Analysing Environmental Education Curricula: The Case of the IBO's Environmental Systems

Tom Maxwell

Peter Metcalfe

University of New England

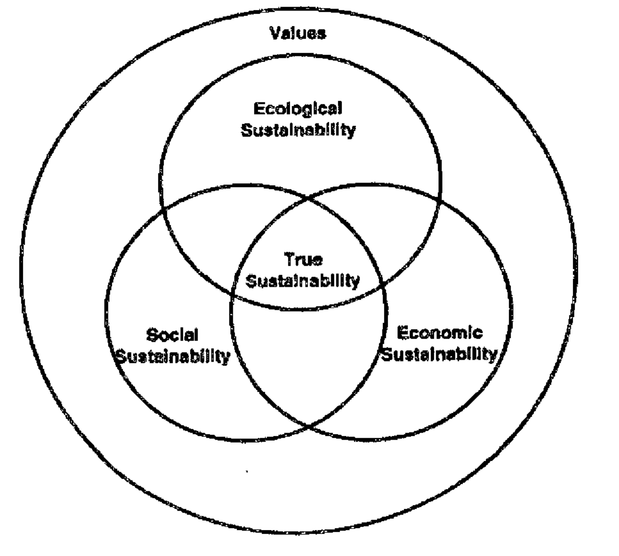
A B S T R A C T

This paper uses a two part analysis of a new syllabus document developed by the International Baccalaureate Organisation (IBO) for its Diploma in the area of environmental studies. The environmental analysis is based on the need for concepts to support sustainability. Key ideas in this model are natural systems of flows of energy, cycles of materials and webs of life and human impact on these natural systems. This analysis suggests that some concepts for sustainability, such as soil and water as basic resources, are not covered adequately and that the identification of the syllabus as a science precludes essential economic and social sciences considerations and the dominance of the methodology of manipulation. Using the Habermasian technical, practical and emancipatory interests as analytical categories, serious difficulties are identified. These include the likely lack of congruence of the syllabus with the advertised philosophy of the Diploma and the fundamental technical interest of control expressed in the syllabus. Taken together, it is probable that in many teachers' hands students may inadvertently learn about exploitation rather than sustainability of the environment. Modifications to the syllabus are proposed.

In this paper we support John Fien's thesis that more narrow views of environmental education need to be replaced by social and economic concerns associated with the environment (Fien 1997). We take the stance that social and economic decisions are dependent upon the values that people hold and so decisions about the environment will also depend upon their values. We use the idea that education for sustainable living is central to environmental education as a starting point. Our aim is to analyse a major curriculum document, *Environmental Systems* (IBO 1996), as a form of curriculum intention and to show that its conceptualisation as a subject within the sciences in the International Baccalaureate Organisation's Diploma short changes students. Descriptive information about the Diploma and Middle Years programmes and the IBO itself are set out in the glossy *Education for Life* (IBO *circa* 1995). In broad terms, the *Education for Life* booklet sets out the rationale for the Diploma, including the ralationship amongst the six groups of subjects and the three core areas. *Environmental Sciences* is a subsidiary [rather than higher level] subject which can be selected from the sciences group. The Diploma is a senior secondary school award taken in over 700, often independent, schools in a wide range of countries. Our understanding is that the IBO's Diploma is a prestigious academic award, recognised internationally. It is expensive. Not all students in the largely independent schools which form the solid base for the candidature of the Diploma have the capacity to attempt it. The IBO headquarters is in Geneva and its curriculum base is Cardiff.

There is a growing international realisation that the environment is under threat locally and globally (Huckle 1991, pp. 43-5, Fien 1997). One proposal to address these problems is via environmental education wherein environmental sustainability is a major issue. Recognising these concerns, there have been some moves to develop curricula to address, for example, the need for a sustainable human society which would depend upon an environment that was ecologically in balance and at the same time was in balance with human demands. While the definition of "sustainability" is still contentious (see Huckle 1991, Greenall Gough 1992) and its use has the potential to be regressive (Payne 1995, p. 96), we agree with Fien (1997) that the essence of sustainability is about "meet(ing) the needs of present generations without compromising the ability of future generations to satisfy their needs" (World Commission on Environment and Development 1987, in Fien 1997). Clearly claims for sustainability demand a long time scale perspective and there is some agreement that three conditions have to be met for sustainable living; ecological, economic and social sustainability (Diefendorf 1997). These three areas, which are required for the planet to survive, can be represented as three interlocking circles within a larger circle of human values, the latter representing the primary place that human decision-making has on environmental sustainability at the present time (cf Payne 1995). The intersection of the three areas at the centre of the figure, *true* sustainability, is ultimately the focus for this paper. As can be seen from Figure 1, conceptually the study of the environment which aims at true sustainability requires an interdisciplinary approach rather than one based in a particular discipline, that is, the disciplines of economics, the social sciences and science are required.

Figure 1 Primary areas associated with Ecological Sustainable Development (Metcalfe 1997 after Diefendorf 1997)



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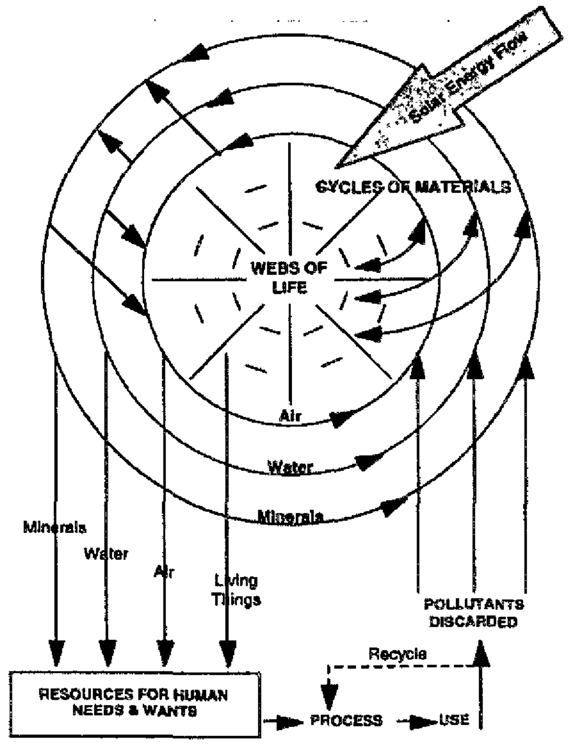
Within this interdisciplinary approach, people need to appreciate the basic mechanisms that are at work in the biosphere and understand the impact of human activities on biospheric mechanisms. One way of showing these and their inter-relationships is shown in Figure 2 (for a short explanation, see Appendix A). This diagram emphasises the cyclical form of the ecological system(s) and their interdependence as well as the interaction with social and economic systems. The cyclic natural systems contrast with the linear systems thinking often used by human society, the latter shown at the base of Figure 2. The human impact upon the environment is linear because resources are taken from one site and redistributed to another, for example, plastics materials mined elsewhere appear as bags found on the streets of towns and cities. For true sustainability, economic advantage for society has to be weighed against ecological change. That is, human needs and wants and the economic advantage gained from these need to be balanced against the damage to the ecology. Negotiation will need to take place as groups vie for alternative uses of resources. This is the place of values as humans make decisions about the right use of resources over time. True sustainability requires an equilibrium be established between the social (political and cultural) and economic demands of humans and that of the ecology.

Given these key ideas, any curriculum plan concerning the environment would need to address all elements found in ecological systems, namely, flows of energy, cycles of materials, webs of life *as well as* human impact (Figure 2). This would best be done within a value framework of sustainability.

Figure 2 Flows of energy, cycles of materials, webs of life and human impact (Metcalfe 1997)



John Fien (1997) pointed out that sustainability includes such ideas as social justice (meeting all humans needs, equity, human rights and participation) as well as ecological sustainability. Fien (1997, p. 25) advocates action, as does Payne (1995). Phillip Payne uses the central concept of ontogeny to explain that the depletion of the environment demands situated, embodied action. Thus sustainability requires us to be empowered, which is mediated through values.

Values, according to the critical social theorist Jurgen Habermas (Grundy 1987), depend upon one's cognitive interest. For Habermas, there are three modes of thinking that inform what we do; the technical, the practical and the emancipatory interests. There is not the space to go into these interests here in any depth. Broadly within the technical interest, knowledge is perceived to be produced via the hypothetico-deductive (scientific) method typically found in the sciences and the purpose of gaining knowledge is to *gain control*, most expressly of the environment (so to exploit it). Secondly, the practical interest has *understanding* as central. The underlying process for producing knowledge here is the hermeneutical process of dialectical discourse. Finally, the emancipatory interest supports autonomy and responsibility by promoting self-reflection and group action. Central here are *critical theories and authentic insights leading to empowerment*. The kinds of interaction would be those which transcend understanding and these experiences would tend to be liberating (Habermas, in Grundy 1987).

The purpose of this article is to investigate an important environmental education document from two standpoints based upon text analysis: a curriculum analysis using Habermas and an environmental analysis using the model developed by Metcalfe (Figure 2). We ask the question to what extent *Environmental Systems* contributes to concepts and relationships which support sustainable living. This work continues that of John Fien (1992) and Kim Walker (1995) into the critical analysis of environmental education policies and contributes to the debate about the value of centrally developed policies (Gough 1987 in Fien 1991, Robottom 1987 in Fien 1991). Further, as *Environmental Systems* is a subject, it is extending the concept of policy to link it to environmental education policy analysis.

Method

Two independent analyses were undertaken. In the first analysis (Part A), the approach adopted was to undertake a text analysis of the main features of two major and related documents *Education for Life* (IBO 1995); and *Environmental Systems* (IBO, 1996). The procedure was based upon that advocated by Grundy (in Maxwell 1992). Grundy recommends taking an holistic approach by addressing the visual impact, considering the language used (particularly images and metaphors, and language patterns and its evocative quality) as well as the historical and political time of development. In Part B the method was comparative based

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on the IBO Diploma *Environmental Systems* syllabus, and was undertaken in two stages. The first "internal" analysis mapped the topics against the concepts of the syllabus. Secondly, using external criteria, as defined by the model presented in figure 2, the same topics were analysed to establish the extent to which they support true sustainability.

Results: Part A

This perspective addresses the nature of the documents, especially concerning their intentions and coherence, using the Habermasian framework as the basis for analysis. An important caveat in necessary here: this is an analysis of intention as set out in the documents. Implementation of such documents, even when they represent the basis for a major external examination, will usually depend considerably upon the teacher, the resources available, and so on. Never-the-less, such an analysis is worthwhile since the formal curriculum documents govern what can be learned (Maxwell 1998). Many teachers in IB schools around the world will respond chiefly to the syllabus documents as they prepare their students for examination.

The attractive *Education for Life* document features photographs of children learning throughout. It describes "The Diploma Programme" (IBO 1995, pp. 2-7) and other details include the technical and historical details concerning the IBO. The history is significant in that the Diploma was originally developed "to establish a common curriculum and university entry credential for geographically mobile students" (p. 12).

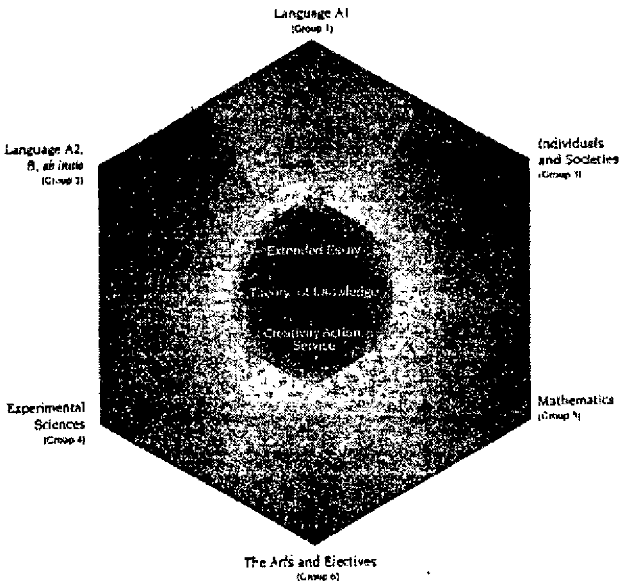
The analysis of introductory pages of *Education for Life* (Table 1) indicates that the initial statements about the Diploma are essentially practical in orientation (eg, "Education for Life" (title, p. 1), "develop the individual talents of young people" p. 1, "international understanding" p. 1) with some technical emphasis (eg, "intellectual rigour and high standards" p. 1).

Table 1 Text Analysis of IBO's "Education for Life" Introduction

Technical:	Practical:
"relate first to their own national identity" p1	"identify with the corresponding traditions of others" pfly
"challenging assessments" p1	"encouraged to respond intelligently" pfly
"intellectual rigour and high standards" p1	"national diversity ... tolerant respect" pfly
"responsible citizenship" p1	"know themselves better" pfly
"comprehensive and balanced curricula" p1	"others can be right in being different" pfly
	"Education for Life" (title) p1
	"develop the individual talents of young people" p1
	"international understanding" p1
	"compassionate" p1
Emancipatory:	"shared humanity" p1
Nil	"respecting the variety of cultures and attitudes" p1

The model of the Diploma (Figure 3) indicates that it has a core which is surrounded by six subject Groups (the Diploma hexagon) from each of which one subject must be chosen by the student. It is possible to complete the IBO Diploma without any academic subject in The Arts (though there is the core requirement of creativity in Creativity, Action and Service (CAS) [see below]). It is possible that this creativity/community service requirement is marginalised given the relative importance displayed in the six academic subject areas. There is a strong language component as represented in two of the six subject groups.

Figure 3 The Diploma Curriculum Model (IBO 1995, p. 5)



An analysis of the language of the description (Table 2) indicates that the Diploma Programme has language which is largely practical but with some expressions which are emancipatory. Thus the Diploma is depicted as essentially about developing understanding but goes beyond this to autonomy and responsibility, mainly in its unique features; Theory of Knowledge, Creativity, Action and Service and the Extended Essay. There is an intention for selected subjects from the subject groups to be integrated through these unique features. Theory of Knowledge acknowledges that knowledge is socially constructed and has the potential to include critique ("be aware of subjective and ideological biases" - emancipatory). It has the potential to integrate the academic subjects. CAS is essentially practical ("whole person" and "compassionate citizenry" are two phrases that illustrate this). The Extended Essay provides the opportunity for students to create an individualised project and as such might be emancipatory, practical or technical in nature. Thus the central features have the potential to be emancipatory if the spirit of the documentation is fulfilled.

In the Diploma environmental content appears as *Environmental Systems* within Group 4 (experimental science). An analysis of the *Environmental Systems* syllabus document (IBO 1996) indicates that *Environmental Systems* is clearly presented throughout as a science as indicated by its rationale. It is:

> rooted firmly in the underlying principles of science. The programme consequently provides a perspective that pays full deference to the value of empirical, quantitative and objective data in describing and analysing environmental systems (IBO 1996, p. 4).

Table 2 Text Analysis of IBO's "Education for Life" Diploma Descriptions

Technical:
"the two great traditions of learning - the humanities and the sciences" p4
"higher level ... subsidiary/standard level" p4
Practical:
"interdisciplinary" p2
"transcends and unifies the academic subjects" p2
"importance of life outside the world of scholarship" p2
"the goal of educating the whole person" p3
"compassionate citizenry" p3
"topic of special interest" p3
"independent research and writing skills" p3
"criterion referenced" p3
"pursue areas of personal interest" p4
Emancipatory:
"critical reflection upon the knowledge and experience gained" p2
"question the bases of knowledge" p2
"aware of subjective and ideological biases" p2
"share ... developing awareness, concern and the ability to work co-operatively with others" p3

Furthermore, the scientific method is central to the programme (IBO, 1996), but the syllabus intends to develop "moral and political responses within the participants". Placement of *Environmental Systems* in the Experimental Sciences firmly indicates it as a technical subject in the Habermasian sense and so primarily about prediction and control. However, the language of the syllabus document is a mixture of the technical and the practical, but mainly the latter. For example, to achieve "profound understanding" suggests the practical. The intention to include moral and political responses and to ensure that "students' attention can be constantly drawn to their relationship with their environment and the significant choices and decisions they make in their own lives" is a very practical idea, possibly an emancipatory one in some teachers' hands. Alternatively, the positivistic "manipulation and analysis of quantitative data" is very suggestive of the technical interest, that is, control of the environment. An analysis of the "Suggested teaching approach" section reveals a retention of technical and practical language with a greater emphasis upon the practical interest ("'hands-on' practical work"). Teaching should involve the "holistic modelling of particular environments", the "interrelatedness of [the] components" and the "systems approach". This is integrative, but within the sciences. On the other hand, the use of empirical approaches and the primacy of testing ("prepare students adequately for assessment") is suggestive of the technical interest. In summary, it would appear that the practical, perhaps even emancipatory, language of the overarching statements in *Education for Life* is not congruent with language that is more informed by the technical interest of the *Environmental Systems* syllabus.

Results: Part B

The "internal" analysis focuses upon the *content* of the syllabus within the scientific paradigm and so is necessarily focussed on the ecological concepts, rather than the economic or social concepts that are needed for sustainability. When the science concepts of the IB *Environmental Systems* are tabulated using internal criteria, that is, criteria as suggested in the syllabus itself, then the content may be mapped out as in Table 3 (√ = concept developed; 0 = concept not developed, but anticipated). Topics (compulsory and elective) are placed on the horizontal axis, science concepts on the vertical. The content analysis indicated that the coverage of water as a human *resource* is relatively minor and the crucial role of soil in ecologically sustainable development is inadequate, based upon experience of such environments as found in Australia. This is especially the case in their under representation in the compulsory part of the syllabus. Metcalfe contends that soil and water are proving to be the key limiting factors to development on every continent, but especially in the drier ones, but perhaps less so in Europe. This assertion is based upon his extensive consultancy experience concerning environmental issues around the world.

Some other general comments may be made about the syllabus. Firstly, there is an emphasis upon mathematical understandings. For example, each of the three ecosystem analysis options, marine, terrestrial and freshwater emphasises the measurement of physical components, biotic components, system productivity and changes. While valuable, it is arguable that this emphasis on collection and processing of hard data obscures many of the important environmental relationships that are easily seen but difficult to quantify. Given the emphasis placed on quantitative data, if a relationship cannot be quantified it is likely to be overlooked, irrespective of its importance. However, Appendix 2 in the syllabus provides a set of four criteria by which to measure practical activities; quantitative modelling, working with living materials and natural ecosystems, holistic investigations and assessability and qualitative requirements leading to the development of numerical models and arguments about the environment. Secondly, *Environmental Systems* has a strong set of aims (IBO 1996) related to science but they do not mention understandings, skills and attitudes specifically related to environmental education. This emphasis may well be the consequence of being placed within Group 4 (the sciences) of the IB Diploma hexagon. Furthermore, in the Objectives section of the syllabus it is indicated that "assessment will draw upon the social and economic effects of the experimental sciences" that could be linked to the aim "raise awareness of the moral/ethical, social, economic and environmental implications of using science and technology", but this notion is tucked away rather out of sight of the bulk of the scientific nature of the systems approach. More importantly these ideas are not translated into examinable objectives 1, 2 and 3. In examinable subjects, such objectives are usually closely addressed by teachers. Thirdly, there is very little on soil erosion and its conservation though it is seen as a physical component of the terrestrial ecosystem in Option B (Table 3). Finally, agriculture is only seen as part of Option D as an example of a system of inputs and outputs and as a source of food resources, also as a source of pollutants in Option F (typical of the technical interest of control), rather than as an ecosystem manipulated by people for the benefit of people.

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Control of the environment is not problematised.

The key concepts for sustainability vary from community to community. For example, "sustainability" in a city depends on the right choice of transport and energy systems to maintain air quality. As another example, rural communities would need a greater emphasis on soil conservation and maintenance of biodiversity. Particular communities dependent on a particular resource need to have these resources and their wise management as a focus in the curriculum. Such local adaptations to curriculum needs can be met through local studies and environmental projects. As a consequence the development of local studies in *Environmental Systems* is seen as a strength.

The second analysis of the syllabus of this Part is set out in Table 4 where the content is mapped against those concepts consistent with ecological sustainable development as represented in Figure 2. The analysis considers the potential of the syllabus to contribute to ecological sustainable development. Although all major areas of Figure 2 are present, from a perusal of the table it is evident that material cycles are relatively less well represented in the syllabus. Some concepts get mentioned but once (eg Living web adaptations, in an elective) while others are present up to five times across the core and electives (eg Living web niche/habitat).

It might be that environmental concerns can be found in other syllabus documents. This is an important consideration since

Table 3 Science concepts/topics developed in the *Environmental System*

SCIENCE CONCEPTS DEVELOPED	COMPULSORY					CHOICE OF ONE			CHOICE OF TWO		
	SYSTEMS & MODELS	THE ECOSYSTEM	GLOBAL CYCLES	PHYSICAL SYSTEMS	HUMAN POPULATION	MARINE	TERRISTERIAL	FRESHWATER	RESOURCE EXPLOITATION	CONSERVATION & BIODIVERSITY	POLLUTION
Thermodynamics	√		√						√		
Equilibria	√										
Feedback	√	√									
Transfer) Transformation)	√	√									
Flows & pools	√	√									
Productivity		√				√	√	√	√	√	
Food chains/web		√				√	√	√	√		
Community/niche)		√				√	√	√			
Habitat)		√				√	√	√		√	
Limiting factors)	√				√						
Carrying capacity)	√					√	√	√	√		
Population dynamics		√			√					√	
Pollution					√	√	√	√			√√√
Ozone depletion/UV			√								
Global warming			√								
Acid rain			√					√			√
Renewable/non-renewable					√				√		
Sustainability					√	√	√	√	√		
Physical components						√	√	√			
Biodiversity						√	√	√		√	
Conserving biodiversity										√	
Soil as a resource		o		o			o		o		√
Water as a resource		o		o				o	o		√

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the International Baccalaureate Diploma is very much concerned with the integration of knowledge and the complementarity of knowledges. From our conceptualisation (Figure 1), some considerable amount of discussion of environmental issues could be expected in the *Economics* syllabus (IBO 1991). In point of fact, there is very minor mention ("failure of the market to put socially acceptable prices on ecological externalities" and pollution as an aspect within quality of life). Rather, growth is a fundamental idea to this syllabus.

The ideas of sustainable living might be found within Group 3 (Individuals and Societies) subjects of the hexagon. Our analysis of Geography (IBO 1996) indicates that there are a number of places at which the environment is explicitly mentioned. Topics where the environment is brought in include population, problems of development, human use of marginal lands, food production and urbanisation. The Resources section within this syllabus could be used as a vehicle for sustainability but this approach is not made explicit. Finally, our analysis of the objectives of the Geography syllabus would indicate that the interest of the geography syllabus writers is a practical rather than an emancipatory one. Five of six syllabus objectives explicitly state "understanding" while none are aligned to an emancipatory intent. Clearly not all students studying *Environmental Systems* will take *Economics* or *Geography*.

Table 4 Ecological Concepts in *Environmental Systems*

KEY ENVIRONMENTAL CONCEPTS		TOPICS IN ENVIRONMENTAL SYSTEMS: COMPULSORY				CHOICE OF ONE			CHOICE OF TWO		
		SYSTEMS & MODELS	THE ECOSYSTEM	GLOBAL CYCLES/ PHYSICAL SYSTEMS	HUMAN POPULATION	MARINE	TERRESTRIAL	FRESHWATER	RESOURCE EXPLOITATION	CONSERVATION & BIODIVERSITY	POLLUTION
ENERGY FLOWS	Sun	√	√	√					√		
	Water, Wind			√					√		
	Food chains		√			√	√	√			
	Fossil fuels			√					√		
	Efficiency	√	√						√		
MATERIAL CYCLES	Water cycle			√							√
	Rock and soil						√				
	Soil degradation/ conservation			√					√		
	Nutrient cycles		√				√		√		
	Atmosphere		√								
LIVING WEBS	Biodiversity			√		√	√	√		√	
	Coevolution									√	
	Adaptations									√	
	Trophic levels		√			√	√	√			
	Niche/habitat		√			√	√	√		√	
HUMAN IMPACT	Ozone			√							
	Greenhouse			√					√		
	Acid Rain			√					√		
	Resources				√						
	Recycle etc				√						
	Changes				√	√	√	√			
	Extinction									√	√
	Pollution										√

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Conclusion

First a caution: our analyses of the IBO *Environmental Systems* do not take syllabus implementation into account and research is needed here. However, the analyses are useful since the syllabus documents govern what most students will learn (Maxwell 1998). *Environmental Systems* takes a strongly scientific, potentially highly mathematical, approach to the study of the environment. There are some serious content omissions and the absence of social and economic considerations in the examinable objectives suggest that these are likely to be minimised given the pressures of teaching an externally examined subject within a prestigious Diploma program. Thus while the ecologically sustainable development concepts are reasonably well covered (with noted exceptions) those that relate to social and economic sustainability are not. True sustainability, dependent upon all three areas, is not therefore addressed.

In independent analyses we found that placing the environmental course into the sciences subjects group of the IB Diploma hexagon constrains the study of the environment to being, on the one hand, a science with its emphasis upon quantification and variable manipulation (and separation from the self), and on the other, a use of language that is informed by the technical interest. Both are controlling fomulations and suggest exploitation. The consequence of the decision to place *Environmental Systems* into the experimental sciences group is thus profound. The course cannot easily address economic and social issues of sustainability that are central to any study of the environment. We are reminded at this point of Huckle's (1991, p. 43) observation that "much environmental education is part of the problem rather than the solution".

Perhaps the IBO needs to relax its strict interpretation of the IB hexagon. The syllabus does have strengths, notably its local area studies. These could be developed further. In the syllabus the ecological area is catered for (some concern about soil and water has been noted) but not the economic and social dimensions of environmental education. The fundamental decision-making role that humans have is not likely to be addressed by IB teachers, especially those who focus upon the examination requirements as they are presently set out. What is needed (a way forward) is for an interdisciplinary approach so as to include human decision-making in all parts of the syllabus. This blends nicely with the findings of the text analysis based upon Habermasian cognitive interests and would likely as not create a syllabus more congruent with the IBO's *Education for Life*.. For true sustainability, emancipatory concepts needed to be introduced, though their introduction would be a challenge to the practical orientation to education set out in the IBO's *Education for Life*.

Note

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Appendix A

Notes on Key Concepts in Figure 2

Each heading under "Key Concepts" is a shorthand way of specifying content. Science courses may provide more detail and yet still fail to develop concepts that contribute to understandings that support the concept of sustainability. The former usually happens when a topic is taught as "biology" or "chemistry" or some other science discipline in isolation. Environmental education is really about relationships between the elements of science and social science, too often isolated by the walls of the specific disciplines.

The key concepts listed below arise from Metcalfe's experience of teaching about the environment to various age groups in Australia and other countries. The list is not exhaustive and it is important that specific local needs are met by the study of local systems and local problems.

Energy Flows

Sun - source of energy in living systems, world weather systems

Water, wind - as alternative pathways of solar energy

Food chains - as a series of steps with losses involved at every step.

Fossil fuels - as a source of most of our energy and much of our air pollution. Speeding up geological cycles of carbon*.

Efficiency - overall efficiency of conversion in all energy systems.

Material Cycles

Water Cycle - as a natural cycle and as diverted for human use and resultant water pollution.

Rocks and soil - as a long scale geological cycle with soil being a minute time interval in the full cycle.

Soil degradation/conservation - human activity and its impact on soil through soil erosion, changed water tables, salinity, loss of chemical and physical fertility.

Nutrient cycles - the role of the living organisms in cycling soil nutrients. Soil as a living system.

Atmosphere - as a mix of gases now being modified by human techno-metabolism. Overall role of oceans and sediments in CO_2 balance*

Webs of Life

Biodiversity - named species, estimates of overall number of species. Within species genetic diversity.

Co-evolution - as a source of species diversity and interdependence. Specialisation. Why introduced species become weeds or pest species. Co-evolved pests and their use in biological control.

Adaptations - for survival in the physical and biological environment such as drought and fire resistance, reproductive cycles, pollination, seed dispersal. Adaptations for special habitats.

Trophic levels - as interdependence rather than an energy flow. Producers, consumers and decomposers. Populations

Niche/habitat/community - where species fit within the web of life

Human Impact

Linear use of resources by humans and human impact on energy flows, cycles of materials and living webs.

* linked together in a study of global warming

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