and Wilson (2005) point out, there are many possible ways in which TVET can be reorientated towards sustainability and global citizenship. These might include:

- Competencies in economic literacy, sustainable consumption and eco-enterprise.
- The minimizing waste and pollution in production processes.
- The application of traditional skills and the development of new ones to accommodate the demands of new environmental technologies, eco business development, sustainable construction, sustainable agriculture agriculture, etc.
- Generic understanding of key sustainable concepts, principles and values.
- Operationalising an ethic of social and eco-responsibility in business managers and in the actions of technical employees.
- the development of team and group skills, the ability to explain, justify and negotiate ideas and plans, and the promotion of practical citizenship in the wider community.
- Facility with smart technologies.

As Fien and Wilson (2005, p.279) write:

‘...there can be no long-term economic growth on a planet depleted of natural resources, too infertile to support the production of the plant and animal products upon which people and industry depend, and too polluted for humans to enjoy a healthy and productive life’.

Sustainability, Social Learning and the Age of *We-Think*

It is important too that as current younger learners have been ‘born digital’ the sustainability, learning and knowledge creation affordance of new media/learning technologies are recognised and properly shaped. New Media offers superb opportunities for networked learning, the development of collective knowledge, the nurturing of collective intelligence and the emergence of various modes of social learning. Charles Leadbeater (2009) has referred to this as ‘We-Think’ and Pierre Levy (1997) has discussed how these technologies and these different modes of thinking and doing are reshaping our culture. It is quite feasible that today’s tried and tested pedagogical approaches, common in today’s formal education institutions, will be overtaken by the dominance of social learning facilitated by, and within, new networks and resembling, to some extent, the webs of learning envisaged by Ivan Illich (1972) nearly forty years ago. The implications of these learning webs for sustainable development is that learning will be something that is not so much subjected to a metric of quantifiable targets, enclosed by a matrix of modules anticipating vertical linear progression, but rather a learning that itself fashions new relational structures between HEIs, professional bodies, private corporations, think tanks, third sector groups, individual learners and so on. For Wals, der Hoeven and Blanken (2009, p.10) an important vehicle for sustainable development is a social learning that is both highly practical and capable of handling ‘complex challenges in ways we can look for a meaning that we can all relate to meaningfully, and which consider the integrity and interests of other species and entire ecosystems’.

The effectiveness of social learning depends on social context and how it occurs. An important aspect of success is creativity in multi modal expression in a free and enabling

environment. This may mean, and in many cases certainly will mean, that it will difficult or even inappropriate to determine learning outcomes in advance. Social learning is often characterized by a high degree of dynamic uncertainty. There may be all manner of unanticipated spin offs that a rigid structure to, and organization of, learning could prevent. Much will therefore depend on the cultural, emotional and indeed physical or virtual spaces in which social learning is conducted. Wals, der Hoeven and Blanken conclude (2009, p.28):

‘These questions do make clear however that learning in the context of sustainability is an open-ended and transformative process that needs to be grounded in the everyday worlds and lives of people and the encounters they have with each one another. It is these ‘encounters’ that provide possibilities or opportunities for meaningful learning as they can lead both to (constructive) dissonance and increased social cohesion. The value of ‘difference’ and ‘diversity’ in energizing people, creating dissonance and unleashing creativity has been repeatedly mentioned in this booklet as has the power of ‘social cohesion’ and ‘social capital’ in creating change, and building resilience, in complex situations characterised by varying degrees of uncertainty’.

All this is taking place in a social environment that is becoming increasingly connected. New media technologies and the participatory and interactive activities that they afford are social learning environments. Leadbeater’s *We-Think* world of online sharing, co-operation and self organisation has already impacted on some corporate organisations and not just the ‘funky’ ones such as Google but in less fashionable enterprises. There is an echo here of earlier developments around self organising teams and the individualised corporation (Goshal and Bartlett, 1999). On line learning and particularly the utilisation of its immersive and non linear affordances requires a rethink of what learning is, of what the HE experience is all about and how in fashioning a low carbon green economy and dematerialising our productive processes we replace the wasteful consumerist lifestyles that are currently synonymous with status, success, progress and modernity with one that is immaterial and ecologically harmonious with the planet’s ecosystems. New media is potentially a key aid to both dematerialisation and immaterialisation. Academics, students, lifelong learners and others engaged in learning and development, which means all of us, have a lot of necessary changes to produce and to navigate. Savin-Baden (2008, p.158) concludes her review of the literature on learning in immersive worlds with these highly pertinent thoughts which have a wider relevance to the future of higher education learning:

Immersive virtual worlds offer different textualities that are increasingly ushering in new issues and concerns, such as consensus over authority and process over product. Indeed, what also seems to be emerging from immersive virtual worlds is not just different textualities, but the spatialisation of knowledge, whereby knowledge is multiply located and linked, reconstituted and contested across time and space. In immersive virtual worlds temporality and spatiality become not just contested but dynamic and intersected by one another. Maybe what is needed is the creation not of universities but ruins, to create borderless spaces, much as the University of Bologna once was.

De Freitas et al (2010) have argued that significant benefits and possibilities are already apparent in the application of new media technologies to higher learning. For instance,

learners are positive about using new media tools to support international collaboration, distributed learning communities and the networking of those with shared interests. New media tools have potential applications for mentoring activities with people who do not live or work in the same place. Virtual worlds are already being used to support collaborative work with real world applications such as developing a marketing strategy or extending the possibilities of audio-graphic conferencing that could both aid learning and improve completion rates. Immersive and online learning, including video conferencing, works extremely well with distance learners and in our increasingly 'wired' world is becoming part of the cultural fabric implicit in many forms of continuing professional development, business practice and in everyday life. Indeed, for the game designer Will Wright, inventor of the SIMS, there is much to be learned from the plugged in leisure activities that some conservative cultural critics denigrate. For Sims designer Will Wright (2006), the gamer approaches the world as a place for creation, community, problem solving and self-esteem rather than consumption. All of these will enable an in some way prefigure a more sustainable world and a more sustainable university education./

Conclusion

Lifelong learning and formal higher education are therefore likely to become far more fluid and "funky" and if they are to be fit for purpose in a greener knowledge based economy they will need to adapt to and adopt many of practices already evident in other areas. If they do and if graduates leave universities with a complex of attributes that are underpinned by ecocentric and sustainable values then higher education will not only being doing its job for industry it will have reinscribed its moral purpose in a world that has already entered an ecologically critical phase that endangers a great deal which makes life worth living. Future graduates will need a generic understanding of sustainability to complement their specialist, disciplinary, knowledge and skills but there is also an undoubted need for sustainability generalists who can communicate with and facilitate inter professional and transdisciplinary working. In other words, all graduates will need to exhibit an "active engagement with environmental and sustainability issues" as is found on Essex University's list of graduate attributes. And this attribute will undoubtedly have to deal with the unknowns for the clear fact is that the development of a green economy, a sustainable and just society is something that cannot be precisely action-planned. It will emerge over time as a result of what we do, what we know, what we discover and invent. The means we adopt will be constitutive of the ends and each means is in effect a small end itself, a step on the way. The existing managerialist culture which is so encumbered by targets, outcomes and actions cannot adapt easily to a more fluid, pragmatic, approach more suited to fast changing technologies, knowledge and risks that maybe readily apparent or only vaguely understood. Learning outcomes must be expressive rather than tightly delineated or "intended". Changing times, changing climates, changing economies, changing environments and changing cultures do not make for the predictability that business, governments and for that matter the rest of us feel most comfortable with. A graduate attribute is needed that suggests in a changing world individuals and groups should learn not only to accommodate changes but enjoy them, go with them and in so doing shape them according to values and principles that ensure we do not live beyond our ecological means or beyond the sense that we are just one of a number of other creatures inhabiting this planet.

References

- Abreu, M., Grinevich, V., Hughes, A. and Kitson, M. (2009), *Knowledge Exchange Between Academics and the Business, Public and Third Sectors*, Centre for Business Research, University of Cambridge, Cambridge.
- BERR (2009), *New Industry, New Jobs*, TSO, London.
- BIS (2009), *Higher Ambitions: the future of universities in a knowledge economy*, TSO, London.
- Brinkley, I. (2008), *Knowledge Economy and Enterprise*, Work Foundation, London.
- Brinkley, I. (2009), *Manufacturing and the Knowledge Economy*, Work Foundation, London.
- Brown, L.R. (2006), *Plan B 2.0: rescuing a planet under stress and a civilization in trouble*. Norton, New York.
- Clugston, R.M. and Calder, W. (1999), "Critical dimensions of sustainability in Higher Education" in Filho, W.L. Ed. *Sustainability and University Life*, Peter Lang, Frankfurt am Main.
- Damaud, P. (2001), Enterprise Culture and University Culture, *Higher Education Management and Policy*, Vol. 13, No. 2, pp.67-74.
- de Freitas, S., Rebolledo-Mendez, G. Liarokapis, F., Magoulas, G & Poulouvassilis, A. (2010), Learning as immersive experiences: Using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world, *British Journal of Educational Technology*, Vol. 41, No 1, pp.69–85.
- Denman, B. (2005), What is a University in the 21st Century? *Higher Education Management and Policy*, Vol. 17, No.2, pp.9-28.
- Drucker, J. & Goldstein, H. (2007), Assessing the Regional Economic Development Impacts of Universities: A Review of Current Approaches, *International Regional Science Review*, Vol. 30, No. 1, pp.20-46.
- EEF/Deloitte (2008), *Delivering the low-carbon economy –Business opportunities for UK manufacturers*, London, EEF. available at: <http://www.eef.org.uk/NR/rdonlyres/37DAE973-8472-44CC-AC33-C29759166610/12506/Deliveringthelowcarboney1.pdf> (accessed 18.3.10)
- Etzkowitz, H., & Leydesdorff, L., (Eds.) (1997), *Universities in the global knowledge economy: A Triple Helix of university-industry-government relations*, Pinter, London.
- Etzkowitz, H., & Leydesdorff, L. (2000), The Dynamics of Innovation: From national systems and 'Mode 2' to a Triple Helix of university-industry-government relations, *Research Policy*, Vol. 29, No.2, pp.109-123.
- Fien J. & Wilson, D. (2005) Promoting Sustainable Development in TVET: the Bonn Declaration, *Prospects*, Vol. 35, No. 3, pp. 273-288.

- GeSI (2008), *SMART 2020: enabling the low carbon economy in the information age*. available at: <http://www.gesi.org/LinkClick.aspx?fileticket=tbp5WRTHUoY%3D&tabid> (accessed 18.3.10)
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994), *The new production of knowledge: The dynamics of science and research in contemporary societies*, Sage Publications, London.
- Ghosal, S. & Bartlett, C. A. (1999), *The Individualized Corporation*, William Heinemann, London.
- Green New Deal Group (2008) *A Green New Deal*. New Economics Foundation, London.
- Harloe, M. & Perry, B. (2005), Rethinking or Hollowing out the University? External Engagement and Internal Transformation in the Knowledge Economy, *Higher Education Management and Policy*, Vol.17, No. 2, pp. 157-306.
- Hawken, P. Lovins, A.B. & Lovins L.H. (1999), *Natural Capitalism: The Next Industrial Revolution*, Earthscan, London.
- Illich, I. (1972) *Deschooling Society*, Penguin, London.
- International Association of Universities (2006), *IAU Conference: Education for a Sustainable Future. Conference General Report*. Available at: http://www.iauiau.net/sd/sd_confprague.html (accessed 18.3.10)
- Jackson, T. (2009), *Prosperity Without Growth: the transition to a sustainable economy*, Sustainable Development Commission, London.
- Leadbeater, C. (2009), *We-Think: mass innovation, not mass production*, Profile Books, London.
- Levy, P. (1997), *Collective Intelligence: Mankind's Emerging World in Cyberspace*, Basic Books, New York.
- McKibben, B. (2007), *Deep Economy: The Wealth of Communities and the Durable Future*, Times Books, New York.
- Martinelli, A., Meyer, M. & von Tunzelmann, N. (2008), Becoming an entrepreneurial university? A case study of knowledge exchange relationships and faculty attitudes in a medium-sized, research-oriented university. *Journal of Technology Transfer*, Vol. 33, No.3, pp.259–283.
- OECD (2009), *Sustainable Manufacturing and Eco-Innovation: framework, practices and management*. Available at: <http://www.oecd.org/dataoecd/15/58/43423689.pdf> (accessed 18.3.10)
- Presmus, R., Sanders, N. & Jain, R.K. (2003), Role of the university in regional economic development: the US experience, *International Journal of Technology Transfer and Commercialisation*, Vol.2, No.4, pp. 369-383.

Savin-Baden, M. (2008), From cognitive capability to social reform? Shifting perceptions of learning in immersive virtual worlds, *ALT-J*, Vol.16, No.3, pp.151-161.

SCF Associates (2009), *A Green Knowledge Society: An ICT policy agenda to 2015 for Europe's future knowledge society*. Available at: http://ec.europa.eu/information_society/eeurope/i2010/greenknowledgesociety.pdf (accessed 18.3.10)

Selby, D. (2007), As the heating happens: education for sustainable development or education for sustainable contraction? *International Journal of Innovation and Sustainable Development*, Vol. 2, Nos. 2/3, pp. 249–267.

Selwyn, J. & Leveret, B. (2006), *Emerging Markets in the Environmental Industries Sector*, DTI/TSO, London.

Stehr, N. (2002), *Knowledge and Economic Conduct: the social foundations of the modern economy*, University of Toronto Press, Toronto.

TUC/Impetus Consulting Ltd (2009), *Unlocking Green Enterprise: a low carbon strategy for the UK Economy*. TUC, London.

UNESCO (2005), *United Nations Decade of Education for Sustainable Development (2005-2014)*, UNESCO, Paris. Available at: <http://unesdoc.unesco.org/images/0014/001486/148654e.pdf> (accessed 1.3.10)

Wals, A. E.J. & Jickling, B. (2002), Sustainability" in Higher Education: From doublethink and newspeak to critical thinking and meaningful learning, *International Journal of Sustainability in Higher Education*, Vol. 3 No. 3, 2002, pp. 221-232.

Wals, A.E.J., der Hoeven, N. and Blanken, H. (2009), *The acoustics of social learning: Designing learning processes that contribute to a more sustainable world*, Wageningen Academic Publishers, Wageningen.

Woollard, D., Zhang, M. & Jones, O. (2007), Academic Enterprise and Regional Economic Growth: Towards an Enterprising University, *Industry and Higher Education*, Vol.21, No.6, pp.387-403.

Wright, W. (2006), Dream Machines. *Wired*. Issue 14, April. Available at: <http://www.wired.com/wired/archive/14.04/wright.html> (accessed 18.3.10)