The Importance of Multimedia Principle and Emergence Principle

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Extended Abstract

Keywords: Micro-theories of knowledge creation, evolutionary constructive objectivism, multimedia principle, emergence principle, episteme, theory of truth, metaphysics, evolutionary knowledge creation

The necessity of a better, more detailed understanding of knowledge creation processes in the knowledge based economy for the needs of today and tomorrow resulted recently in the emergence of many micro-theories of knowledge creation, as opposed to classical concentration of philosophy on macro-theories of knowledge creation on a long term historical scale. Historically, we could count the concept of brainstorming (A.F. Osborn, 1957) as first of such micro-theories. However, since 1990 we observe many such new micro-theories originating in systems science, management science and information science, beginning with the Shinayakana Systems Approach (Y. Nakamori and Y. Sawaragi, 1990), the Knowledge Creating Company and the SECI Spiral (I. Nonaka and H. Takeuchi, 1995), the Rational Theory of Intuition (A.P. Wierzbicki, 1997), the I5 (Pentagram) System (Y. Nakamori, 2000), the OPEC Spiral (S. Gasson 2004) and several others. This can be counted as a recent revolution in knowledge creation theories, because all of them take explicitly into account the interplay of tacit, intuitive, emotive, and preverbal aspects with explicit or rational aspects of knowledge creation.

Additional results concerning micro-theories of knowledge creation were obtained also in the 21st Century COE Program Technology Creation Based on Knowledge Science at the Japan Advanced Institute of Science and Technology (JAIST). For example, the brainstorming process was represented as the DCCV Spiral due to the research in this Program. The concept of Creative Space (A.P. Wierzbicki and Y. Nakamori, 2006) developed in this Program tries to provide a synthesis of such diverse micro-theories. The concept of the Triple Helix of normal academic knowledge creation combines three spirals: the Hermeneutic EAIR Spiral of analysing and interpreting scientific literature, the Experimental EEIS Spiral of performing experiments and interpreting their results, and the Intersubjective EDIS Spiral of debating and discussing research results; these three spirals characterize main creativity processes at universities and research institutions. The idea of Nanatsudaki Model of Knowledge Creation Processes (A.P. Wierzbicki and Y. Nakamori, 2007a) tries to derive pragmatic conclusions from such analysis and synthesis, by combining seven spirals (objective setting OPEC, hermeneutic EAIR, socializing SECI, brainstorming DCCV, debating EDIS, roadmapping I-System, and experimenting EEIS) in an order useful for organizing large research projects.

Parallel to the development of micro-theories of knowledge creation, we can observe the perception of change also in classical philosophy. As opposed to Wittgensteinian concentration on words and language with its prohibition to speak about metaphysics, or to postmodernist and poststructuralist belief that world is constructed by verbal discourse only, philosophy turns back today to metaphysical issues. This trend has already certain tradition, see L. Kołakowski (1988), but intensifies recently, see G. Żurkowska (2006), B. Skarga (2007); A. Motycka (1998) proposed also a model of knowledge creation during scientific revolutions, based on emotive and mythical, thus in a sense metaphysical knowledge. In relation to this trend, it is important to

realize that at least two results of the 21st Century COE Program Technology Creation Based on Knowledge Science – namely, the Multimedia Principle and the Emergence Principle – might have an important impact on new discussions of metaphysical issues.

These two principles were first formulated in (Wierzbicki and Nakamori 2006), further elaborated in (Wierzbicki and Nakamori 2007a) as a part of a new integrated episteme called Constructive Evolutionary Objectivism that we believe to be needed for the starting era of knowledge civilisation. However, since these two principles might have a basic impact on understanding of many issues, including such seemingly distant fields as technology formation and metaphysical issues, I decided to devote this paper to the examination of their importance.

We start with recalling these two principles:

Multimedia principle: words are just an approximate code to describe a much more complex reality, visual and preverbal information in general is much more powerful and relates to intuitive knowledge and reasoning; the future records of the intellectual heritage of humanity will have a multimedia character, thus stimulating creativity.

Emergence principle: new properties of a system emerge with increased levels of complexity, and these properties are qualitatively different than and irreducible to the properties of its parts.

Both these principles might seem to be just common sense, intuitive perceptions; the point is that in (A.P. Wierzbicki and Y. Nakamori, 2006) they are justified rationally and scientifically. Moreover, they go beyond and are in a sense opposed to fashionable trends in poststructuralism and the postmodern philosophy or sociology of science.

The Multimedia Principle is based on the technological and information science knowledge: the broadband needed for speech (words) is only 20 kHz, for vision is at least 2 MHz, thus requires 100 times more data. The complexity of processing large quantities of data grows strongly nonlinearly with the amount of data; taking quadratic growth as a lower bound, we obtain the conclusion that the difficulty of processing pictures is at least 10 000 more than processing words: a figure is worth at least ten thousand words. The poststructuralist philosophy stresses the roles of metaphors and icons, but reduces them to signs; the simplest argument against such a reduction is presented in Fig. 1, where the temple of Byodoin as an icon (Japanese 10 yen coin) and Byodoin as a picture are compared. The icon serves only as a metaphor, while we would have to use many words to describe the details of the picture.

Fig. 1. An icon (left) and a picture (right) of Byodoin

Thus, the world is not constructed by us in a social discourse, as the poststructuralist and postmodern philosophy wants us to believe (see, e.g., J. Derrida, 1974): we observe the world by all our senses, including vision, and strive to find adequate words when trying to describe our preverbal impressions and thinking to communicate them in language. Language is a shortcut in civilisation evolution of humans, our original thinking is preverbal, often unconscious, related to intuitive and emotive or jointly tacit knowledge, and this form of thinking is much more powerful and creative than verbal, rational thinking. For a more full description of the functioning and power, of an evolutionary rational theory of intuition, see (Wierzbicki 1997, 2005). The only problem is that our preverbal intuition is not infallible, as it was postulated by Descartes or Kant; it is very much fallible and thus we must use verbal, rational reasoning and logics to initially check our intuitive ideas for their consistency – either internal or with other parts of human heritage knowledge. Further checking, at least in technology, requires empirical testing.

However, this clear distinction of preverbal and verbal thinking and knowledge, and the proof that preverbal is much more powerful, implies that we should also re-evaluate many assumptions in metaphysics. We could thus divide metaphysics into three areas: 1) metaphysics of the unconscious and preverbal; 2) metaphysics of the ultimate and absolute; and, in a sense between them, 3) metaphysics of truth. The ontological pressure rightly stressed by J. Srzednicki as the metaphysical source of knowledge (see, e.g., G. Żurkowska, 2006) is the pressure of preverbal information about beings surrounding us, and can be rationally analysed using multimedia principle; we only need new words, concepts and metaphors when we try to speak rationally about preverbal issues.

On the other hand, since Multimedia Principle originates in technology, it has also diverse implications for technology creation. Technologists know well and treasure visual ways of presenting information; but Multimedia Principle implies more. First, it implies that information technology creation should concentrate on multimedia aspects – including visual, but not limited to them - of supporting communication and creativity. Second, it implies that technology creation starts essentially with preverbal thinking, which might be one of the reasons of the differences between the episteme of technology and that of social sciences and humanities.

Diverse ways of creating knowledge belong to the episteme – the prevalent way of creating and justifying knowledge, characteristic for a given historical era or a cultural sphere. However, the episteme of the industrial civilization, called sometimes the modern episteme, was subjected to a destruction process, particularly visible in the last fifty years. This has lead to a divergent development of separate episteme of three cultural spheres: that of social sciences and humanities (diversified internally, with postmodern subjectivism as its most divergent variant), that of hard and natural sciences (following mostly paradigmatism, see T. Kuhn, 1962), and that of technology (as we shall see, following mostly falsificationism, see K. Popper, 1972): they use different languages, but more important is the fact that they use different fundamental epistemic concepts and different ways of constructing and justifying knowledge, see (A.P. Wierzbicki 2004).

For example, the word technology has many meanings: it can mean:

- ✓ For a post-modern social scientist: an autonomous force enslaving humanity;
- ✓ For an economist: a way of doing things, a technical or technological process;
- ✓ In common language: a technical artefact, a product of technology;
- ✓ For a natural scientist: an application of scientific theories;
- ✓ For a technologist: the art of constructing tools, an inherent faculty of humanity, motivated by the joy of creation:
  - ✧ Liberating people from hard work;
  - ✧ Helping technology brokers (venture capitalists, bankers, managers) to make money - and if any effect of that is enslaving, the brokers are responsible;
  - ✧ Stimulating the development of hard science by inventions which give it new principles to develop new concepts.

If we take the definition of technology from the most competent stakeholders – the technologists themselves – then the statement technology is the art of constructing tools (by the way, this is also consistent with the definition given by M. Heidegger, 1954) implies several related conclusions. This is only one of the ways of understanding the word technology, hence we should call it technology proper, in distinction to technological processes, or technological products, or socio-economic applications of technology. Technology creation is an art, hence it is learned mostly by doing, it is a highly intuitive activity: you can teach technology at an university, but being a technologist implies that you have personally constructed some tools, have actual experience in inventions and technology creation.

It is aimed towards creating tools, called also technological artefacts or products of technology – misnamed by shortened expression technology in common language, what is often unfortunately repeated even in scientific texts. But intuitive, artistic creation of tools implies also that you cannot fully formalize this activity: no matter what quality control you apply in technological processes, a new tool might always be dangerous. Therefore, tools are tested rigorously, subjected to destructive tests. It is well known, e.g., in the case of cars; that the safety of their use must be checked by crash tests; but actually all tools are tested that way to some extent, e.g., laptop computers are tested by being dropped to the floor to check their reliability.

On the other hand, every tool might be used inappropriately: even a perfectly constructed smith's hammer might hurt the user, if she/he wants to apply it for fixing fine nails. Thus, any evaluation of safety of a technological product must take into account the character of its socio-economic application: even if engineers designing cars test them most rigorously, people's fascination with fast driving results in a number of deaths that exceeds many other causes. This distinction between the safety of a technological product used reasonably and the danger of social fascination with certain aspects of such products seems to be lost to some philosophers of technology.

To summarize: testing technological knowledge, embodied in tools as products of technology, relies on direct applications, including destructive tests to check their safety and reliability; thus technology, as opposed to science, follows falsificationism in its everyday practice and is more pragmatic than paradigmatic; see also (A.P. Wierzbicki 2004), (A.P. Wierzbicki and Y. Nakamori 2007a) This distinction between technology and science is also overlooked by most philosophers of technology – and the concept of technoscience (B. Latour, 1987) is thus a misnomer, even if there are obvious relations between hard science and technology.

As opposed to technologists, postmodern sociologists of science ridicule falsificationism, saying that scientists never try to disprove, they want rather to confirm their theories; they do not even notice that tools are not theories and that they are usually falsified, and that their arguments against objectivism (B. Latour, 1987) might be based on logical errors (the lack of understanding of temporal logic and feedback mechanism, where the same phenomenon can be counted both as a cause and effect, see final part of this paper). These controversies illustrate that the differences in the episteme of diverse cultural spheres are actually very big.

Therefore, in (A.P. Wierzbicki and Y. Nakamori 2007a) we presented a proposal of a new integration of the episteme, much needed in the beginning era of knowledge civilization and called Constructive Evolutionary Objectivism. This integration is based on three principles: Evolutionary Falsification Principle (an extension of Popperian falsification towards an evolutionary perspective of human development of knowledge in long term historical sense); and the two principles discussed in this paper: Multimedia Principle and Emergence Principle. We are aware that the contemporary differences between the episteme of the three cultural spheres - social sciences and humanities, hard and natural sciences, and technology - are very great, thus the acceptance of such principles might take a long time. We are also aware that the principles we listed in the episteme might be modified during the adoption process. But we listed them precisely for that purpose, to present them as an object for discussion and possible falsification.

The Emergence Principle stresses that new properties of a system emerge with increased levels of complexity, and these properties are qualitatively different than and irreducible to the properties of its parts. This might appear to be just a conclusion from the classical concepts of systems science, synergy and holism; or just a metaphysical religious belief. The point is that both such simplifying conclusions are mistaken.

Synergy and holism say that a whole is greater than the sum of its parts, but do not stress irreducibility. Thus, according to classical systemic reasoning, a whole is greater, but still explicable by and reducible to its parts. The best recent example of the phenomenon of emergence is the concept of software that emerged during last fifty years. Software cannot function without hardware, but is irreducible to and cannot be explained by hardware. Thus, the Emergence Principle is opposite to reductionism. It must be stressed that hard and natural sciences, more paradigmatic than technology, still believe in reductionism; for example, researchers in physics believe that quantum computing will essentially change computational science – while it will essentially change only hardware, whereas software and its principles will remain practically unaffected.

The Emergence Principle is not a metaphysical religious belief, because it can be justified rationally and scientifically – even if it might have, as we shall see, serious metaphysical consequences. The emergence of new concepts and properties at higher levels of complexity was noticed long ago in philosophy. A clear formulation of the emergence principle, however, first evolved with the empirical evidence of the concept of punctuated evolution in biology (see K. Lorentz, 1965), noted also by (K. Popper, 1972); then it was rationally reinforced by the concept of order emerging out of chaos (see E. Lorenz 1963, I. Prigogine and I. Stengers 1984, J. Gleick 1987). In parallel, it was pragmatically substantiated by technology, in hierarchical systems theory (e.g., W. Findeisen et al. 1980), as well as in the concept of seven layers of telecommunication protocols (see, e.g., A.P. Wierzbicki and Y. Nakamori 2006). The last point is perhaps most telling: computer networks are the most complex technological systems today and we simply could not cope with their complexity if we did not separate their diverse functions into consecutive layers; the functions of the lowest, physical transmission layer are completely separated from higher layers, thus a change to optical or even quantum transmission does influence only the speed of communication and does not influence other functions of higher layers.

Thus, the Reduction Principle of the industrial episteme – saying that the behaviour of a complex system can be explained by the reduction to the behaviour of its parts – is valid only if the level of complexity of the system is rather low. Very complex technological systems today follow the Emergence Principle. This is important for technology creation: a technologist cannot be successful today if (s)he sticks to the Reduction Principle without understanding the Emergence Principle. This also stresses again the distinction between hard science and technology – and shows that the acceptance of the Emergence Principle might be slow because it is conceptually challenging.

The Emergence Principle, even if justified scientifically, rationally and pragmatically, might have, however, important metaphysical consequences pertaining to the philosophy of the Absolute, thus even religious metaphysical consequences. We can ask the question: why we have been always interested in reasons, causes, finally asking questions about the Absolute or God as the ultimate reason or cause? One of possible answers is that we, humans, are accustomed to reasoning by reduction to causes, thus have to ask also about the ultimate cause. But what if reduction is not the only way of explanation, if emergence is equally or even more important? Then even more important question is not about the ultimate cause, but about the ultimate effect, the goal of development. Thus, teleological reasoning and belief in God not as a creator, but the goal of all development – ideas that are certainly not new, but have been largely dismissed in recent times – are becoming justified in metaphysics of the Absolute when accepting the validity of the Emergence Principle.

Finally, the Emergence Principle has also an important relation to the metaphysics of truth, namely the philosophy of mathematics and to the concept of truth in mathematics, see Z. Król (2007). Let us recall here some elements of the theory of truth in formal languages. According to K. Gödel (1931), the question of truth cannot be answered inside a given formal system; A. Tarski (1933) formalized this issue further, postulating the use of a formal metalanguage in order to meaningfully address the issue of truth in a given language. However, Z. Król (2005, 2007), following ideas of I. Lakatos (1976) stresses that it is impossible to create and study mathematics as a purely formal, meaningless game: there is no mathematical theory which is absolutely (i.e., actually) formalised, there is no mathematical theory given as a formal system with a formal metalanguage. To have a strictly formal language one needs a formal metalanguage, to have a formal metalanguage one needs a formal meta-metalanguage, and so on – an infinite recursion. Thus, the only possible way is to stop and study fundamental assumptions in a non-formal, intuitive meta-environment. This intuitive environment is called hermeneutical horizon; Król shows that hermeneutical horizon has been changing historically, that "Euclidean geometry" has been understood differently (in the deepest interpretations of its axioms) by ancient Greeks, differently in times of Descartres, Newton, Kant, differently today. If this can be observed in mathematics, it applies as well in other parts of science: different paradigms use not only different, incommensurable languages, but – more fundamentally - are also related to different hermeneutical horizons, intuitive environments of perceiving the truth of basic axioms. This phenomenon is called horizontal change. This change is not frequent in mathematics; it might be more frequent in other disciplines.

However, even if historically changing, the perception of truth via hermeneutical horizon is not subjective, nor even intersubjective: we do not decide in social discourse what are the components of a hermeneutical horizon (at least, not in mathematics, technology, and hard sciences; the situation in social sciences and humanities might be different). The formation of a hermeneutical horizon is a process of a long term duration; since, on one hand, the hermeneutical horizon is intuitive, on the other hand it is common, say, for all mathematicians working in a given age, then its formation must be unconscious but related to the canon of teaching the given discipline – say, mathematics - in that age.

Based on the concept of hermeneutical horizon, we might turn back to the issue of basic explanations of development of science and technology. First we must select some basic assumptions that could be accepted independently from a disciplinary perspective. We thus propose to assume that science and technology develops historically and the development has evolutionary character: knowledge about theories and ways of constructing tools is preserved in some domain that we shall call the intellectual heritage of humanity, but this knowledge also evolves historically, better theories and tools are constructed and they gradually – or fast in revolutionary periods of punctuated evolution – replace the older ones. Here we already stipulate some basic concepts that actually belong to our hermeneutical horizon: the domain of development – the intellectual heritage of humanity (called before the third world or world 3 in K. Popper, 1972), including its emotive, intuitive and rational parts, see (A.P. Wierzbicki and Y. Nakamori, 2006); the concept of punctuated evolution, see (K. Lorentz, 1965), assuming that evolutionary development is not necessarily smooth, it might consist of slow normal periods and fast revolutionary periods; finally and decisively, the concept of evolutionary fitness: if old theories and tools are replaced, there must be some way of deciding which ones should be replaced, which should be kept.

Thus we must reflect: how human societies historically evaluated the fitness of theories and tools? We can start with a thought experiment: consider a group of people – say, an extended family, or a tribe - in early stages of the development of human civilization. This development depended on three main factors:

- ✓ language and communication;
- ✓ tool making;
- ✓ human curiosity.

Language was used as a tool of civilization evolution, but individual tool makers and thinkers, motivated by human curiosity, might have developed theories and tools. They were prompted to present their theories to the group, even to beautify and defend their theories – which confirms the concept of a paradigm; however, when it came to tools, they had to demonstrate that the new tools actually worked. Creative thinkers presenting new theories might have been rewarded evolutionarily in the biological sense, since eloquence might be considered as a positive aspect of mating selection. However, discourse could not be decisive in proving the fitness of tools and theories – in the case of tools obviously experimental testing was needed, in the case of theories we have to consider the evolutionary interest – in the civilization sense - of the tribe or the group that used the knowledge to enhance its success and survival capabilities. This evolutionary interest required long term falsification: personal theories and subjective truth that were too flowery must have been considered suspicious, finding ways to test them, even to falsify them, was necessary. Thus, Popperian falsificationism, Kuhnian paradigmatism and discursive intersubjectivism are three different sides of civilization evolution of humanity, all of them are needed in adequate proportions.

The question of adequate proportions in this thought experiment might help us to clarify the issue of objectivity versus power (or money), raised by postmodern sociology of science. The chieftain of such a tribe would be pragmatic and value knowledge that helped in her/his short term goals, increased her/his power; why should (s)he bother about objective knowledge? (S)He would, if (s)he cared about long term chances of survival of her/his tribe. We can apply here the axiom of uncertainty as used by J. Rawls in his theory of justice (Rawls 1971): in order to determine what principles we should consider just, we must imagine that we do not know in what conditions our children might find themselves and select such principles that would be most useful for them nevertheless. Note that the same axiom is also applicable to the issue what knowledge might be useful in the long term sense: if we do not know in which conditions our children or tribe might find themselves in the future, we value best well tested knowledge, as objective as possible. Thus, objectivity is similar to justice: absolute objectivity and absolute justice might be not attainable, but they are important ideals, values that cannot be reduced to power and money.

Besides, the attempts of postmodern social sciences to reduce objectivity to power and money – see, e.g., B. Latour (1987) – are based on an incorrect use of more advanced forms of logic, similarly as many philosophical arguments about vicious circle. We know today what is feedback - a dependence of evolving time-streams of effects and causes in the dynamic sense – thus the argument of (B. Latour, 1987, p. 99) against objectivity, "since the settlement of a controversy is the cause of Nature's representation not the consequence, we can never use the outcome – Nature – to explain how and why a controversy has been settled" indicates a clear lack of understanding of the diachronic, dynamic feedback character of the causal loop in this case. On this example, we can also analyze the relation of intuitive or instinctive judgments and rationality. It is difficult to experimentally verify knowledge in social sciences, hence they instinctively (or rather intuitively, in their hermeneutical horizon) prefer subjectivity or intersubjectivity to objectivity. Later they try to rationalize related conclusions – such as the reduction of objectivity to power and money. But the role and power of rationality is precisely to check such judgments for all logical consequences and for consistency (or, in this case, for the lack of consistency) with other parts of human knowledge – with the rational heritage of humanity.

We are prepared now to describe the relation of human knowledge to nature. First, we do not accept the hermeneutic horizontal assumption of B. Latour (quoted above) that "Nature" is only a construction of our minds and has only local character. Of course, the word nature refers both to the construction of our minds and to something more – to some persisting, universal (to some degree) aspects of the world surrounding us. People are not alone in the world; in addition to other people, there exists another part of reality, that of nature, although part of this reality has been converted by people to form human-made, mostly technological systems. There are parts of reality that are local and multiple, there are parts that are universal. To some of our colleagues who believe that there is no universe, only a multi-verse, we propose the following hard wall test: we position ourselves against a hard wall, close our eyes and try to convince ourselves that there is no hard wall before us. If we do not succeed in convincing ourselves, it means that there is no multi-verse, because nature apparently has some universal aspects. If we succeed in convincing ourselves, we can try to verify or falsify this conviction by running ahead with closed eyes.

Second, the general relation of human knowledge to reality might be described as follows. People, motivated by curiosity and aided by intuition and emotions, observe reality and formulate hypotheses about properties of nature, of other people, of human relations; they also construct tools that help them to deal with nature (such as cars) or with other people (such as telephones); together, we call all this knowledge. As formulated by W.V. Quine (Quine 1953), "the totality of our knowledge is a man-made fabric which touches experience only along its edges"; but knowledge cannot be useful without at least touching experience. Thus, people test and evaluate the knowledge constructed by them by applying it to reality: perform destructive tests of tools, devise critical empirical tests of theories concerning nature, apply and evaluate theories concerning social and economic relations.

Such a process can be represented as a general spiral of evolutionary knowledge creation, see Fig. 2. We observe reality (either in nature or in society) and its changes, compare our observations with human heritage in knowledge (the transition Observation). Then our intuitive and emotive knowledge helps us to generate new hypotheses (Enlightenment) or to create new tools; we apply them to existing reality (Application), usually with the goal of achieving some changes, modifications of reality (Modification); we observe them again.

It is important, however, to note that many other transitions enhance this spiral. First is the natural evolution in time: modified reality becomes existing reality through Recourse. Second is the evolutionary selection of tested knowledge: most new knowledge might be somehow recorded, but only the positively tested knowledge, resilient to falsification attempts, remains an important part of human heritage (Evaluation). Naturally, there might be also other transitions between the nodes indicated in the spiral model, but the transitions indicated in Fig. 2 are the most essential ones.

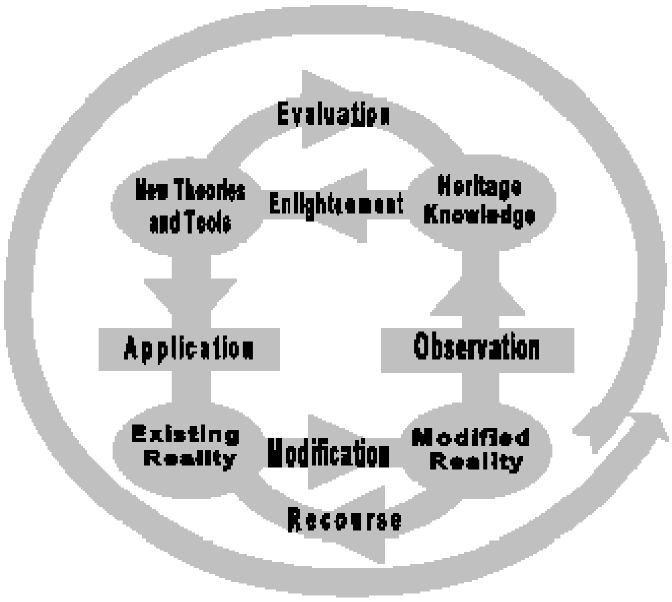

Fig. 2 The general OEAM Spiral of evolutionary Knowledge creation

Thus, nature is not only the effect of construction of knowledge by people, nor is it only the cause of knowledge: it is both cause and effect in a positive feedback loop, where more knowledge results in more modifications of nature and more modifications result in more knowledge. As in most positive feedback loops, the overall result is an avalanche-like growth; and this avalanche-like growth, if unchecked, beside tremendous opportunities creates also diverse dangers, usually not immediately perceived but lurking in the future. Thus, the importance of selecting knowledge that is as objective as possible relates also to the fact that avalanche-like growth creates diverse threats: we must leave to our children best possible knowledge in order to prepare them for dealing with unknown future.

This description of a spiral-like, evolutionary character of knowledge creation, see also (Wierzbicki and Nakamori 2007b), is consistent with our technological hermeneutical horizon and enhances Constructive Evolutionary Objectivism. It is also novel in the sense that even the best recent monograph concerning evolutionary development of scientific knowledge by (Jensen et al. 2003) or the insightful analysis of knowledge societies in (Stehr 1994) do not present this issue in terms of a spiral-like feedback loop; moreover, they follow rather economic than technological hermeneutical horizon, e.g., without distinguishing technology proper from its socio-economic applications.

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