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10. ECOLOGY OF INFORMATION, A BENEFICIAL COMPREHENSIVE APPROACH IN ARTS HIGHER EDUCATION

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Abstract: *Recent research carried out in various fields of knowledge have led to significant results, which are also decisively imposed in the sphere of the arts. These contributions expand not only the area of artistic practices (new means of artistic production are established), but also the range of approaches from art theory, related to these practices. Our study illustrates this fact through a review of the scientific literature: articles, specialized publications, monographs and programmatic documents of some relevant institutions. The complexity of the information constellation in which the practice and theory of art are circumscribed, in the recent period, is thus highlighted, which necessarily leads to new specific requirements regarding the instructional design in the field of arts higher education.*
Key words: *ecology of information, applied formal ontology, instructional design, artificial intelligence, virtual worlds*

1. Introductory considerations

The primary purpose of education is to train the future professional so that he/she becomes a valuable member of society well integrated in the social dynamics, both in the near and distant future. The various forms of learning (formal, non-formal and informal), some of which take place 'throughout life', situates the student in relation both with resources of the official educational system and with resources, realities, which are imposed by the socio-economic context. The dramatic evolution of digital information and communication technologies represents a long-awaited solution to the needs expressed in society, but, at the same time, poses a problem of adapting the human being to the complexity and sophistication in this field that is continuously growing.

Social practice has integrated us, more or less, willingly or unwillingly, in what Luciano Floridi calls the 'infosphere' (Floridi, 2014). According to his assessment, if we refer to the evolution of humanity, this paradigm shift could be defined as the fourth revolution, which is now redefining our reality. Floridi approaches this issue starting from a series of perspectives: temporal, spatial and identity ("TIME: Hyperhistory – "*The living generation is experiencing a transition from history to hyperhistory. Advanced information societies are more and more heavily dependent on ICTs for their normal functioning and growth. Processing power will increase, while becoming cheaper. The amount of data will reach unthinkable quantities*." "SPACE: Infosphere - *In the near future, the distinction between online and offline will become ever more blurred and then disappear*. [...] *As a consequence of the informatization of our ordinary environment, some people in hyperhistorical societies are already living onlife, in an infosphere that is becoming increasingly* synchronized, delocalized, *and* correlated." "IDENTITY: Onlife - *The social self is the main channel through which ICTs, and especially interactive social media,*

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exercise a deep impact on our personal identities." (Floridi, 2014) As a conclusion to this comprehensive philosophical reflection we may say that humanity faces a major paradigm shift, which calls for adequate, coherent and sustainable solutions in order to cope with the challenge of new Information Society.

The educational sphere, in general, if we refer to the diverse disciplinary area, as well as the various successive levels, is strongly influenced by the evolution of digital technology, benefiting in various forms of resources, means, concepts and even in the form of educational paradigms inspired by ICT ontology (Brown 2006, Brown 2015, de Oliveira et al 2015). The latest developments regarding the modeling of reality through immersive worlds (VR – virtual reality, AR – augmented reality, XR – extended reality) (Ebinger et al 2022) as well as artificial intelligence (AI) (Duggan, 2020) have been decisively installed in educational practice and theory, ranging from the 'updating' of practice in teaching laboratories[255], up to supporting data, knowledge mining and communication activities, as well as scientific research.

In particular, artistic education has greatly benefited from the involvement of recent digital technologies, some segments of this education achieving an adequate and necessary synchronization with artistic practice and creation in the field, which, for the most part, develops in advance and causes equivalent changes in the related educational process.

In a previous research, we proposed a short motivation on the importance one must give to the information-driven perspective, both as citizens of the Information Society and as professionals working in education. Moreover, we performed a brief review and explanation of the systemic vision and also the approaches named as 'applied formal ontologies' (Grigoraș 2022 citing Gruber 1993, Munn et al 2008, Guarino 2009). The remarkable results recorded in the last decade by information technologies are a result of the boost of the computing and storage power of digital machines, the increase of formalization capability (description, modeling by computer program) and to make inferences like in the case of artificial intelligence.

The most recent advances are based on the enormous amount of information that can be found as interconnected data on the Internet, as well as the high performance of inference engines based on semantic processing or pattern recognition. What brings together in a navigable, accessible, interactive whole, a wealth of entities that describe the reality in which we live (most of the inanimate ones, but also a large part of what constitutes the living sphere) is the 'horizontal', universal layer, which we generically call 'information'. "Big data is here to grow. The only way of tackling it is to know what you are or maybe looking for" (Floridi, 2014)

2. Ecology as a quintessential concept to be modeled by applied ontologies

Reality is approached by human mind by use of models, namely humans build information systems that formalize knowledge about perceived reality. All along known history one can identify attempts to model reality, which activity, in terms of today, we designate as 'knowledge engineering', that basically is knowledge representation and reasoning. Research in the domains of biology (study of plants

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and animals, most known are Carl Linnaeus - "Systema Naturae" - 1735 and Charles Darwin – "On the Origin of Species" – 1859), which led the way to the development of taxonomies (systematic classifications), but we must also mention research on natural language (human language) and the development of the formal (computational) languages which entailed construction of vocabularies, dictionaries, thesauri, classifications and other more complex, evolved, forms of systematic descriptions (see details below).

The study, the observation of nature represented an important way to come into contact with a series of models (constructs) characterized by internal coherence, viability and which inspired scientists, artists, sociologists, philosophers and other categories of investigators alike. One of the models that have acquired the status of a concept, which has become fundamental in the contemporary world, is the one related to 'ecology', namely the study of the relationships between living organisms and the environment in which they live.

The name was introduced in 1866 by Ernst Haeckel, being the basis of the future science with the same name that developed in the second part of the 19th century, by incorporating some other concepts among which evolutionism stands out, and which generated the ecological theory, a science with strong systemic foundations. Thus, beyond the coexistence of the component elements, their interaction and evolution within a well organized dynamics, which encourages systemic stability, balance, in the long term, is noted.

Ecology is an example of a complex natural system (various components, interconnections and temporal evolution) that can be employed as an archetype for an extended concept, successfully usable in other disciplinary fields. Thus, the ecological perspective becomes a universal way of modeling complex systems, whose context can be assimilated to a natural ecosystem.

Given the complexity of the Information Society, there is the approach by which, applying ecology-driven modeling concepts, we discuss information ecology, which deals with the approach of information ecosystems. Baker elaborates on information ecology: An information ecology provides a conceptual framework to consider data, the creation of knowledge, and the flow of information within a multidimensional context. [...] Complexity, ambiguity, and nonlinearity are part of an information ecology and addressed today by exploring multiple types of knowledge, developing information system vocabularies, and recognizing the need for intermediation. (Baker, 2007)

Burgin invoques 'ecological approach as a new methodology for Information Studies': Definition 2. Information ecology is a holistic study of information processing systems in the context of their surroundings by explicating patterns of, processes in and interrelationships between these systems and their components in the context of their environment. (Burgin, 2018)

While ecology as an extensive concept and study perspective implies definitions, principles, rules, data sets, it needs to be implemented in some way. Our opinion is that the best way to implement it is by building an Applied Formal Ontology (AFO, see Gruber 1993, Munn et al 2008, Guarino 2009, cited in Grigoraș 2022). According to Guarino, "An ontology is an engineering artifact constituted by a specific vocabulary to describe a particular reality." In other words, an AFO is a

computational construct, a model using concepts and artificial reasoning, in order to make a representation of a complex entity. The range of applications is quite large, like ontological analysis, conceptual modeling, knowledge engineering, knowledge management, information systems development and semantic technologies in general. Well known are bio-medical AFOs[256] and the Semantic Web[257].

Modeling through AFOs brings a series of specific advantages, extremely useful in the previously mentioned case of information ecology, namely portability (possible replication on similar cases), reusability (partial reuse of previous programming effort to develop a new case), scalability (facile adaptation to systems of various sizes), interconnectivity (easy dialogue with other external systems) and universal access (for users of various professional categories), interoperability and others.

3. Higher education approach to Ecology of information

Due to recent developments in the Knowledge Economy and Information Society, educational initiatives are under a high pressure not only concerning the content, the subject matter, managed in relation with the learners, but also new requirements arise regarding the instructional strategies, particularly the instructional design. Today, knowledge resources are navigable, interconnected, relational databases and, in accordance with the new realities of Information Society, new educational paradigms are in use. The roles of the teacher and of the learner evolved, in agreement with the available new technologies and paradigms, in such a way that the teacher is more like a mentor for the learner in the process of knowledge navigation and construction. In our days, the instructional designer takes the role of information configurator (Brown 2006, 2015), a specialist in building ecologies of learning. Higher education is thoroughly scrutinized with the aim of composing a vision for the near future. (GUNi 2022, Hashim 2022, Digital Education Action Plan, 2021-2027, Duggan 2020)

With focus on 'ecology' and AFOs, research in the field of higher education reports use or implementation of both perspectives, considered separately or combined in low scale systems, but it seems that the high potential of merging these two approaches for big scale systems (at the level of University or larger, life-long education for instance) has not been reached yet. While some papers deal with aspects of ecology concept involvement in learning theory (Campbell, 2022), or in collaborative learning activities (Vasiliou et al 2014), Muñoz and collaborators propose "an ontological model that provides intelligence and knowledge capabilities in the creation of a learning ecosystem.

The main objective of the model is to generate a learning ecosystem according to the needs and capabilities of the user. An ontological architecture is proposed that represents the knowledge management of the learning ecosystem from the vision of knowledge as a service." (Muñoz et al, 2019). Learning space regarded as 'ecology' of resources is a very generous idea, because "[a]s information and communication

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[257] Introduction to the Semantic Web (cambridgesemantics.com) https://cambridgesemantics.com/blog/semantic-university/intro-semantic-web/

technologies increasingly contribute to teaching and learning in higher education, digital ecosystem principles can help to understand how to maximize technology to benefit active learning." (Muñoz et al, 2019). Use of AFOs in Universities is extensively analyzed in the work of Tapia-Leon and collaborators. (Tapia-Leon et al 2018) Chimalakonda and Nori report "an ontology based modeling framework for design of educational technologies" (Chimalakonda et al 2020).

Arts education undoubtedly has certain specific attributes, due to the fact that human creativity, feelings and subjectivity are some of the foundational elements. Although considerations on the creativity or artistic abilities of the 'machine' (namely, computer systems) have been made for quite a while, recent developments in AI brought the discussion to high levels of controversial debates. Understanding and creating art with the help of computers has somehow acquired a quasi-historical perspective. (Cetinic et al 2022) Moreover, neurosciences recently brought to the fore the instauration of a new discipline, i.e. neuraesthetics, a sub-discipline of empirical aesthetics. (Chatterjee et al, 2022) While art production and education are very complex phenomena, which find roots in a wide range of historical references, current development in digital solutions offer appealing assistance to either artists or teachers and students.

In this quite intricate panorama comprising art production (which most of it ends up in digital worlds), art education (which extends the studio, as learning space, to larger ecologies of knowledge and practice), digital platforms (professional and popular ones) we identify a potentially generous solution for the high level of instructional design of the future. It may require collaborative teams of specialists belonging to the educational realm, also to applied ontological modelling informed with the perspective of ecology as universal complex concept.

According to personal experience within international educational exchanges, we found that, at least in the arts domain, the study programmes contain disciplines which are more or less interconnected in terms of subject matter. This is mostly due to the limited time covered by the study programme, consequently the teaching focuses more on highly significant content. The solution we see fit is to introduce a specific discipline which takes the role of 'gluing' together the discrepant content into a 'information ecology' which can be a foundation for a very useful 'learning ecology'. The learning context defined in terms of ecology could be extended to higher levels than study programme, namely integrating resources from the University (Library, laboratories, relevant disciplines from other study programmes, etc.) and moreover resources outside the University (employers, external relevant resources like museum collections, galleries, hubs and relevant individuals, institutions – local and international ones).

The important comment here is that the ecology implementation transcends mere accumulation of resources, in the sense that is the result of a careful study of the complex and dynamic reality involving those resources. The above mentioned world of resources is actually in use by current educational practice, maybe only under the guidance of the teacher, but lack of systematic approach may lead to partial, improper use or occasional use. The learner has to have immediate and unrestricted access to all needed and available resources in order to fulfill his/her goals in learning. The approach to teaching and learning in terms of information

ecology modeled by AFOs may have also multiple advantages like easy integration of 'Outcome-based education' and extensive use of Professional competency standards. (Lester, 2017)

4. Conclusions

In this paper, we outlined the impact of two important paradigms, namely 'information ecology' and 'applied formal ontology' methodology of modeling, in contemporary higher education. Based on their strong capabilities of conjointly describing complex, dynamic systems in an advantageous manner, we proposed that the future of instructional design should take into consideration these two paramount paradigms for the further development of complex high level ecologies for teaching and learning, as powerful information environments for the education of the next generations.

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