Theoretical and Factual Meaning in Assisted Instruction

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Technology determines new borders for knowledge domain while education reflects more complex activities. A solution in this context is to integrate technology in the educational system, extending it as e-Education. E-Education is a dynamic system and a concept developed on three kinds of infrastructure which are likely to emerge: technological infrastructure, conceptual infrastructure of the type of the study programmes, and cognitive infrastructure of all participants involved in the teaching-learning activities. The purpose of this paper is to provide a meaningful framework for contextual learning, developed on the idea that a personal computer can deliver many skills to a student, but only academic environment can connect those skills to a modern community where they belong. This approach is developed on the much known principle which sustain that the educational system becomes the engine of the learning society.
Keywords: *Scientific Research in E-Education, Assisted Instruction, E-Classroom, Didactic Knowledge, Concepts Map Approach*

1 Introduction

The main feature of our evolving world, analysed from a cognitive point of view, is that it could be understood as a global information system. Such an approach could sustain a didactic definition for e-Education: an extension of the traditional education system. As soon as the basic concept of the global information system is *the application* and an aggregate concept is represented by *services*, we define assisted instruction as being a social application of the global information system, offering educational services.

The basic component of the dynamic concept *e-Education* is the technological infrastructure and, at the same time, knowledge developed by scientific research is recorded in technology. That means an extension of the traditional scientific research methodology is necessary when we explore the *e-Education* domain. Research is the orderly investigation of a subject matter for the purpose of adding to knowledge. Research can mean "re-search" implying that the subject matter is already known but, for one reason or another, needs to be studied again. Alternatively, the expression can be used without a hyphen and in this case it means typically investigating a new problem or phenomenon [17]. The author describes types of educational research and highlights that here are also a number of ways they may be classified. So, studies may be classified according to a topic (teaching methods, school administration, classroom environment, etc.); studies may also be classified corresponding to a context (exploratory or confirmatory); a more widely applied way of classifying educational research studies is to define the various types of research agreeing to the information they provided. Accordingly, educational research studies may be classified as follows: historical research, descriptive research, correlational research, causal research, experimental research, case study research, ethnographic research, research and development research.

The technological advances have considerable influence since they enhance the field of scientific research methodology while allowing further testing or rejection of theories. The modern society of information is changing not only the way of working in all branches of science but the methodology of learning itself, given that they have at their disposal the latest advances carried out in different subject matter [15].

The research methodology used in this article is based on the working model developed as a paradigm, published in [26]. According to this approach, *the article* is considered the basic result of a scientific research activity. This model is refined as it is shown in Figure 1, where the articles focus on study cases, which are reflected as applications and they could be integrated or aggregated in the conceptual framework.

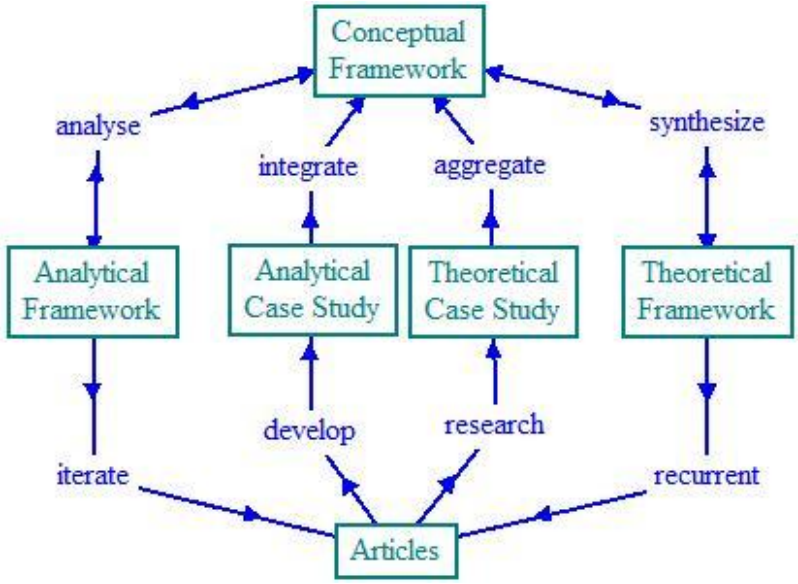

Fig. 1. The working model developed as a paradigm

Referring to scientific knowledge, [15] remarks that an element of personal knowledge is the methodological doubt, since it is healthier to understand things than to learn them. One has to place certain limits on personal knowledge as there are things that we don't understand but we accept them because they are generally accepted. To this extent our personal scientific knowledge is more limited than general scientific knowledge. This description sustains the necessity of a technology based theoretical framework for scientific research in education, developed as e-Education.

2 Conceptual frameworks

A technological infrastructure considered as an environment for e-Education started when the first computer was invented. While infrastructure reveals a dynamic contextual frame, the first computer is the programmable one in 1936, a digital one, from 1937 until 1942, a RAM based one in 1955 or a transistor based one, in 1956. The first computer company was the Electronic Controls Company which it was founded in 1949, and the first commercial computer was available in 1951 [3] [10] [11] [18].

A cognitive infrastructure of a participant involved in the teaching-learning activities suppose a frame and one of the most frequently cited and applied systems for categorizing cognitive processes has been the classification system proposed by Bloom and his team in the Taxonomy of Educational Objectives, Handbook I: Cognitive Domain, in 1956 [14]. This taxonomy identifies six hierarchical levels of thinking based on the type of cognitive processes required to complete the objective or answer the question. The authors conclude that it is important to note that the cognitive levels are cumulative in structure as each level integrates and builds upon the cognitive activities of the levels below it, implying a type of sequence, or a hierarchy, to the levels of thinking. [12] discovered that “over the last decade a new technology has begun to take hold in American business, one so new that its significance is still difficult to evaluate. The new technology does not yet have a single established name. We shall call it *information technology*". The authors developed the idea and mentioned that it was composed of several related parts: one included techniques for processing large amounts of information rapidly, and it was epitomized by the high-speed computer; a second part centred on the application of statistical and mathematical methods to decision-making problems; a third part consisted of the simulation of higher-order thinking through computer programs.

Early editions of scientific research in education highlighted the idea that educational methods can be defined as ways of organizing the learner's cognitive activity to ensure the acquisition of knowledge and skills and the general upbringing of the student in the process of instruction [21]. The same study focused on an already known problem; education is passing through a double crisis: quantitatively, a vastly increasing number of people must receive formal schooling forever longer periods; qualitatively, a rapid change in the content and methodology of instruction is taking place.

As we presented in this short review, the conditions of a theoretical framework were available in the middle of the last century for the development of the e-education concept. Since then, the conceptual framework had to be analysed in order to develop an appropriate analytical framework, capable to sustain developing and implementing applications. [20] proposed an education and research model that connects and integrates the following three essential components or pillars can be broadly applicable and successful: content, context, and cognition. Content (knowing what, where, or when) can be roughly described in this model as the information or knowledge that is of interest for teaching or research in any discipline. Context (knowing how) can be roughly described in this model as the driving forces that provide motivation making the content of interest to the individual. Cognition (knowing why) can be roughly defined in this model as the intellectual process of developing structures and causal relationships that will be useful in any learning situation, either education or research.

Applying this approach using a concept map tool for an assisted instruction design process, we focused on the native features of the information, and the result is obtained in the image presented in Figure 2.

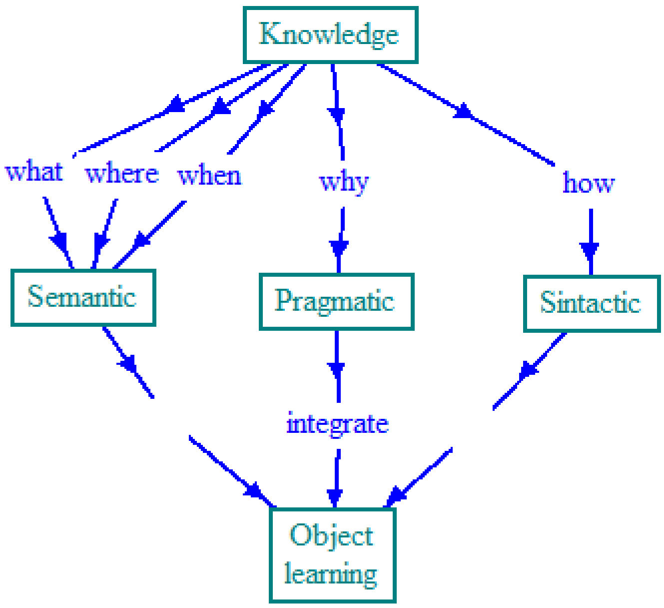

Fig. 2. Basic components in a learning situation design

So, the basic components in a traditional educational system are knowledge and the objects learning, developed for a traditional transfer from teacher to students. Based on the 'knowledge cube' proposed in [22], Figure 3 presents the concepts map for a didactic developing of the educational knowledge content, and connected with the previous approach, this process is a periodical one and it consists of regional features implementations.

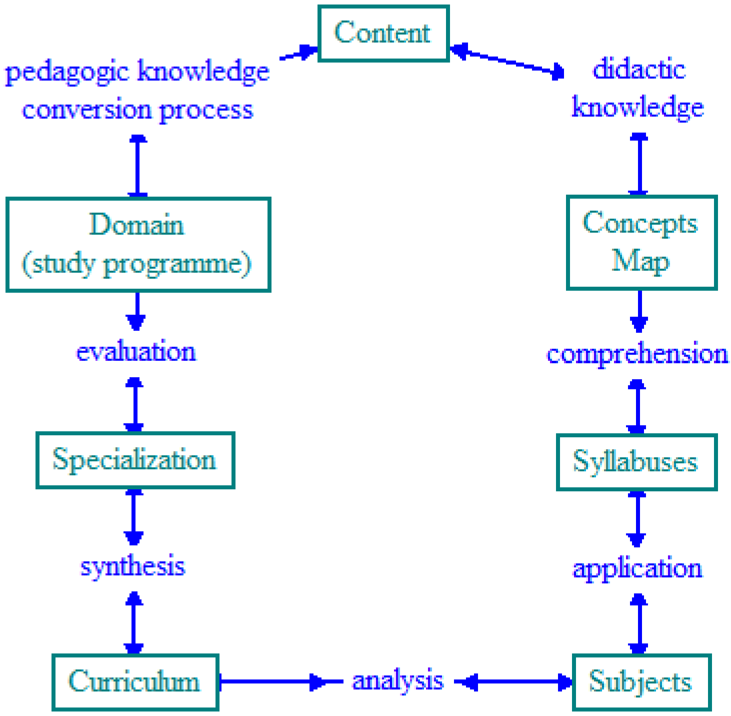

Fig. 3. The concepts map for a didactic developing of the content

In this approach, developed as a working model for assisted instruction, scaffolding consists in developing and using dedicated applications in order to match tacit knowledge to explicit knowledge in the zone of proximal development, as a pedagogic knowledge conversion process.

3 Theoretical frameworks

Previous researches [23] [26] introduced a theoretical framework for scientific research in e-education, based on the technology approach and developed the idea that as soon as knowledge is recorded in technology and scientific research is a continuously human activity, the key of a learning society consists in training the trainers in a dynamic technological infrastructure. According to the concepts map presented in Figure 3, we have to observe that over the last decade, practical implementations in educational system could be synthetized as new subjects: Modern Educational Means, Information and Communication Technology, Computer Assisted Instruction; and subjects are positioned in the middle of a long term cycle content oriented model. At the same time, we can present articles developed as analytical case studies which mention that "while there is a huge research literature on the field of ICT (Information and Communication Technology) as a tool in teaching and learning, there is much less research on the area of ICT as a subject or similar designations such as school informatics. As a result, there is a lack of theoretical grounding of the didactics of ICT and associated teaching and learning processes [8]. One of the main reasons for the lack of theoretical underpinnings of the didactics of ICT considers the author, is that there have been in the past and there persist even now strong disagreements and confusion about the nature of ICT as a school subject. [16] consider that "Information & Communication Technologies [ICT] have become a powerful force which are transforming and will continue to transform all aspects of education. While eLearning has obvious advantages related to time-space distanctiation, we feel that didactical eLearning issues are problematic”.

A modern approach is developed in [6], where the authors focus on e-Learning, considering the relationship between the Sciences and Didactics, in order to illustrate the concept of Discipline and Didactic Object. Didactics, as the Science of Teaching, it has to be based on a specific model of reference and their model begins with a definition: “Didactics represents the conjunction of Knowledge, Processes and Strategies intended to guarantee the acquisition of competences concerning a specific area of human behaviour to one or more individual”. The same authors define e-Didactics as the Didactics for the e-Learning and confirm that e-Didactics represents an extension of the traditional Didactics. They consider that the e-Didactics Paradigm can be built up from a new definition: E-Didactics is the set of Knowledge, processes and strategies intended to guarantee to one or more individuals the acquisition at distance of competences represented by specific Didactic Objectives.

A similar perspective is detailed in [19], where the authors argue that educational technology is facing a new kind of challenge, a new area of opportunity. They use the label Web-Based Distance Learning System (WBDLS) as shorthand for this area. WBDLS on one reading must embrace all areas of learning – kindergarten through higher education, informal learning in the community, home or workplace, training courses in industry, adult education courses, and so on.

Other perspective defines pedagogy strand of the eLearning programme sustaining it has as its core aims to provide the post-16 and HE community with accurate, up-to-date, evidence- and research-based information about effective practice in the use of eLearning tools and to promote the application and development of eLearning tools and standards to better support effective practice [2]. Exploring the nature of learning in the 21st century, [7] looks at how well traditional methods of teaching and learning fit contemporary’s learning environment; the author also looks at the approaches to teaching and learning, and examines the feasibility of them, displacing traditional pedagogies.

[26] developed a theoretical case study focused on e-Class, as the first application of the e-Education concept. Considering assisted instruction as a social application of the global information system, we can define e-Classroom as the first application of the assisted instruction in e-Education. This approach reflects e-Classroom as an extension of the traditional classroom, because face-to-face interactions are included, and confirms that the prefix “e” from electronic could be apply to a software system but not to an activity centred on human thinking.

4 Analytical framework

Based on the previous research developed in [25], where knowledge is embedded in technology and theoretically it is structured in subjects, we propose a working model for scientific research in e-Education, as it is shown in the image presented in Figure 4.

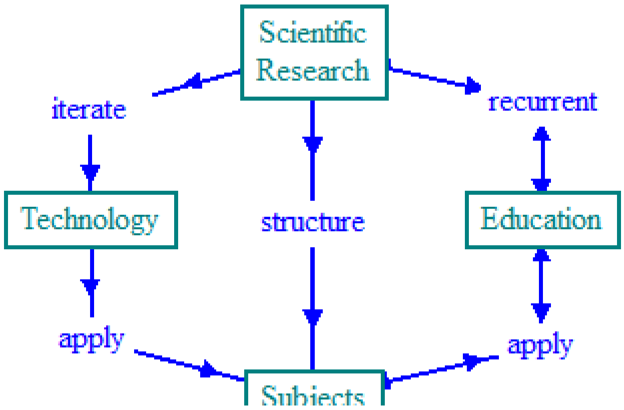

Fig. 4. The working model for scientific research in e-Education

In this case, technology is an iterative component, which exists through versions, while education is a recursive component which evolves through generations. Both of them are correlated in a process developed in an e-Education system. Both of them are the pillars of the scientific research, activity which updates permanently the knowledge content and restructures it into subjects.

As soon as technology develops as implicit knowledge, scientific research in e-Education has to harmonize explicit knowledge with implicit knowledge using technology, so the basic educational activities include knowing, understanding and applying technology.

[26] defines in a case study e-Class, mentioning that in assisted instruction, the key feature of a teaching-learning process in an e-Class is reflected by the granularity of the e-learning objects. As soon as the teaching-learning process is knowledge's application, and e-Class is an assisted instruction's application, the granularity of the e-learning objects is determined by the assisted didactics design when converting tacit or personal knowledge in explicit or codified knowledge.

Scientific research, considered as a continuously human activity, requires two categories of terms: working terms and scientific field's terms. The group of working terms has a double function: a descriptive one (knowledge function) and an explanatory one (educational function). While the scientific field's terms develop subjects, the working terms, used for an explanatory function develop meta-subjects [24]. This relation could be described in a linguistic approach, comparing pragmatics with semantics, as soon as the second notion is concerned with the stable meaning resources of a language-as-a-system and the first one with the use of that system for communicating in particular contexts [5]. In linguistics, a new phenomenon is, by no means, relativism. This notion is closely associated with the American linguists Edward Sapir and Benjamin Lee Whorf, whose work on Native American languages in the early years of the twentieth century led them to propose the idea that learning our first language causes us to acquire a particular world view, distinct from that of native speakers of other language. What makes the notion of relativism different in Cognitive Linguistics is the idea that there is a variation across different speakers of the same language with respect to the interpretation and coding of particular situations [13]. The same author attempts to elaborate on the claim that there is an interrelationship between thought, meaning, and linguistic structure by examining the major concepts in the theory: construal, perspective, foregrounding, metaphor, and frame.

Cognitive linguistics argue that there is no direct mapping from the external world to language; a particular situation can be construed in different ways, and that different ways of encoding a situation constitute different conceptualizations. One factor

involved in alternative construal has to do with perspective. A second factor involved in contrasting construal has to do with prominence of the various components of the situation (foregrounding). A metaphor is essentially a device that involves conceptualising one domain of experience in terms of another. The concept of frame embraces the traditional concept of connotation and it should not be taken to imply that there is necessarily a well-defined boundary between the elements that form part of the frame for the meaning of a particular word and those that do not.
[9] considers that among the language purveyors, a small number (especially teachers, translators and lexicographers) have been enthusiastic with scholars in the interdisciplinary field of applied linguistic. For many working field, the relationship with mainstream linguistic is as remote as that between business administration and economic theory. Two areas of applied linguistics connected with our working model are computational linguistics, where the researchers explore the interface between language and machine and the second language teaching, where they design curricula and materials, create valid testing and evaluation instruments and examine the effectiveness of teaching methodologies.
As soon as humans are limited in their capacity to process information, personal computers developed as an extension of the users' capacity for knowledge, comprehension and application, the basic activities involved in a learning process. The key of this process is the interaction, and Human-Computer Interaction developed as a basic area in e-Education. Interaction models and the style of the interface became fundamentals in this area.
According to this dynamic subjects, assisted didactics design in e-Education evolve as a meta-subject permanent adapted for training the trainers in a specific technological, conceptual and cognitive infrastructures.

5 Case study

Endowing classrooms with personal computers transformed the teaching-learning formal context in e-classrooms, and this activity represented the first step to the e-Education environment: individualized learning. Using standards in hardware and software generated the basics for the second step: personalized learning in assisted didactics design. This stage requires systematically update for the dynamic educational content and for the diversity of the cognitive infrastructure of the participants. The basic action in preparing the content for a teaching activity is the didactic knowledge which reveals the concepts map as a background for the syllabus. In assisted didactics design, the concepts map is a recorded one and represents a scaffold for each learning application, which can sustain the student's understanding.
As it is concluded by previous researches [1], the concept is the word meaning that it is the unit of analysis for the understanding of verbal thinking. The construction of the meaning is a generalization process, process that it is implied in the creation of the relation between concepts; the meaning not only depends on the material referent (objects, material reality), but as well depends on other concepts. Their review focus on common theoretical perspective: theories of re-structuring, and the relevance of previous knowledge for the formation or acquisition of the new concepts. The same authors synthesize that the concept map is a representation as well a metaphor of the conceptual structure from a knowledge domain, and, at the same time, the concept map is a representation of the human cognitive structure; the elaboration process of the concept map helps to make visible the previous cognitive structure and, if the activities demand it, developing new cognitive structure.
There are several theories about the nature and structure of concepts. One of them, classical theory of concepts, also known as the definitional theory, considers that every concept is associated with a definition;

everything that satisfies the definition belongs to corresponding conceptual category. Prototype theory considers that the concept is centred round a representation of an ideal example, or prototype. In most versions of this theory, the prototype is represented by a set of features reminiscent of those found in the classical theory. Exemplary theory promotes the basic idea that the concept is represented as a collection of memory traces of individual examples. In this case, the prototype is the example with the greatest similarity to the largest number of other examples. The 'theory' theory reflects the basic idea that a concept is represented not just by information about appearances, but more importantly, by not-directly-observable properties such as causal relations, purposes, and internal constitution; in other words, a concept is like a mini theory about the members of a category [5].

In an analytical approach, [27] emphasizes three board types of relations that appear to unite events with category. In perceptual concepts, stimuli are grouped primarily on the basis of shared physical features. In relational concepts, there are the relations among these features that are grouped. Finally, in associative concepts, stimuli are grouped on the basis of shared function, e.g. a common response that they engender, or a common consequence with which they are correlated.

The threshold concepts emerged from a UK national research project: Teaching and Learning Research Programme (http://www.tlrp.org, 1999-2009), project which is focused on Technology Enhanced Learning until 2012. The notion of a threshold concept was developed to reveal the fact that in scientific disciplines there is conceptual gateway leading the students to a better understanding of a subject. The researchers in this project synthetized the characteristics of the threshold concepts: transformative, irreversible, integrative, bounded, and troublesome.

In a learning process the content could be develop on a concepts map integrated in a pyramid of concepts enabled to know, understand and apply, while the teaching process could be design on a concepts map aggregated in a concepts network enabled to analyse, systematize and evaluate the content of the subject. In a pyramid there are concepts as basis or aggregate, while in a network, the concepts could be considered, functionally, as threshold concepts. In assisted instruction, the applications design for teaching include a sequential set of tasks, gradually from simple to complex and functionality for knowing, understanding and applying concepts from conceptual network. It is the role of the teacher, in a face-to-face interaction in the e-classroom, to harmonise the conceptual infrastructure of the content in the zone of proximal development of the learner and to identify and solve the troublesome knowledge generated by the threshold concepts or by missing concepts in his cognitive infrastructure.

Passing from a theoretical case study to an analytical one, we highlight the idea that a new technology reflected first, an optimized solution for a traditional problem; so in the cognitive domain, personal computers could be used as a learning environment for intelligence tests, if we define intelligence the individual capability for learning; this way involves, at the same time, learning the technology as an educational environment.

Let's consider the following statement [4]:

Which is the single one letter you can see nine times in the square presented in Fig. 5?

V	N	V	W	E	V	E
M	E	W	F	F	N	V
W	N	E	M	W	F	M
F	E	M	V	E	W	V
F	N	W	M	F	M	E
N	V	M	N	V	F	W
W	N	M	F	N	E	N

Fig. 5. The square referred in the statement of the IQ test

In order to solve this exercise, we use an electronic sheet and it is important to mention that this is not a first level application for understanding and using electronic sheets. It is supposed that there were passed previous exercises for basic concepts of this environment [25]. This application is an interactive one, with individual approach, and develops solutions for understanding and applying aggregate concepts of an electronic sheet. So the first step when the user opens the application is to identify himself (his name and his actions will be stored for future analyses).
The new context of the statement is presented in Figure 6.

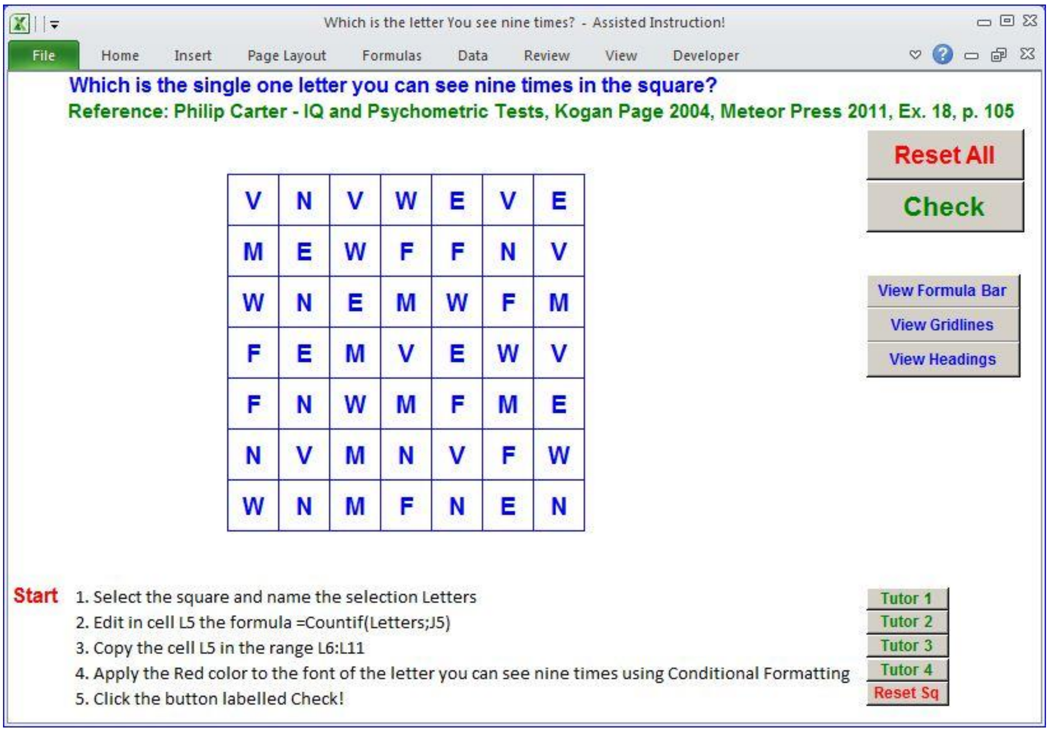

Fig. 6. An assisted instruction environment for an IQ test

The interface developed to assist solving the statement, which is presented in Figure 6 is a standard one for an assisted instruction application. This standard assumes the personal computer as a contextual learning environment, and involves three roles of the personal computer in a teaching-learning activity:

a) Personal computer as a tool, and there are four steps described below the square;
b) Personal computer as a tutor, and there are four buttons labelled **Tutor 1**, **Tutor 2**, **Tutor 3** and **Tutor 4**, each of them containing explanations as commands to use to finish previous steps;
c) Personal computer as a tutee, and there is a button labelled **Check**, which was programmed to confirm or to sustain activity of the learner.

The interface contains two more different types of buttons: first one is designed for recovery the interface, when this operation is necessary (totally **Reset All** or partially, only the square, **Reset Sq**), and the second one is design to help the user to improve the interface with the native options of the electronic environment, when the learner considers that it is also necessary (**View Formula Bar**, **View Gridlines**, **View Headings**).

It is important to mention that the functionality of the buttons was designed to assist the user offering information in the context of the software's version he uses. At the same time, the functionality of the buttons was designed to assist the user offering information in the context of the stage of his solving activity.

For example, if the learner starts by clicking the button labelled **Check**, the application displays the message box, as it is shown in Figure 7, and for each step designed in the tool section, it displays what's to do (see the image in Figure 8).

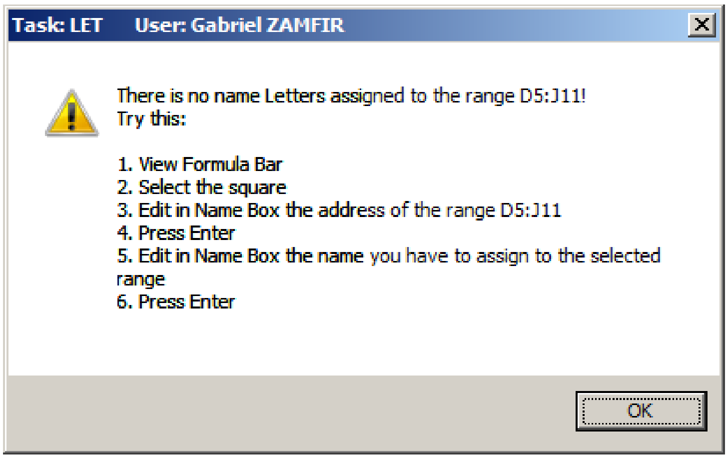

Fig. 7. How to name a range

For the first step, the learner has to do one operation: to name the square Letters; if he wants to know how, he has to click the button labelled **Tutor 1**. For the second step, the user has to edit a formula, using the default list separator for the regional Romanian format, but, clicking the **Tutor2** button, he will see the syntax for the regional format configured in the system he uses (as a contextual help). For the third step, the learner has to copy a formula in another six cells, located below, and if he clicks the button labelled **Tutor3**, he will get a solution usable in all versions of the environment. For the fourth step, the user has to know to apply conditional formatting, so, if he doesn't know, he will get the necessary information in the context of the version he uses.

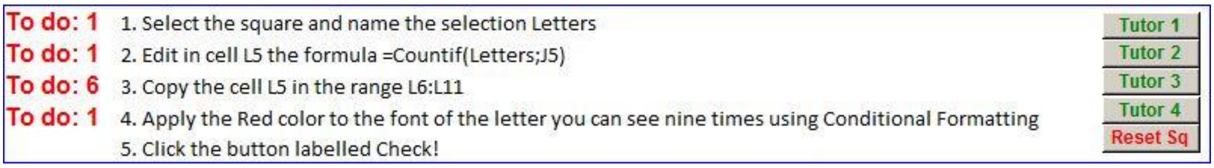

Fig. 8. What to do to solve the problem

If the user tries to name a range and he fails, because he assigns a wrong name, the application offers him the information how to delete an assigned wrong name. This message is presented in Figure 9, but this is a contextual help he can get, depending on software’s version.

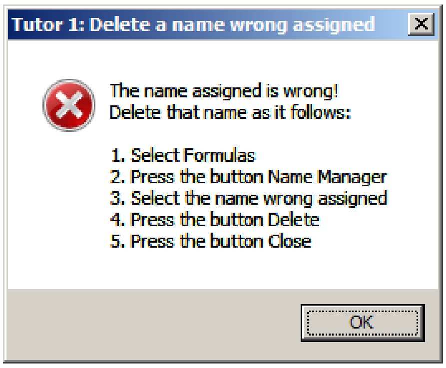

Fig. 9. How to delete a name wrong assigned

As far as the previous dialog boxes are an exclamation one and a critical one, when the learner use the tutor mode, the dialog box are the information type (see the images presented in Figure 10 and in Figure 11).

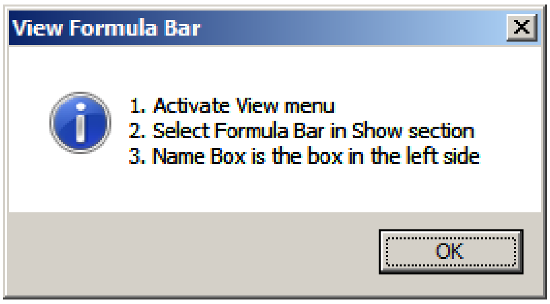

Fig. 10. How to view *Formula Bar*

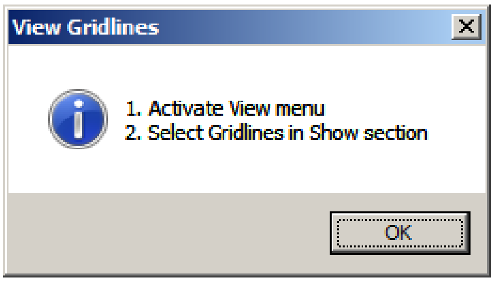

Fig. 11. How to view *Gridlines*

The objectives of this task are to solve an IQ test and, as a matter of fact, to assign a name to a range and to use *Conditional Formatting* for highlight the solution. So, if the learner uses **Tutor 4**, he gets the answer (the image presented in Figure 12), and applying the method he gets the solution.

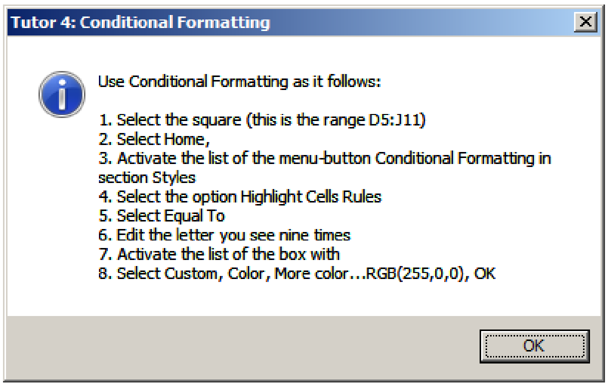

Fig. 12. How to apply *Conditional Formatting* for the previous statement

When the learner passes the steps and solves the problem, the application confirms the solution (see Figure 13) and generates a new file keeping the name of the user.

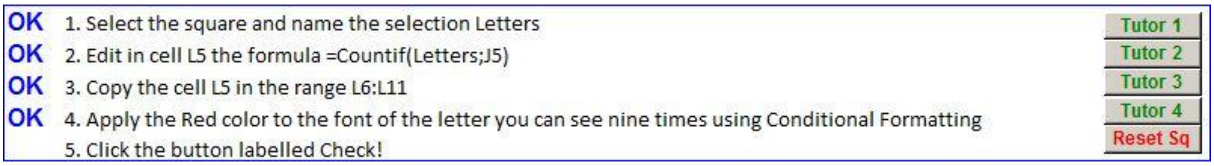

Fig. 13. The confirmation of the application for a complete solution

These types of file, monitoring the learner's actions and the face-to-face dialog between the professor and the student during assisted instruction activities represent the basis information for new versions of the application and for new tasks, before or after this type of exercise.

6 Conclusions

E-Education is a developing environment which generates alternatives: school as a reflection of our society or the society as a result of our school. Our syllabuses require new subjects in order to offer an answer. One of these subjects is the assisted didactics design, an interdisciplinary approach for teacher training, promoted in order to integrate technology in the cognitive infrastructure of the learner as an alternative of changing the user in an extension of this technology. Theoretical and factual meaning in assisted instruction converges for personalized training in e-Education.

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