

Exploring OER: Internet Information Literacy, Problem Solving and Analogical Thinking

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«En vérité, j'ai toujours voulu et aimé enseigner, mais enseigner surtout pour connaître. C'est en enseignant que je peux continuer ma quête vers la connaissance du mouvement. C'est en enseignant que je comprends mieux comment «ça bouge». C'est en enseignant que j'ai découvert que le corps sait des choses que la tête ne sait pas encore ». [1] Jacques Lecoq

Abstract

In adult learning education contexts, the Internet Information Literacy (IIL) process comprises not only of fundraising for its immediate use, but in particular conditions it also requires to “shed light” on a problematic condition using open educational resources (OER) that incorporate analogical thinking into professional problem solving. This paper presents a model to apply analogy in problem solving (PS). Based on studies, on experimental evidence found in specific literature, and on empirical data obtained from a case study, the model focuses on the awareness level that professional adults engaged in learning activities have in applying this thinking process. Their use of the web and of OER serves multiple purposes: for self-guided training, to plan educational activities, to solve problems or to express their creativity. Field experience conducted during three annual editions of teaching IIL in the specialisation course *Social software and Web 2.0 for didactics and education* highlighted the importance of setting up online, problem oriented activities which focus on analogical thinking and a creative use of OER.

Keywords: Open Educational Resources, Internet Information Literacy, creativity, analogical thinking, problem solving, Information retrieval, analogy retrieval.

Introduction

This article was inspired by personal experience in teaching an online module, Internet Information Literacy (IIL), as part of the university specialisation course entitled *Social software and Web 2.0 for didactics and education* [2] and from some theoretical considerations on the importance of analogical thinking in promoting creativity. The course, conceived for adults working in different professional environments, analysed forum discussions on IIL and the results of a questionnaire which participants had filled out during the three annual editions of the course, from 2008 to 2010.

In considering forums, it is worth noting that the participants (teachers or professionals) who attended the course applied the proposed technological tools, uncovering the actual problems they face on a daily basis. The latter can be better clarified by IIL, by surfing the vast and complex world of information, by knowledge sharing tools and of OER. Online research is often launched from a perceived need to obtain information on knowledge and education. Open resources can therefore meet such needs as they are not only easy to apply and to transfer but they also trigger analogical thinking which is recurrent in professional problem solving.

The questionnaire illustrates that participant awareness of the reasoning strategies involved in both processes, information literacy and problem solving (PS) was scarce. It underscores the that research and education on creative strategies, especially analogical thinking, can have ample ground in the field of science education. In managing online training activities, and from forum discussions, *Internet Information Literacy skill* comes into play whenever a professional encounters theoretical or practical problems requiring the search, elaboration and presentation of information (or integrated information systems) to improve professional problem-solving ability. A concrete example could be a teacher seeking to acquire new teaching methods who resorts to using the Web 2.0 tools. In such case, a complex process in which acquired and consolidated knowledge blend with new knowledge must be activated when planning additional activities or subjects for the students. From this perspective, the ability to retrieve or develop OER is needed, and is often related to their use and to professional practice. (Ehlers and Conole, 2010; Geser, 2007).

In an context other than a school or university, as for instance in a private or public organization, the same process is often launched whenever a professional issue has to be investigated, be it related to an individual

or to a group, within work groups or in a community of practice. Analogical thinking is a kind of creativity, that is, a feature of learning and of symbolic and interpretative creativity of human beings. Several approaches and examples have been used to improve understanding: theories, models, procedures and techniques. They serve to “regulate” or to encourage the artistic and scientific production in learning environments (Hadamard, 1945; Guilford, 1950; Osborn, 1959; Wertheimer, 1959; Koestler, 1964; Gardner, 1983; Wartofsky, 1980; Wiener, 1993; Runco, 1994).

Creativity is a process which realizes “something” new, like a theory, a word, a technique, a material or a cognitive artefact. This is new to the person that produces it or for the domain of interest. It is possible to point out the analogical reasoning as a particular process that facilitates creativity.

Not all studies on creativity have addressed the issue of analogy. For instance, inside the wide range of literature concerning creativity, there are some important principles or theories as “Productive thinking”^[3] (Wertheimer, 1965), “Divergent thinking”^[4] (Guilford, 1950, 1967), “Lateral Thinking”^[5] (De Bono 19..), “Bisociation”^[6] (Koestler 1975), “TRIZ model”^[7] (Altschuller, 1999), just to mention some well-known.

Concerning the relationship between analogical reasoning and creativity only a part of studies and articles have shown the close relationship between these two aspects (Polya, 1954, Sternberg, 1988; P. Johnson-Laird in Vosniadou and Ortony, 1989; Gero and Maher, 1991; Hofstadter, 1995; Christensen, 2005; Ross, 2010).

The concept of analogy becomes a principle for the explanation or the invention of knowledge. It is in this meaning that creativity plays an important role to manage IIL and PS processes. Creativity can be the ability to search and discover the proper analogy to solve a cognitive or practical problem. In the IIL cycle, the creative process is pivotal. It involves research, the use of open resources and a study of suited analogies to apply to professional PS.

The purpose of this paper is to show that during a PS process the information retrieval and the evaluation of content found can involve the analogical reasoning in a deep way, and then promote creative solutions. The participants of course “Social software and Web 2.0 for didactics and education” often use analogy to learn something new or to solve problems but they do not recognise an effective role of analogy. The reason seems to lie in the fact that during web searches, people do not have the awareness of their thought processes. They have difficulty to reconstruct their deep reasoning.

In summary in this paper are some key concepts: analogical thinking is important in promoting creativity, it is a particular kind of creativity and it is recurrent in professional problem solving. There is a link and at times an overlap between PS and the process cycle of IIL. Therefore IIL can play an important role in transforming the problem in PS from ill defined to well defined. The process of information retrieval is related to analogy retrieval. The availability of analogy is not self-evident, but only a deep work of reprocessing can create the conditions for reuse information with the aim to generate learning or problem solution through analogical reasoning.

The module IIL within the course “Social software and Web 2.0 for didactics and education” does not propose reasoning strategies, but a theoretical framework for Information Literacy and several tools to search, to collect, to organize and to reuse information (i.e. how to use advanced search of a search engine, how to find resources published in Creative Commons, how to organize information through news aggregator and RSS, how to share bookmarks, how to create a custom search engine, how to publish open content). The OER movement is involved because educational resources, sought and published by the participants themselves, are located inside institutional websites (such as schools and universities) or websites where the author of the resources (a teacher, a researcher, a blogger) wants to release the material under a Creative Commons license.

Internet Information Literacy in relation to problem solving

Internet Information Literacy is defined as the ability to manage a variety of activities such as: research, selection, management, use, processing, evaluation and information diffusion by means of web technologies (Eisenberg & Berkowitz, 1990; OECD, 1997; Armstrong, 2008; Ferranti, 2010).

Information literacy is often triggered by a more or less complex problem that requires the use and the research of information. What follows is a cross-over and at times an overlap between PS and some of its phases and IIL. Whenever PS is relatively simple, it suffices to find the “proper” information and to proceed towards the solution. In some cases however, the problem, to be properly understood, requires a new perspective, thus in many cases the use of analogical thinking strategies (Keane, 1988; Vosniadou and Ortony, 1989; Holyoak and Morrison, 2005). According to the Davidson and Sternberg model (2003), PS foresees a series of phases: the recognition and identification of the problem, defining and representing the problem mentally, developing a solution strategy, organizing one’s knowledge in relation to the problem, building up the physical and mental resources to solve the problem, monitoring progress in relation to the

goal, and assessing the solution in terms of accuracy and sustainability. The process phases do not necessarily unfold in this particular order. The model however, identifies, in a manner that can easily be applied to different situations, the fundamental elements. From experience in teaching IIL to adults, the IIL cycle can prove especially useful in the PS phases of recognition, identification, definition, representation, and of developing a problem solving strategy (Davidson and Stenberg, 2003). Worth noting is the relationship between IIL and PS in what is known as “ill defined” problems: information literacy can play an important role in transforming the problem, from “ill” to “well”, especially when a good analogy is found. It will help to clarify the representation of the problem and will prompt the application of solutions found in another context. Moreover *Internet Information Literacy* calls for an integrated use of the first and second generation Web 2.0 tools to assist the entire process, from information analysis needs to the presentation of information. This process goes hand in hand with strategic capacity which allows to plan and understand what tools or actions have to be adopted (the use of research engines, OER, newsgroup, blogs, wikis, tagging, being a member of a virtual community of practice, being part of a social network) (Petrucco, 2006: 43-45) and what sources (paper or Web documents, books, scientific articles, expert interviews) best respond to our information needs. Adults employ the set of competences mentioned above for self-directed learning or to manage various professional PS processes. The creativity principle which enables academics and professionals to generate new knowledge and to express their creativity at work resides in the blend of information research and problem solving contexts.

An important feature of PS: analogical thinking

Analogical thinking is based on the transfer of knowledge of a topic or context to another. It focuses on the relationship of similarities and on the a possibility of identifying three fundamental elements:

1. an object/context **A** identified as the source (generally known),
2. an object/context **B** identified as the target (generally unknown) and
3. a series of elements or relationships among elements that facilitate the correspondence between A and B (Gentner in Vosniadou and Ortony, 1989)

Gentner (1983) proposes 4 levels of similarity: a level of literal similarity characterized by a high number of attributes in common between A and B, for instance in considering the Andromeda 12 star galaxy system similar to our solar system; analogy exists when mostly rational proprieties are transferred, for instance in considering the “atom as a solar system”; abstraction exists when in a comparison, A becomes an abstract relation as in “The atom is a gravitational system” and finally anomaly, in which any common traits are scarce or inappropriate as in “coffee is like the solar system”.

Analogy between A and B occurs when there are only a few discriminate elements that make up analogical mapping. In PS, what is unknown is the right solution and the right mapping of the problem P. Often even the A analogy is not available as our background and prior knowledge. *Gick and Holyoak's* experiments highlight the importance of analogy within the learning process (Gick e Holyoak, 1980; Holyoak e Thagard, 1997). They depart from Dunker's[8] radiation problem (Duncker, 1945), found in the literature, and demonstrated that if an appropriate analogy is suggested in problem solving, the probability of solving the problem successfully will be good. The authors undertook a series of experiments which involved posing a problem to a control group without the aid of diagrams or analogies [9] to help in the task. The experimental groups instead had stories recounted. The situation differed in terms of context and type of problem, though it was analogically aligned to the target situation. In considering our goals, the focus was directed to a “proper” analogy which augments the probability of right solutions by about 10% to 76% (Gick e Holyoak, 1980: 346). In problem solving studies, *analogy retrieval* proves to be of assistance. Yet in most real life contexts that see professionals involved no such analogy is available, but it ought to be explored. The solutions applied in similar cases we are investigating can be transferred by means of deductions. Thus if A is like B, the solutions or deductions for A can be valid solutions for B. Holyoak (2005) proposed a model based on the main components of analogical reasoning and on reciprocal relationships. A problem (target) can be understood through another situation by mapping the correspondences between the two situations. Both can help to define a schema, an abstraction of contingencies that enable a generalization or its application in different contexts. (Figure 1)

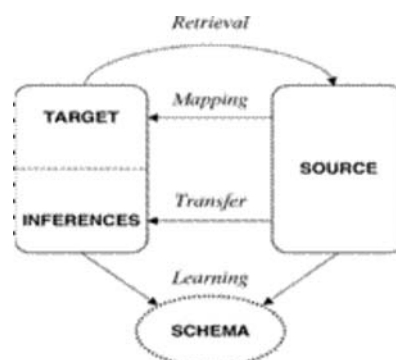


Figure 1 Holyoak's Model (2005)

When IIL is applied to PS, the analogy is not previously given or known. From a problem, the Target, and from the probable presence of a schema, that is more abstract and implicit than the entire problem, an analogy that can clarify the problem is examined. A series of inferences will then lead to a proposal to solve the problem. This analogy has two main functions: to restructure the problem and to contain a series of implicit information which, if well inferred, can be used to progress in the entire PS process.

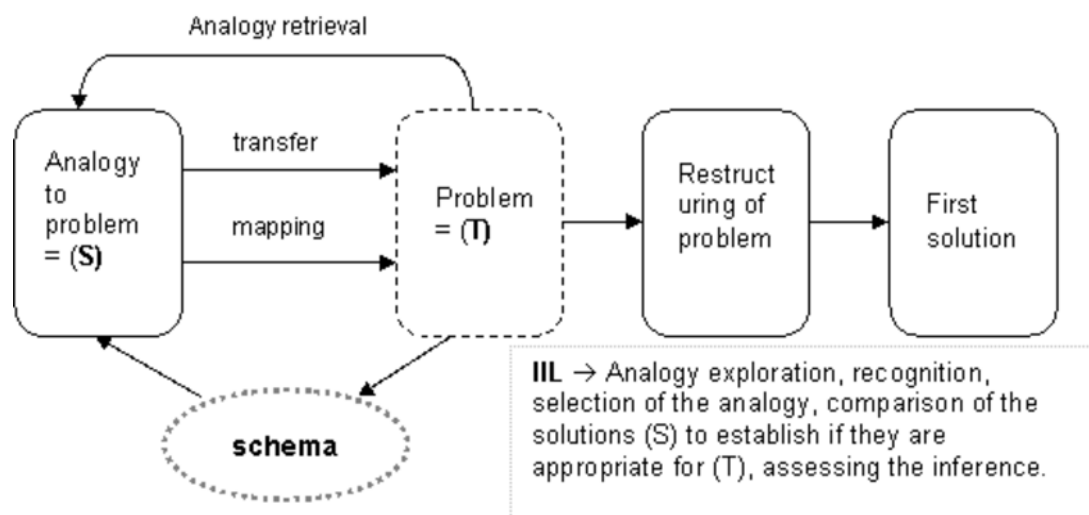


Figure 2 IIL – Research model, analogy discovery

The problematic issue (T) requires that an analogy sheds some “light”. An individual will start to develop an implicit schema on the problem which may often be incomplete or may lack awareness. IIL prompts to search on the Web (using research engines, semantic methods, tagging more often than hypertextual surfing, using OER or interacting with other people in the social media) to have concrete examples of a particular abstract schema, that is the analogy (S) of the initial situation. The person therefore goes through the phases of perceived need, research, recognition to subsequently choose the analogy. The latter yields the inferences, which once assessed, can represent the solution to the initial problematic issue.

Adults, in complex or partial problematic contexts, often implement this form of learning when expertise and a lack of knowledge concur in tandem with an availability of OER in different disciplines which represent a cognitive knowledge capital.

A case study: the course *Social software and Web 2.0* for didactics and education

The points illustrated above, as stated in the introduction, are the product of a 3 year experience with an online course called “Social software and Web 2.0 for didactics and education”, and of current personal research experience conducted at the doctoral school in “Science Education, pedagogy and training” which explores the creative features of PS through digital narration and by belonging to online communities.

The professional training course referred to above was designed for adults and it offers a series of theoretical instruments, methods and techniques to apply the new Web generation in teaching contexts as in schools or training courses held in private or public organizations.

The empirical reference in my study comes from a participatory online investigation initiative conducted with (Moodle), a virtual environment. The course was designed and implemented using forum discussions, lab work aimed at technical/practical learning and by handing out two questionnaires (pre and post course).

Module description and participant profile.

The Internet Information Literacy module, being a synthesis of the proposals that emerged in the three editions, from 2008 to 2010, incorporates the following content: a warm-up phase comprising a virtual room game on the strategies and metaphors associated to IIL; theoretical aspects of Information Literacy skill and activities to comment the articles; Web research on the information (tools, sources, resources and procedures); collaborative filtering and use of RSS feed; information aggregation (readers and personalized home pages); developing personalized research engines; planning personalized environments for school or company use; presentation and communication of information by means of integration and through

subsequent modules dedicated to Blogs, wiki, digital storytelling and to the final project work.

The three-year study had 75 participants, 26 males and 49 females. There were 29 participants who work in a school context (at all levels), 42 from private companies and public organizations and 3 were free-lance. The percentage of participants with a high school diploma was 25%, the remaining 75% were university graduates.

One of the lab activities consisted in having participants perform an analysis of information needs, to identify the most suited Web tools, specify the best sources and strategies to implement, to then search for the information online. From the results analysis on the information search activity proposed, we can infer that the entire IIL process begins with a problem which, at times may be well defined, others less, in which the learner tries to bridge the different kinds of gaps: cognitive, procedural, related to awareness, organizational, investigative, emotional, interpretative, related to environment or to colleague relationships or explorative. The entire IIL process involves creative abilities, analogical thinking being one aspect as it entails a thinking strategy which enables the transfer of acquired knowledge from one context to another, maintaining some relations of resemblance. The online course experience underscores the importance of analogy in three different ways: analogy for teaching, which through research and the use of OER can serve to propose analogies to help learn new information; analogy for learning, in which research and the use of OER are directly performed by the learner in a self-managed process of *analogy retrieval* from a set of educational resources; analogy for professional problem solving or for structuring, in which the transfer of OER knowledge is applied to natural and complex settings by a procedure that transfers solutions from one context to another or even by intentionally developing OER based on analogical thinking.

The first case emerged from the participants with a teaching role in formal contexts. Teachers or trainers applied analogical thinking to bridge the gap between the learner's prior knowledge and new content. Analogy helps to learn new concepts through what is already known. The more specific and befitting the use of the analogy, the easier it will be for the learner to understand.

The second case is particularly evident in self-instruction, when it is the participant who comes up with analogies wherever there is the need to learn new things, thus what is unfamiliar, basing oneself on what is known. This often happens in an incomplete or unconscious manner, relying on whatever the need to be able to continue with the learning process.

In the third case, the use of analogies helps to create new contents or new professional actions or artefacts. The participant in the professional sphere uses IIL skills to solve problems or to express one's creativity. This can be achieved with the support of analogical thinking.

In online searches, the analogies adopted cannot be observed. In addition they involve deep awareness which emerges more easily through attentive thinking processes on the strategies and practice. Based on such assertion, what was remarkable from the short questionnaire, with a response rate of 29.33%, handed out to all the participants at the three editions of the module exploring the Web 2.0 tools and sources used in professional problem solving was the insight it provided on the analogical processes. Participants had to answer the following question: "Problem solving often encompasses thinking strategies that are based on analogies. For example, in *day surgery* to reduce the incidence of human error, solutions were sought from other contexts. An analogy to the safety problems in the field of surgery and to aviation led to the adoption of a checklist method, used when planes take off as well as in the pre-operative phase. Can you give an example of an online search that helped trigger an analogy which can help solve a professional problem? Describe the episode and specify the analogy used". There was no answer in 45.45% of the cases (leaving a blank or stating they did not know the answer), the answer was inappropriate in 4.55% of the cases, 31.82% described a case of PS, illustrating the gradual progression or the adoption of a best practice, an experience, or template but did not specify the analogy used, and 18.18% proposed an analogy used to solve a problem that did not involve the participant directly without specifying the personal PS episode.

In focusing only on some of the answers in detail, the following cases are worth highlighting:

A) those that proposed an analogy, though it may not be contextualized in one's PS process and B) those that shifted their attention onto practice and templates.

The answers in **case A)** were the following:

1. By analogy I thought about a tool that I know well: the telephone. The telephone network is a technical device comprising of the telephone, cables and processing centres. But most of all it is a communication tool, as most of the millions of phone users consider it. Internet, like the telephone network, also enables the diffusion and exchange of information among the students of a class. While computers are the instrument that manages and transfers the information in digital format, the content comes from the students who spend their time in front of the video screen and keyboard. Naturally, as with every analogy, here too many aspects of the phenomenon that it strives to clarify are unfulfilled. In fact, differently from the "old" telephone, Internet offers a variety of communication tools. Thus the communication capacity is much richer and more articulate. The internet exchange that occurs among my students not only includes sounds but also multimedia information. All kinds of information is available online, for all computers to use and manipulate:

texts, images, films, sounds and computer programs, all codified in digital format. And, theoretically, all online users can send and receive information in each of the forms stated above. Another characteristic of online communication is its interactivity: the possibility for each internet user to be both the sender and the receiver of a communication; the opportunity the receiver has to actively intervene in the form and within the time frame of fruition (listening, reading, viewing etc.) the messages.

2. I cannot think of any personal example right now. I do however recall in one of the university subjects, maybe Operative Research, there was the idea of optimizing flight connections at the JFK airport in New York was related to an analogy with the animal kingdom, bees in particular, their access into and out of the beehive.
3. To clarify their function, the arterial, venous and lymphatic system are compared to a hydraulic system. The analogy between the blood system and a hydraulic system alludes to the principles of physics that the two have in common.
4. A person who has great faith and one who is studying something new. Both must keep an open mind if they do not wish to lose grip of their objectiveness due to over enthusiasm.

In **case B**) participants answered:

1. The linguistic university centre (known as CLA) I have been working in for years decided to use the Moodle platform as an online testing platform. The former software (Perception) was thus replaced. Moodle was conceived for constructivist courses. The design and use of the platform in order to attain the first goal (online tests) was therefore not easy. My search for answers and solutions had me turn to forums, working group blogs in the Moodle community since even ad hoc material was unclear (testing and assessment guidebook in Moodle), exhaustive or sufficiently up to date. Moodle, being a project featuring an ongoing phase of evolution and development, does not permit a contextual production or distribution of up to date guidebook or tutorials. There is a marked diachronic gap between the development and the information distribution phase involved in this process. I believe this problem can be perceived in all the fields that work with rapidly changing technology (as robotics, medicine, the digital domain etc.). A solution to this probably is going online to find discussion groups, blogs or thematic sites related to the topic of interest.
2. In problem solving one relies on a gradual procedure and subsequent acquisitions which different fields have explored and evaluated.
3. Hoping to have understood the question, from the templates or model documents (on Google Docs for instance), I elaborated management models of projects designed mostly for company work, which I transposed into the institutional domain (the organization of conferences, linguistic projects involving a series of players in various phases), or even associationism, in which the projects are called service, but are equally related to a coordinated collaboration and which a pre-set agenda must be followed.
4. My online search often explores best practice in education contexts that are similar to mine. I am therefore exposed to new operative modes, styles and solutions which can be, by analogy of service, applied to my reality as well. I came across an example of this kind of process some time ago, in a working group promoting the launch of a new low-cost residential service for people with minor disabilities.
5. My research online often explores experience, activities, laboratory or teaching projects related to school or in the field of education. I frequently find activities or experience that are oriented towards a different context (recreational, social) or to different age groups. I therefore try to transform or to adapt them to my specific goal, group counselling to parents.

In having to interpret these answers, the main difficulty is to acquire some degree of awareness of the analogies used in IIL processes during PS. Frequently, the level of analogy is clearer when it refers to the need to transfer best practice, to search for and to apply models that solve operative and execution problems. In addition, the transfer of knowledge from one context to the other, even when done analogically, is not explicit or evident but it is situated deep within, though many professionals use it with little difficulty. In another research[10] about creative dynamics within a community of practice, one of the best Italian jazz singer answered at the following question: "May you remember an episode where you had coming to a creative solution in your professional context? Can you describe your feelings?" She remembered an episode when she had to compose some songs in a short time and she had no ideas. She passed the *impasse* with prayers, in this way the ideas have started to flow freely. This narration does not seem focus on awareness of reasoning strategies or creative techniques.

Another aspect of analogy is that it is based on a complex semantic representation of a problem, on metaphoric potential which seems to contain a greater number of information compared to the abstract schema (Gick e Holyoak, 1983). In the field of adult education, the interpretation of such answers opens an area that is worth exploring in order to investigate in greater detail, and from the viewpoint of education practice, how the analogies used can be more explicit. Moreover it can serve to better understand how OER can be used, knowledge shared, connecting the conceptual level of analogy retrieval with a more operative level to transfer the practices. Additionally it would be interesting to see how the IIL know-how can lead to discover analogies in real contexts and how the representation level can be connected to the operative level of professional practice. From on-the-field experience, from the problems participants encountered in applying what was learnt, and from the explorative value of the questionnaire which had been handed out at the end of the course, what ensues is the need to investigate , in upcoming PhD dissertations, the

relationship between analogy retrieval and problem solving. How in IIL, awareness with regard to analogical thinking can be raised by means of education so that there be greater understanding of this process and its practice.

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[1] *I have always wanted and loved to teach, especially to understand. It is by teaching that I can continue to explore the knowledge of movement. It is by teaching that I understand "how it works". It is by teaching that I have discovered that the body knows what the mind still does not know.* From «Le Corps poétique: un enseignement de la création théâtrale», (J. Leqoc).

[2] Web site: http://www.educazione.unipd.it/perfezionamento/social_software/

[3] The productive thinking begins when inside a problem-solving setting, the insight allows to find a solution through the restructuring of the initial partial and confused data. It is a "structuring of the field" which gives rise to new ideas and solutions.

[4] Divergent thinking is a way of thought that, in the creative act, tends to the production of many solutions for the same problem. It is like to see many different developments (fluency and originality) within a problematic situation.

[5] The Lateral thinking is opposed to the vertical thinking that follows a direct and deductive line, inside known directions. Lateral thinking seeks the production line, generating new directions, it is stimulatory, synthetic. It accepts entries of the randomness and it does not necessarily need to define and classify. The lateral thinking explores paths less evident (De Bono, 1970: 38-45).

[6] The "bisociation" is the ability to connect ideas with no apparent relationship, it is an operation that combines two "Frames of reference, context or associative structures of reasoning that would normally be considered not related" (quoted in Koestler, Antonietti, 1994: 40).

[7] TRIZ is a complex theory of inventive problem solving composed from different parts: the knowledge and analysis of many inventive processes, a methodology, practical tool sets and a model for generating new ideas.

[8] A patient with stomach cancer that you can not operate can be treated with X-rays. Unfortunately, X-rays, which are strong enough to destroy the cancer, also destroy the surrounding healthy tissue. How the radiation can be used to destroy the tumor without damaging healthy tissue around it?

[9] The story describes a fortress attack. Several mined roads converge to the fortress. Troops succeeded to reach the site by having soldiers take different roads to avoid the mines from going off (small forces on the same road) but it is done in such a way as to reach the target simultaneously (great military force reaching the same point to crush the enemy).

[10] It is my PhD research.