Knowledge and competence. Key concepts in an educational paradigm for a sustainable society

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Abstract. This paper examines two key concepts in educational paradigms - knowledge and competence - from the perspective of their importance for a sustainable society. It is argued that knowledge should not be considered as something existing that is to be acquired, but rather as part of a knowledge-building process that poses questions regarding why we build knowledge and what kind of knowledge we build, as well as how we build it and how we use it. Knowledge building is also considered a type of competence in an endeavour to go beyond current models that tend to see competence as merely the application of knowledge and fail to do justice to the role of both in promoting sustainability.

Keywords: Knowledge, competence, education, sustainability, resilience, transformability

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Introduction

A society makes two types of essential investment for a sustainable future. In this paper, a sustainable future is seen as depending on an educational process which both for society and its members is able to promote *resilience* (*the capacity of a system to absorb disturbance and reorganize while undergoing change, so as to still retain essentially the same function, structure, identity, and feedbacks* - Westley et al., 2011) and *transformability* (*the capacity to create untried beginnings from which to evolve a fundamentally new way of living when existing ecological, economic and social conditions make the current system untenable* - Westley, et al., 2011).

As a first investment, society gives birth to children and takes in immigrants in order to *assimilate* both and *accommodate* itself to the change brought by these new generations and new arrivals. In this context, *assimilation* is intended as a composite both of knowledge-building processes, whereby new information is incorporated into given information already stored in existing cognitive structures (Piaget, 1977, Vygotsky, 1978, von Glaserfeld, 1995), and physiological processes, whereby nutrients are absorbed and incorporated into metabolic pathways for building new materials and producing work (Jobling, 1993, Kroemer et. al., 2010, López-Arredondo et. al. 2013)[1]. Accommodation is the resulting process of reframing existing structures on the basis of the new input, of deriving sustenance that promotes vitality and endurance.

The way in which such processes of assimilation and accommodation feed into and out of each other is characteristic of all learning processes and in this sense a society is a living organism that evolves to the extent that it is able to learn by adapting to input provided by the experience furnished by formal, non-formal and informal learning

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[1] In both senses the term *assimilation* is used quite differently from that which makes reference to various forms of *cultural assimilation* whereby immigrants should become indistinguishable from the members of the existing group they join (Alba and Nee, 1997).

environments. In order to ensure this, a society must make a second investment in its future by promoting an educational process based on an educational system that permits every person and every new generation to develop their learning potential to the maximum extent and thereby make a full contribution to society as a dynamic cultural community (Rogoff, 2003). By educating its members, society educates itself. The learning processes of the people who inhabit it are the learning processes of society itself. Through education a society shapes the future of both its individual members and its collective self. If the goal of an educational system is to promote the sustainability of society, then the achievement of that goal depends on the sustainability of the system, on its capacity to promote individual and collective resilience and transformability.

The purpose of this paper is to consider one particular aspect of current educational paradigms - the relationship between the concepts of knowledge and competence - from this perspective on sustainability. Until relatively recently - and in large measure still today - the dual process of shaping and contributing to society was conceived of principally in terms of economic growth. Educational systems have been largely based on human capital and functionalist paradigms (Parsons, 1951, Durkheim, 1956, Blau and Duncan, 1967, Davis and Moore, 1970, Ball, 2008, Gewirtz and Cribb, 2009). Although these paradigms have been heavily criticized in terms of concentration of economic and political power, social injustice and ecological imbalance, much less attention has been paid to questioning their epistemological base in terms of the relationship between knowledge, competence and learning. Even if within educational theory social constructivist paradigms of learning (Ormrod, 1995, Hill, 2002, Driscoll, 2005, Jordan et al., 2008) have become widespread, school systems still tend to be based on the assumption of given bodies of knowledge that are to be acquired (perhaps through innovative teaching/learning methodologies) and then applied in terms of developing competence. This paper argues that at the heart of sustainable educational processes should be posed questions such as why build knowledge, what knowledge to

build, how to build it, how to use it and how all these aspects are interrelated.

Linguistic and epistemological premises for analysing current educational paradigms

Before examining these questions about the importance of knowledge building, we first need to analyse the concept of competence in current educational paradigms. Over the past two decades in particular there has been an increasing awareness of how a progressive acceleration of change in every aspect of life requires a new educational paradigm, able both to understand a society characterized by complexity, impermanence, uncertainty and unpredictability and to promote an educational process that is coherent with these characteristics. All member countries and various organisations within the UN, OCSE or the EU are involved in researching such a paradigm and a central role is generally assigned to the concept of competence.

In order to analyse the significance of any concept, it is useful to examine some linguistic and epistemological premises that form its theoretical background. Indeed, the existing literature concerning the concept of competence provides an interesting example of the phenomenon of *signification*, the way we use language to create meaning and thereby understand and act in the world. Within any language *signifiers* and *signifieds* interact in a process of construction of *signs*, the building blocks with which we make sense of the world by giving meaning to it and our experience. The signifier and the signified mutually define each other. A concept is built through various types of relationships: between signifiers and signifieds, between signifiers or between signifieds (Dodman, 2014a).

Within this perspective, it can be particularly useful to consider the four *paradigmatic* relations that characterize the lexis of a language system: *synonymy, antonymy, hyponymy and meronymy*. Synonymy is a relation of *equivalence* or similarity between signifiers and signifieds. Antonymy is a relation of *opposition* or difference. Hyponymy is a relation of *categorization* or exemplification, in which signifiers and signifieds are examples of the superordinate categories. Meronymy is a relation of *particalization* or fragmentation, where signifiers and signifieds are parts of an overall whole. These four paradigmatic relationships can shed light on the process of conceptualization of competence, in which there exists considerable diversity in the way that the relationship between signifiers and signifieds is built. Problems can arise both at the *intralingual* level (for example, the relationship between words like *knowledge, skill, ability* and *competence* in English) and the interlingual level (the relationship between these terms and their apparent equivalents in other languages).

These linguistic premises can also help us understand the importance of another, epistemological, premise which concerns one of the specific characteristics of any transition from one paradigm of reference to another. According to Kuhn (1962), such a transition requires the search for new lexis and new relationships with which to interpret the complex processes of change taking place, and therefore leads to an inevitable terminological confusion, which involves both existing and new signifiers and signifieds. This confusion is not necessarily negative, but is rather a reorganization of relationships and a redefinition of meanings that are naturally part of the new conceptualization. From this confusion new relationships emerge and establish themselves, thereby enabling users of the paradigm to share and make reference to common definition.

In many respects today we are experiencing the paradox of how the very same features that the new paradigm must encompass - the accelerating speed of change and ever increasing complexity of society - make more and more difficult our attempts to build it. No sooner does the paradigm begin to emerge than it risks being superseded by new developments. Thus we are obliged to live with the inevitable terminological confusion and treat it as a potentially fruitful and enriching feature of educational discourse.

The concept of competence within current paradigms

In spite of their differing perspectives and terminologies, the various current national and international documents produced by and for educational systems refer to three general objectives of the educational process: 1) developing an aptitude for lifelong and lifewide learning; 2) furthering a process of personal acculturation and the building of ones own personal and professional life project life; 3) promoting an idea of citizenship based on awareness, responsibility and active participation. Each of these goals is considered to require the development of competence through education. Some documents put more emphasis on the definition of what competence is and why it is important, while others are more concerned with the description of the types and levels of competence envisaged. In most cases national curriculum documents emphasize why certain competences are considered important and list some types. Competence is described with regards to *motivation* (*essential for achieving the general objectives*, ...), *categories* (*basic, technical-professional, cross-curricular, key for citizenship , ...*), *types* and/or *examples* (*mathematical, social, digital, ...*), *features* (*dynamic, polyfunctional, specific to contexts, generalizable, ...*) or *components* (*knowledge, skills, attitudes, ...*).

In general, competences are considered as a *threshold* or *base*, *essential* or *key*. Many countries refer to specific aspects of the general objectives of the educational process for which competences are important. In this way, in French-speaking Belgium "socles de compétences" are "necessary for social integration and the continuation of studies", in Luxembourg "compétences de base" are "necessary for further learning and study", in Spain "competencias essencias" are "necessary for citizenship in today's society", in the UK "key competences/skills" are "necessary for membership of a flexible and competitive workforce and for lifelong learning", in Germany "Schlüsselkompetenzen" are "essential for operating effectively on a personal and

professional level" and in France "socles de compétences" are "indispensable for the successful conclusion of school, continuing with further education, building one's personal and professional future and being successful in social life". Less frequent is reference to certain characteristics of competences, such as in Flemish Belgium, where the "sleutelcompetenties" are described as "transferable, applicable in different contexts and situations and polyfunctional in terms of reaching various kinds of objectives, solving problems and performing tasks".

Over the past ten years, two documents have become required points of reference for all European educational systems: the "Recommendation of the European Parliament and of the Council on key competences for lifelong learning" (KCLL, 2006) and the "Recommendation of the European Parliament and of the Council for the establishment of the European Qualifications Framework for lifelong learning" (EQF, 2008). Both provide descriptions rather than definitions of elements considered as constitutive of competence and reasons for its importance. In the KCLL competence is described as "a combination of knowledge, skills and attitudes appropriate to the context". "Key competencies" are those which all individuals need for "personal fulfilment and development, active citizenship, social inclusion and employment".

In this sense, knowledge, skills and attitudes would seem to be meronyms of competence, i.e. parts of a whole, called competence, which allows an individual to deal with a given situation. At the same time, an idea of competence as the *application* of expertise emerges, as the combination of knowledge, skills and attitudes to be assembled and applied in a particular context in order to achieve a goal or solve a problem. But where do the knowledge, skills and attitudes come from? How is it that someone can possess them in order to have them ready to face the situation? The EFQ states that knowledge is "the result of the assimilation of information through learning, the set of facts, principles, theories and practices related to a field of work or study", described as being "theoretical and/or practical".

The problem with this description is that first it begs the question of how one comes to know, how people build knowledge, and second it seems to suggest that the body of knowledge to be learnt already exists as a given set related to a given field. We will consider the second aspect later in this paper and for the moment concentrate on the question of how we know. If the process of *assimilation* is at the heart of knowledge-building, in which new information is incorporated into given information already stored in existing cognitive structures, surely this process of construction should be considered a *hyponym*, or type, of competence, that of being capable of building knowledge. It is indeed arguably the most important component of a lifelong and lifewide learning process. The key question is whether knowledge (relegated to the status of something which comes before and is then used as a constituent part of competence) is to be considered a meronym, a part or element which is constitutive of competence (as in the KCLL and the EQF), or rather, and I would suggest much more importantly, as a knowledge-building process, a hyponym, an example or type of competence, of vital significance for individual and collective learning as well as the sustainability of the entire human enterprise. This perspective assigns to knowledge-building competence an essential and dynamic role in learning processes together with other types of competence.

Types of competence

To understand this relationship between knowledge-building and other types of competence, we can examine the use made in the KCLL and the EQF of the signifier "skills". These are described as "the ability to apply knowledge and use know-how to complete tasks and solve problems", and divided into two types: "cognitive (the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools)". What kind of relationship between skill and competence

emerges from this description? While "the use of logical thinking" can be considered a cognitive ability and therefore a meronym, or part, of competence (since logical thinking enables one to excogitate possible problems and solutions), surely "complete tasks and solve problems " is a hyponym, or example, of competence? Similarly, is not "manual dexterity" a meronym, a part of "use methods, materials, tools" (since using ones hands enables one to manipulate things and put procedures into practice), while "use methods, materials, tools" is a hyponym of competence? In many cases it is indeed difficult to distinguish between the examples of what is considered skill ("the ability to apply knowledge and use know-how to complete tasks and solve problems") and competence ("the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and/or personal development").

Clearly what characterizes this idea of the concept of competence is always the *application* of knowledge in situations or contexts. Why, what and how to build knowledge are not considered as being under discussion, but merely to be taken for granted. The principle argument of this paper is that this is a serious defect in the prevailing notion of what competence is and thus an impediment to defining the importance of its role in educational processes and systems. Moreover, such a characterization is hardly compatible with many of the proposed examples in the KCLL itself. For instance, "competence in science" refers to "the ability and willingness to use the body of knowledge and methodology employed to explain the world around us, to identify questions and to draw conclusions that are based on proven facts". Examples of knowledge are "fundamental scientific concepts, principles and methods, technology and technological products and processes". Skills include "the ability to use technological tools and machines as well as scientific data to achieve a goal or to a decision or conclusion based on evidence ... to be able to recognize the essential features of scientific inquiry ... communicate the conclusions and reasoning that led to them". In these descriptions,

knowledge and skills would often seem to be hyponyms or even synonyms of competence.

The EQF, an instrument that unites educational institutions and work-based contexts for lifelong learning, addresses the question of how to describe different levels of knowledge, skills and competence. Competence is described as a contextualization of knowledge and skills "in terms of autonomy and responsibility", in which the various levels of competence are determined by elements such as contexts characterized by simpler or more complex problems and by different degrees of predictability and unpredictability. While the attempt to describe the levels with reference to features such as complexity and unpredictability is clear and important, we always encounter the same types of problems as those previously illustrated. For example, at the 7th and 8th levels of competence, in the column referring to skill we find "to develop new knowledge". In this case it would seem clear that knowledge and skills are not antonyms, or different things, and that skill is not only "the ability to apply knowledge", but also that of building it. But should we consider the building of knowledge in some cases as a hyponym of skill and in others as something different from skill? Should not building new knowledge and activating skills be rather considered as two hyponyms, or two types, of competence?

Redefining the concept of competence

If the concept of competence is to occupy a central role in the educational paradigm, then its definition must be of particular relevance to the educational process. The definition must be able to interpret and facilitate learning processes and to promote formal institutional as well as non-formal and informal environmental (workplace and society in general) curricula as well as learning pathways, personal curricula and life projects. Starting from its etymology, the concept of competence is particularly significant in that it expresses (*cum-petere* = "seek", "aim, "project" - "with", "together") the idea of learning as process which is dynamic and based on constructing something which is essential ("essence", "vital" as well as "necessary", "indispensable"), capable of constant expansion and enrichment, to adapt to change, the need to pose and face new problems that require new solutions, identify new requirements and challenges, continuously build new knowledge.

My proposal is to define competence as the ability to *orientate oneself* in life in such a way as to promote sustainability. In this sense, *orientation* is considered as identifying a position (for example, in space, in time, within thought processes) and taking a direction (for example, a point of reference, a pathway, a way of proceeding), thereby adapting to the circumstances presented by environments and specific settings. In other words, competence is the ability to understand situations with particular characteristics and act with awareness in order to achieve objectives related to personal and social resilience and transformability. These objectives can be grouped into four major categories that relate to building knowledge (knowledge-building competence), communicating information (communicative competence), experimenting and consolidating a range of approaches, ways of doing and acting (methodological and operational competence) and developing relationships with oneself and others (personal and social, competence). Thus four types of objectives that enable people and societies to orient themselves in all situations, lifelong and lifewide, can be considered the four major types of competence that form human learning and render orientation central to the sustainability of human enterprise.

These competences are interdependent and feed into and out of each other. The construction of any form of knowledge depends on a simultaneous acquisition of language as the vehicle that is indispensable for this process (Dodman, 2014b). In this sense, the development of communicative competence - knowing how to use a multiplicity of languages to understand, interpret, narrate, describe and represent phenomena and processes, re-elaborate data, express and argue ideas - is essential to the

development of knowledge-building competence. Moreover, in all learning processes the growth of these two competences depends on the criteria that determine practices and procedures, both consolidated and innovative, and require the development of methodological and operational competence - analysing data, assessing situations and evaluating outcomes, formulating hypotheses and predictions, experimenting choices, solutions and procedures, using tools and instruments, carrying out processes and realising products. And at the same time, all these competences require personal and social competence – developing relationships with oneself and with others, acting with autonomy and awareness, reflecting on and assessing ones own work, respecting environments, people and things, discussing, collaborating, cooperating within a group.

Moreover, each type of competence is lifelong and lifewide and therefore cross-curricular in any educational agency. Each specific example of a competence is the result of the way in which it is declined on the basis of the particular characteristics of the situation, be it in study-based, work-based or recreational contexts, or any specific combination of these variables. At the same time, every way of declining specific competences (both promoting them through education and developing them through personal experience) must be determined by criteria of resilience and transformability.

Knowing and acting

If knowledge-building competence is placed at the heart of the educational process, we can now consider some aspects of questions concerning what is knowledge and why, what and how to build knowledge. My aim is to consider knowledge-building competence as an essential aspect of the ability to orient oneself in situations, a human potential to be used and developed by learners who build their own learning pathways in order to be able to develop personal resilience and transformability and enable society to do likewise.

For our purposes, knowledge can be considered as a construct, the product of a process whereby a *knower* constructs a *known* that is the outcome of adapting, or accommodating, given to new experience. The consolidation of this relationship between the *knower* and the *known* gives rise to *knowledge* in the same way that the relationship between *signifiers* and *signifieds* gives rise to *signs* and thereby our way of creating meaning and making sense of the world. One feature of this relationship is what Dewey defines as making "one experience freely available to other experiences" (1916: 349) and therefore generalising experience by creating connections and relationships in order to build concepts (*cum-capere*). Such a process of sharing experiences takes place both at intra- and inter-mental levels. At the intra-mental level the individual creates connections between experiences, builds personal knowledge and develops personal intelligence. The consolidation of relationships at an inter-mental level, based on criteria that are commonly determined, held and applied, turns individual processes of knowing into shared knowledge and thereby a potential for collective intelligence within a participatory culture (Lévy, 1997, New London Group, 2000, Ivey & Tepper, 2006, Jenkins, 2006), particularly if based on developing personal and social competence related to respecting, collaborating and cooperating.

For Dewey, another feature of the knowledge-building process is "knowing as understanding and thereby acting" (1916: 350). Moreover, "knowledge is a perception of those connections of an object which determine its applicability in a given situation" (1916: 353-54). Central to this idea is "maintain[ing] the continuity of knowing with an activity which purposely modifies the environment" inasmuch as "knowledge in its strict sense of something possessed consists of our intellectual resources - of all the habits that render our action intelligent" (1916: 400). If our action is to be intelligent, then it cannot be mere understanding and application of existing knowledge, but rather a complex construction based on questioning why, what, how to know and act in such a way as to maintain sustainability through promoting resilience

and transformability. In this respect, the link between knowing and acting described by Dewey is the same as that between knowledge-building and methodological-operational competence and the dynamic interplay between them.

On the basis of this relationship between knowing and acting, knowledge can be considered as an interpretative model that works, inasmuch as it satisfies the conditions established by given criteria and it continues to produce the desired outcomes, generally conceived of as satisfactory explanations or functional applications. When it fails to satisfy the criteria applied it becomes invalid and when it ceases to produce the desired outcomes it becomes obsolete.

Knowledge-building: motivations, types and characteristics

Both knowledge and the criteria that render it valid or invalid, functional or obsolete, can be analysed from three intersecting perspectives: *motivations, types and characteristics.* The nature of the relationship between knowing and acting is essentially defined by the reasons why knowledge is built. These reasons determine both the type of knowledge and its particular characteristics. Within human history, as within the life of every human being, we can identify a number of different motivations for knowledge building. The stimulus to build knowledge may stem from wonder and a desire to understand together with a natural impulse to satisfy needs. Much indigenous knowledge (Adamson, 1978-2007, Martinéz-Cobo, 1986, Ajibade, 2003) demonstrates motivations, types and characteristics that would seem to unite these two components in a relationship of dynamic equilibrium designed also to place the sustainability of the human enterprise at the heart of their knowing and acting in the world. This equilibrium is based, for example on types of knowledge that can be defined as practical, craft-based and narrative, with characteristics such as local, contextual and experiential linked to ways of learning based

on observing and pitching in (Rogoff, 2003, Ochs, 2014)).

By contrast, while both wonder and satisfying needs can be considered important initial stimuli at all phylogenetic and ontogenetic levels, much recent human history clearly shows how knowledge building has increasingly become a prerequisite for something else, generally dominating, manipulating and exploiting, a driving force for exercising power and enslaving, thereby rendering large parts of the human enterprise unsustainable, precisely because they become destructive of resilience and incapable of transforming *the current untenable system*. The types of knowledge generally associated with this tendency relate to categories such as disciplinary, paradigmatic, scientific and technological (largely concerned with extracting, manipulating and producing for mass-consumption, as well as for devastation linked to military purposes).

At the same time, it is possible to envisage the wish to build knowledge as the impulse to problematize what we know and how we act and foresee outcomes in terms of potential and limits, opportunities and risks, taking nothing for granted, above all, some spurious idea of the superiority of our way of knowing and acting in the world. Sustainable educational processes and systems must promote this vision as crucial to lifelong learning, personal acculturation and life projects, active and responsible citizenship. In this respect there is a crucial link between the development of personal and social competence, based on respecting, collaborating and cooperating, and the move from disciplinary to inter- and transdisciplinary knowledge

Educational systems are generally based on the primacy of disciplinary knowledge and in recent decades increasing attention has been paid to approaches based on interdisciplinary and transdisciplinary perspectives. Disciplines can be considered as particular sets of cultural practices typical of given fields of enquiry, experience and activity characterised by specific epistemological, linguistic and methodological features. While the belief in the importance or even supremacy of disciplinary knowledge is deeply rooted and widely held,

the limits and dangers of concentrating learning curricula within disciplinary boundaries have long been recognized. As Popper puts it: "We are not students of some subject matter, but students of problems. And problems may cut right across the borders of any subject matter or discipline" (Popper 1963: 8). In the same way, for Clark sustainability science requires a perspective which "... brings together scholarship and practice, global and local perspectives from north and south, and disciplines across the natural and social sciences, engineering, and medicine — it can be usefully thought of as "neither "basic" nor "applied" research but as a field defined by the problems it addresses rather than by the disciplines it employs; it serves the need for advancing both knowledge and action by creating a dynamic bridge between the two" (Clark, 2007: 1737-1738).

Other criticisms involve the risk of blinkered or tunnel vision and objectification since phenomena are represented as being apparently objective or definitive, rather than as contingent events that depend on circumstances and agencies, the perspective of the observer and the linguistic lens that determines both vision and representation (Wells, 2013, Dodman, 2014a, Stenner, 2015). Moreover there is the paradox of a constant proliferation of disciplines that splinter and limit vision and have the effect of excluding both people who do not possess a certain expert knowledge and different visions that might offer different ways of knowing and acting.

What is fundamental for educational processes is the presence of interdisciplinary approaches that are collaborative, in that disciplines and their practitioners help each other to better address the questions they pose, and transdisciplinary approaches which are cooperative, in that disciplines and their practitioners come together to build new constructs that are the very reason for being of the team, developing new epistemologies, methodologies and languages that go beyond those of the single disciplines in order to address new and common questions (Camino et. al. 2014).

Of equal importance is the perspective of the relationship between narrative and paradigmatic knowledge (Bruner 1991). Narrative knowledge is experiential, both in the sense that it is built on experience and in that it is still encoded as experience. It is knowledge as process, understanding a world in which things happen, people act in particular circumstances, knowledge mediated by verbal language (Dodman, 2014a). By contrast, paradigmatic knowledge is experience re-codified through nominal language. It is knowledge as product, an abstract, symbolic, objective and economic way of managing complexity and variability, rebuilding and structuring everything in terms of scientific concepts and taxonomies, rendering it subject to forms of logic and reason that lead to reification, categories as rigid containers built on principles of identification and exclusion rather than based on relationships and overlapping flexible networks that promote empowerment and inclusion.

The way in which motivations for knowledge-building influence the types of knowledge built has led to modes of perceiving, constructing and acting based on a dominance of disciplinary and paradigmatic knowledge whose principal characteristics have at different times and in various ways been seen as global, objective, certain, determinate, complete, permanent and product-oriented. Much education still tends to promote such a vision and a risk of *understanding without awareness*. By contrast, the focus of interdisciplinary, transdisciplinary and narrative knowledge leads to characteristics such as local, subjective, uncertain, indeterminate, incomplete, temporary and process-oriented and thereby modes of performing and reflecting which lead to *awareness and responsibility*.

Cross-curricular themes and visions for sustainability

What could such an approach to educational processes and systems look like? One possible answer could be that of basing learning curricula on unifying cross-curricular themes,

designed to give rise to interwoven visions for sustainability that reciprocally feed out of and into each other, as in the following example. Such a theme could unite the key questions this paper has proposed and could be called *Why/what/where/when/how on earth*?[2] These are questions of vital importance for all learners of whatever age, be they in nursery schools or universities, formal, non-formal or informal educational contexts. The theme can link parallel phylogenetic and ontogenetic learning processes, both in terms of the history of human ways of learning and being and our understanding and awareness of ways of learning and being, reflecting on ways of learning and being, posing problems related to why, what, how I have learnt, participating in activities that also constantly involve asking the question "what if ...?". Such imagining of alternatives should be seen as indispensable for true understanding of what we know (Gramsci, 1971) and the predicting involved should be considered not just as abstract hypothesis but rather as an urgent prerequisite for intelligent action.

The initial focus for the theme can be that of considering and practising, imagining and experiencing human and personal learning as discovering the world, initially perceived as a world *that is as it is*, unchanging and outside me, to explore, measure, describe, draw, a process of creating maps and imagining unknown parts still to be mapped, calculating dimensions of what exists, exploring new horizons and producing narratives of this experience, constructing different spatial scales and building relative borders within space, developing types of language and using metaphors to mediate and transform experience, create different ways of representing reality and establish frames of reference.

Gradually the idea of a changing world emerges, a world that develops and grows in complexity, something that, rather than static, becomes dynamic, rather than a-temporal, becomes evolving, something with a history that ranges from the formation of planets to the movement of plates and colonisation by forms of life, the emergence of biomes, climatic zones, ecosystems, cycles of matter, the causes of spatial and temporal changes, the crucial role of solar energy, gathering data and making predictions. This changing world becomes one in which life itself changes the world. I perceive life as a cause of change, ranging from the large-scale effects of life on the environment, from dolomitic deposits to the composition of the air and climate changes to the small-scale effects of life on the environment, niches and biodiversity.

At a crucial point the relationship between my knowing and my acting involves a movement from representing to remodelling, my knowledge becomes related to - both determined by and potentially aware of - the development of human communities and territories. From the first communities and their reciprocal interactions with their environments in different parts of the world, the development of anthropic spaces and environments based on science and technology, distancing and reification, spreads voraciously, leading to present day communities, a world of omnivores and populations, local and global inhabitants, a prevailing idea of knowing and acting as incorporating for using, employing measures of utility, producing ecological footprints, determining biocapacity, a parallel socio-cultural construction of beliefs, norms and stereotypes related to categories such as ethnic origins, gender or status.

Gradually I become conscious that if our knowing and acting are to be sustainable, they must be based on awareness of possible ways of being and possible worlds to inhabit. Our recent history is based on new forces that emerge, the growth of science as an idea of the world and technology as a means of acting in that world often based on anthropocentric motivations and beliefs in progress and betraying ignorance of the "limits of human ingenuity in the face of complex dynamics" (Westley et al., 2011). I realise the importance of understanding and analysing past and present uses of technology, awareness of its

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[2]   I am indebted to Elena Camino for many conversations that have helped me develop ideas for the example proposed.

potential and impact, assessing future developments, the relationship between needs and opportunities and the exploitation of large-scale reserves of energy, new problems such as the distribution and the availability of water for all the uses of it we foresee, and the consequences that derive from such complexity. I realise the significance of changing concepts of borders, rules, means and time-scales for travel, ways of communicating and purposes/themes, ways of living and using territory, knowing people and places, new forms of understanding the cumbersome and overbearing presence of human populations, the need to redefine consumption habits in terms of what is a sustainable relationship between resources, products and services. I become aware of how knowledge building must crucially be linked to understanding feedback in complex systems, local changes, global effects, local consequences, of the necessity to understand the nature of spatial and temporal limits, the interdependence of all knowing and acting, the reasons for, presence and consequences of conflicts, sustainability relationships based on who and what sustains who and what, the need to identify and monitor bioindicators of environmental health, the crucial importance of moving from an anthropocentric to an ecocentric vision.

Conclusions

The principal idea of this paper is the crucial importance for educational processes of posing problems about human knowledge in order to build a paradigm based on sustainable knowledge. The sustainability of the human enterprise on our planet depends on building such knowledge. In this sense we need to create some common assumptions, starting from the main reason why we try to construct the paradigm: to promote an educational *process* and an educational *system* capable of promoting that process, made up of *agencies* that propose *institutional and environmental curricula* and learners who create their own *learning pathways* and thereby build their own *personal curricula*

and *life projects* based on awareness and responsibility in knowing and acting, foreseeing and producing outcomes.

Within this vision the constructivist idea of learning (that has thus far considered how we learn, but not why) addresses the vital question of why and what knowledge to build as well as how to build it and use it. At the same time, competence is considered as working together and towards (as in a constructivist model) rather than being in competition with (as in an economic functionalist model). In this way, teachers and learners can be seen as working together in a co-construction of knowledge and scenarios for social learning and sustainable being. Knowledge should primarily be seen as a resource, to be built, stored and used with care. Since all sustainability depends on the use of resources, sustainable knowledge depends on the use we make of it and the use we make of it depends on why we build it. As with all kinds of resources, this depends on our relationship with the ecosystems in which we live and that are the unique source and reservoir of all the processes that give rise to us and to our products on the planet we inhabit as *earthlings* (Latour, 2007).

Knowledge is always based on motivations and the consequent criteria that derive and determine its types and characteristics. In this sense knowledge is never innocent nor is it completely disinterested. All knowledge contains within itself a relationship with the specific nature of the knowledge builder and user, with the context of its construction. At the same time, how we know and how we use what we know are intertwined. Assuming that there are given, unquestioned bodies of knowledge to be learned and then applied as competence is not only an inadequate treatment of the relationship between learning, knowledge and competence but is incapable of assigning to knowledge-building competence its vital role in promoting sustainability. Sustainable knowledge is both resilient and transformable and at the same time promotes resilience and transformability.

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