INFORMATION SCIENCE SYLLABUS AND TEACHING PRACTICES WITHIN THE HIGHER EDUCATION

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INTRODUCTION

Born in USA, in 1968, the Information Science became meanwhile a genuine adult science in its own rights. In 2008 it will celebrate its 40th anniversary!

According to Le Coadic [2] , "the today's Information Science is including a definition of its *study object*, a set of *methods*, a lot of basic *concepts*, some fundamental *laws* and *models*, etc. In addition, Information Science is more and more concerned with its own history; that is a mark of its maturity!"

According to other authors, Information Science and Information Technology are today the fundamental enablers of Information Society [1].

1. THE DEFINITIONS OF INFORMATION SCIENCE

In October 1961 and April 1962, the *Georgia Institute of Technology* (USA) organized two important conferences dedicated to the development of information scientists' movement. These conferences recognized the *need for education in Information Science* and published a *first definition* of Information Science.

<*Information Science* is a science that investigates the properties and the behavior of information, and the means of processing information for optimum accessibility and usability. The processes include the organization, dissemination, collection, storage, retrieval, interpretation and use of information>.

According to Debons and Otten [3], Information Science could be seen as a *metascience of information* (or *Informatology*) that was developed in response to the need for a critical reevaluation of the foundation upon which many information disciplines and technologies are based today. It could be defined as "the study of the fundamental principles underlying the structure and use of information".

Debons and Otten identified and expressed in this manner *the needs* for the existence of such a “metascience of information”:

<1.There is a need to provide a *common basis* upon which all information-oriented specialized sciences and technologies can be understood and studied

2. A *common framework and language* must be established to serve technologists concerned with information

3. There is a need *to build bridges* between the abstract theories attempting theoretical explanations of the phenomena of information, on the one side, and between the predominantly empirical theories describing man’s relationship to information phenomena, on the other side”

Some *questions* to be answered by Information Science (as metascience of information) may be, according to them, the following:

<1.Can the concept of *selective information* (of Information Theory) be extended to permit the measurement of semantic or qualitative information? (*Information Theory and Semantics)*

2. Can the various forms of information processing be analyzed in the form of common elementary processes and can these processes be described by fundamental laws? (*Mathematical Logic, Automata Theory, Computer Science*)

3. How can different methods of information processings, which achieve the same results, be compared and what are suitable quantitative measures that will enable the differentiation of the complexity and efficiency of operations on information? (*Computer Science, Computational Linguistics*)

4. How does man associate meaning with information and what is the relationship between meaning and his established value system? (*Psychology, Philosophy, Semantics*)

5. What are the laws that make natural languages (including in their widest sense music and forms of artistic expression) the universal means of formulating/creating and communicating new concepts and ideas? (*Linguistics, Semantics*)

6. What are the interrelations between the forms of energy, matter and order (or structure) and the use of these forms to represent ‘selective information’? (*Information Theory, Physics)*

7. What are the physical limitations of communication, information processing and information storage? *(Communication Science, Brain Research, Storage Technologies)*

8. What are the laws governing the organization of information as it applies to mass information storage and retrieval? *(Experimental Psychology, Library Science, Computer Science, Brain Research)*

9. What are the laws of information dissemination which explain the processes of cognitive perception? *(Educational Psychology, Self-Adaptive Systems Theory, Cybernetics)*

10. Are there properties of information which stimulate creativity? ; Is creativity an information processing function for which laws can be developed? (*Cybernetics, Artificial Intelligence, Semantics)*

11. What are the laws of information accumulation, updating and assimilation? *(Educational Psychology, Library Sciences, Computer Science)*>

These questions are not at all exhaustive but they are very representative and relevant for the information scientists' expectancies in 1970. After 35 years, one can find that some questions were answered (especially by contributors residing in USA, EU and Canada) but for a lot of other questions, World's information scientists still have to provide adequate answers!

Hawkins noticed that "a working definition of Information Science had never been developed by Plenum" and quoted different definitions proposed – during over 30 years! – by Hoshovsky and Massey (1968), Klempner (1969), Giuliano (1969), Harmon (1971), Farradane (1980), Diener (1989), Bohnert (1989), Williams (1987-1988), Rayward (1996), Bates (1998), Morris and McCain (1998), Ding, Chowdury, and Foo (1999), McCreadie and Rice (1999), Summers, Openhheimer, Meadows, McKnight, and Kinnel (1999), Buckland (1999) and Saracevic (1997, 1999).

All these definitions and concepts were brought together into a recent and useful ISA *working definition* of Information Science:

<*Information Science* is an interdisciplinary field concerned with the theoretical and practical concepts, as well as the technologies, laws and industries dealing with the knowledge transfer and the sources, generation, organization, representation, processing, distribution, communication, and uses of information, as well as communications among users and their behavior as they seek to satisfy their information needs.>

2. "INFORMATION" – A DIFFICULT CONCEPT

The "information" concept – as it was employed within different disciplines (computer sciences, communication sciences, electronics, telecommunications, mathematics, library science, documentation, journalism, linguistics, biology, psychology, etc.), during many years – had a *heteroclite, ambiguous, polyvalent and unclear* character, despite its considerable *heuristic value*. [1] In 1978 Trauth found twenty definitions of concept „information" [5]. She categorized them into four groups of meaning:

<1.Definitions stressing *the external movement of information* itself

2. Definitions assuming that information would be a *process-oriented concept* in that movement from information source to the information destination

3. Definitions viewing information as an *object operating within some dynamic process* (such as decision making or problem solving)

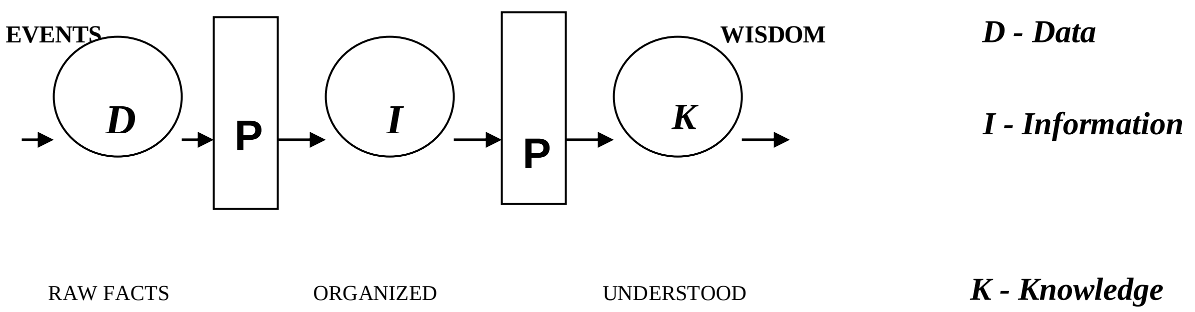
4. Definitions seeing information as *fact or discrete data elements*>

Based upon these definitions, Debons concludes that words "data", "information" and "knowledge" can be used interchangeably, depending on context and intention [5]. Hence, an *integrative approach of these concepts and of their applications* would be <much more effective>.

For purposes of this paper let us consider the following definition of "information concept:

Information = set of data, ideas, findings and / or creative works realized and transmitted by living or non-living things. In a given context, information has a specific *meaning*, which can be communicated, stored and preserved by means of an *information conveyor* and an *identification code*.

Information concept may be thus defined as a collection of "data" representing facts (and structured as answers given to a set of questions) and organized in such a way that they have additional value beyond the value of the facts themselves. I/"Information" concept should not be confused (see Fig. 1.1) with concepts of D/"Data" (related to raw facts or events) and of K/"Knowledge" (which relates to answers given to another set of questions and representing understood information).



DATA INFORMATION

(what? who? when? where?) *(why? how?)* ***P - Process***

Fig. 1 - From *Data* to *Knowledge* and from *Events* to *Wisdom*, through *Information*

Generally speaking, the « information » – as « data » organized in order to be understood and to become « knowledge » – is the object of some activities, obeys to some phenomena, models, laws and theories, may be stored at individual or institutional level (on a material conveyor – for example *the document* – or on a immaterial conveyor – like, for example, *the electric signal*) and may be "consumed" immediately or used again later. The amount of information produced, communicated, stored and used, around the world, during the last 20 centuries augmented continuously according to an exponential law.

Until the advent of Information Science, the old information professionals (i.e. documentalists, librarians, bibliographers, journalists, etc.), the old information techniques and technologies as well as the precursory disciplines of Information Science (library science, documentation, journalism, etc.) were predominately involved almost only in the processing and transfer of *information conveyors* (especially *documents*). These old information professionals involved themselves only occasionally also in the processing and transfer of conveyed data and information and / or in the information acquisition / generation and information use. These were considered - usually and traditionally - as being an exclusive matter and concern of users!

3. THE PROCESSES STUDIED BY THE INFORMATION SCIENCE

The Information Science is based on an *interdisciplinary* approach as well as on some *multidisciplinary* processes.

A worldwide known model of communication is the so-called *Model of a General Communication System* developed in 1948 by Americans Shannon and Weaver, in their basic work entitled *Mathematical Theory of Communication*. Based upon some concepts, models and theories provided by Americans Nyquist, Hartley and Laswell, its authors gave to word „*communication"* a very broad sense in order to include <all procedures allowing to one mind to affect another mind> (as for example, by written or verbal messages, by sounds or images, etc.).

Weaver proposed to classify all possible problems of communication in three categories:

-a *technical* problem: how accurately can be transmitted the symbols of communication's message?

-a *semantic* problem: how precisely do the transmitted symbols convey the desired meaning?

-an *effectiveness* problem: how effectively does the received meaning affect conduct in the desired way?

He recognized that all these categories of problems are closely interrelated and overlapped in a "rather vague way"…Shannon himself stated that "the semantic aspects of communication are irrelevant to the engineering aspects"! "But this does not mean that the engineering aspects are necessarily irrelevant to the semantic aspects" – commented Weaver! Today, this fundamental work – known also as *Shannon's Information Theory* – is considered as "an attempt to quantify the movement of signal through space and time" (Debons). After 50 years it is obvious that this model (Fig.2) and its concepts are fundamental in order to understand and solve only *technical* problem of communication (as for example those related to channel efficiency and optimization of signal-noise ratio). *Semantic* and *effectiveness* problems of communication have to be solved by Information Science….

According to this model, an *information source* generates a *message* **m** (containing generally selected written and / or spoken words, sounds, images, etc.). This message is conveyed by a corresponding *signal* **s** (converted from *message*, by *transmitter*) through a *channel*, to the *information user* (where the signal is converted back into a message, by a *receiver*). The signal **s** – as information immaterial conveyor – may be affected during its propagation through the transmission channel by the noise **n** (a general special concept including all possible unwanted impairments of signal and affecting its quality). This model included a feedback loop that was introduced later by Norbert Wiener - "the father of cybernetics" - in order to optimize the communication between source and user (since, thanks to **n**, signals **s** and **s'** as well as messages **m** and **m'** may be quite different…

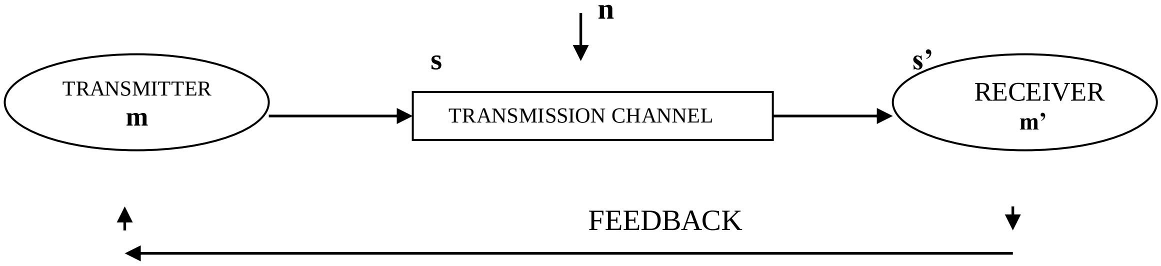


Fig. 2 – Classical model of communication and information transmission processes

Within our daily life, the terms "information" and "communication" are often considered synonymous, so that the expression "information communication" may be considered as being redundant.

According to a social model called "information cycle", ***information communication*** (or, simply, ***communication***) is an *information transfer*, i.e. a movement of meaning. It has not to be confounded with the ***information transmission*** *without intent*, representing purely a conveyance of energy. In other words, *communication is an information transfer or an information transmission with intent.*

Communication may be seen also as *a knowledge transmission*, i.e. as a conveyance of understanding.

Consequently, communication is a very complex social and psychological phenomenon investigated for many decades, by a lot of researchers, around the world.

Some basic today applications of Information Science are: Problem Solving, Decision Making, Paperwork Reducing, and others.

4. RESEARCH AREAS IN INFORMATION SCIENCE AND TECHNOLOGY

The main research in Information Science and Technology was undertaken in the following seven basic *research areas*

A. Information needs, ways of information circulation and use, individuals and collective communication behaviors, man-machine relationships, etc.

B. Structure of signs and symbols contained by different kinds of data, their operation within the communication process, natural and artificial languages, semantic and semiotic analysis, automated processing of texts, automated linguistics and automated translations

C. Documentation techniques, classification and indexing systems, content analysis of documents, computer aided processing (partially or integrally, of all above mentioned tasks), design and implementation of systems enabling the information storing and retrieving, structuring of data bases, automation of some documentation chain tasks (index and bibliographic information editing, etc.), automation of some of library's specific operations, network development, information systems units management, etc.). *Till now, the most numerous research works were undertaken in this third basic area.*

D. Surveys and evaluations of information based operations, at all levels (by means of qualitative and quantitative measurements of performance as well as of simulations)

E. Recognition of alphanumeric characters, voice analysis and recognition, sounds processing, image analysis, recognition and processing, artificial intelligence, auto-adaptive systems

F. Economical, legal and social aspects of information (intellectual property rights, information systems' security, economic and social impacts, systems' ergonomy, etc.)

G. Education, training and teaching methods, information professions (genesis, evolution, limits, etc.)

The distribution of these seven *research areas* A, B, C, D, E, F, G within the four *basic processes of information* (generation, communication, storage and use processes) is shown in the Fig.3

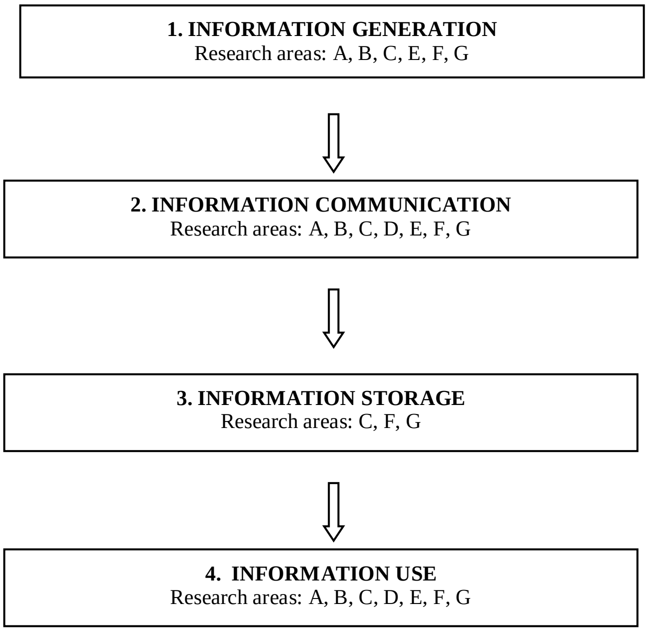


Fig. 3 – The Four Basic Information Processes Investigated by Research in Information Science and Technology

4. INSTITUTIONNALIZATION OF INFORMATION SCIENCE

The emergence of Information Science was accompanied by the set up of some specific structures aiming to confer "scientific and social statutes to this new science" [2]. These structures and institutions were: *scientific journals, data / information banks, scientific and professional societies / associations* and ***higher education schools*** - all dedicated to Information Science.

According to Flood [7], "the need for education in Information Science was recognized in USA at the beginning of the 1960s".

In USA there were, in 1963, three higher education schools that offered specific education and training in Information Science matters. They were: *Georgia Institute of Technology* (with an "engineering approach"), *Lehigh University* (with a "theoretical approach with philosophic, mathematical as well as engineering components") and *Drexel Institute of Technology* DIT (today Drexel University, with a "more applied approach designed to prepare practitioners"). Disciplines of the program implemented in DIT, for example, emerged from interdisciplinary sources in response to perceived needs. The principles taught in the original DIT Information Science MS Degree curriculum "endure as central to Information Science", according to Flood.

Today, Information Science is taught in USA IN some dozens of universities…

In France, the first higher-education "specializations" in the domain of Documentation were proposed in 1950, by the *CNAM = Conservatoire national des arts et des métiers*, through the *INTD = Institut national des techniques de la documentation* [2]. During many years, INTD was the only one French higher-education school offering a full education and training program in *Documentation* matters.

The first French education and training programs in Information Science (they were called "Maitrise de science de l'information et de la documentation" / *Master of Information Science and Documentation*) were offered, beginning with the year 1990, by the Universities *Université Nancy I* and *Université Paris V*. In 1992, other Universities decided to propose such programs: *Université Paris I, Université Paris VIII, Université Paris X, Université d'Aix-Marseille III*, and *Université de Lille III*. A specialized higher-education school was founded: ENSIB - *Ecole nationale supérieure des sciences de l'information et des bibliothèques.*

5. « INTRODUCTION IN INFORMATION SCIENCE » - A SYLLABUS FOR HIGHER EDUCATION

(Cours: 40 heures ; Workshops : 20 heures)

Based on the author's experience in teaching Electronics related disciplines (including Theory of Information Transmission), it was conceived the following Syllabus of an introductory course entitled « *Introduction in Information Science* ».

It was applied to the courses taught by the author in United States of America (at the University of Pittsburgh, Pennsylvania), in France (at the Ecole Nationale Supérieure d'Electronique et de ses Applications, ENSEA) and in Romania (at the University Polytechnics of Bucharest).

Teaching objective of the course: supporting students' actions with a view to continuously improve their learning strategies.

Syllabus content :

1. Information

1.1. Definitions, characteristics, classifications

1.2. Information and knowledge; information and communication

1.3. Measure of information

1.4. Conveyors of information

2. Fundamentals of Information Science

2.1. Historical premises

2.2. Information Science forerunners

2.3. Interdisciplinary approach and multidisciplinary processes.

2.4. Information Science pro cesses

2.5. Concepts, methods, laws, models and theories of Information Science

2.6. Institutionalization of Information Science

2.7. Towards the Information Society

3. Applications of Information Science in education and training

3.1. *Memorizing* (Memory operation, Methods for improving memory operation, Learning strategies, Mnemonic techniques)

3.2. *Jotting and reviewing notes* (Principles of jotting, Techniques of notes reviewing)

3.3. *Summarizing courses* (Panoramic reading, Analysis and synthesis, Drafting)

3.4. *Summarizing published texts* (Nodes and relations diagram, Graphical summary, Diagrams, Maps)

3.5. *Preparing and confronting examinations and tests* (Written examination, Oral examination, Answers drafting)

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