

Learning e-Learning

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What You Understand Is What Your Cognitive Integrates. Scientific research develops, as a native environment, knowledge. This environment consists of two interdependent divisions: theory and technology. First division occurs as a recursive research, while the second one becomes an application of the research activity. Over time, theories integrate methodologies and technology extends as infrastructure. The engine of this environment is learning, as the human activity of knowledge work. The threshold term of this model is the concepts map; it is based on Bloom' taxonomy for the cognitive domain and highlights the notion of software scaffolding which is grounded in Vygotsky's Social Development Theory with its major theme, Zone of Proximal Development. This article is designed as a conceptual paper, which analyzes specific structures of this type of educational research: the model reflects a foundation for a theory and finally, the theory evolves as groundwork for a system. The outcomes of this kind of approach are the examples, which are, theoretically, learning outcomes, and practically exist as educational objects, so-called e-learning.

Keywords: *Assisted Instruction, Cognitive Infrastructure, Concepts Map, Software Scaffolding*

1 Conceptual framework

Starting from the idea that assisted instruction is a social application of the global information system, this research focuses on designing interactive educational standards referring to teaching, learning, assessing and self testing as methodological procedures and aims at implementing them in an information system available for vocational mentoring in higher economic education.

The achievement such an objective is possible using meta-subjects (didactics, computer literacy, and English, which is considered the native language for information technology area) to highlight the user's skills in the economic domain and to create a reference profile of the future student. In this approach, it is very important to apply assisted didactic design based on the concepts map of the subject, so as to develop individualized learning procedures.

The approach of this paper integrates the concept "workplace learning", which is well defined in the knowledge age. In higher economic education domain, educational organizations are considered the basis subsystems of the global informational

system.

However the global informational system has generated standards both for hardware and for software, and they are under construction standards for computer literacy, it is very important for the educational system (which can be seen as a processor of the economic system) has to define standards for teaching, which include syllabus based on concepts map and correlated in curriculum.

Considering previous idea the main targets of our research, next move has to explain the structure of this article; this is required as soon as theory and practice interact in the educational space, so we have to integrate learning in e-learning, and at the same time, we have to use e-learning in learning activities.

Every new level of study or research is a learning experience, and a learning experience that takes place in a particular context, with all communications being influenced by the context. This context can be thought of as a social context in which we are writing, presenting or publishing – what may be thought of as our 'discipline' [1]. Related to the previous reference, we introduced the concept of *contextual assisted*

instruction in e-education, using a similar discipline in [2]. As far as research is an iterative human activity, we had followed the same structure here, developing the prior knowledge, as a new step of learning. Knowledge processing is more than a deterministic link between a conceptual map and technological infrastructure. Debating the meaning of profession and professional behavior has a long and contested history in relation to education. In knowledge age, science represents the main manner for environment research and, at the same time, technology became default application of this research; a priority in order to optimize these activities is the research in educational area [3].

When people know their level of competence, they could learn what they need to know in order to meet specific job requirements and performance standards. Notions are shaped by the paradigms we hold. In this sense ‘paradigm’ means the ‘working model’ of what we do, why and how that we exist as intellect entities. Such a working model is Bloom’s Taxonomy for the cognitive domain. The cognitive domain involves, as input, a knowledge-process, and offer, as output, the knowledge-object [4].

[5] develops an overview of the main activities of the permanent cognitive restructuring: maintaining the infrastructure that makes technology works. In this approach, three kinds of infrastructure are likely to emerge: technological infrastructure, conceptual infrastructure of the educational study programs, and the cognitive infrastructure of the participants implicated in the learning activities. Technology is usually ‘embedded’ in a device that, potentially, changes the way a task is carried out. Such a device could be a solution in order to carry out certain functions within an activity. Thus it may be useful to think of technology more in terms of functionality rather than devices. The context generated becomes infrastructure. In relation to teaching and learning, appropriate infrastructure has potential functionality in areas such as clarifying the zone of proximal development for a learner, scaffolding learning activities, mediating learning while in progress [6].

Figure 1 presents a conceptual description of the scientific research as a technological application in higher economic education, developed from previous researches.

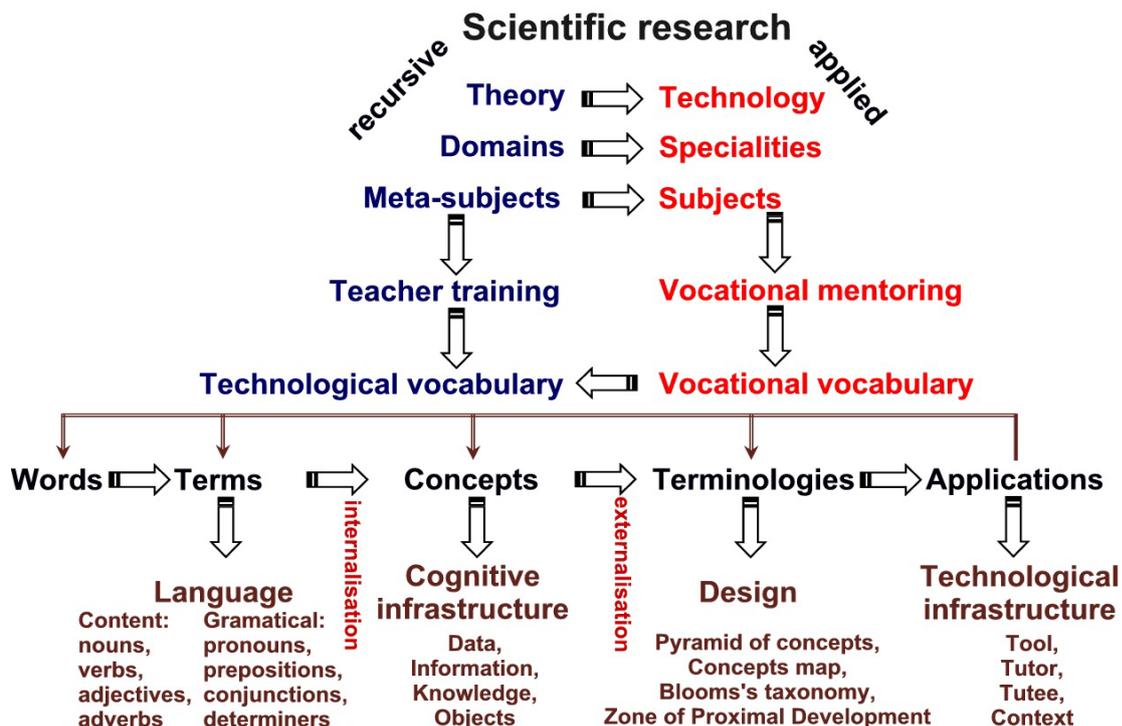


Fig. 1. A conceptual framework for scientific research in e-education, developed from [2]

The purpose of this conceptual framework is twofold. First, a structure for educational scientific research is supposed, and then a functionality in order to turn the theory into practice is promoted. Both points presented are founded on the idea that learning is a continuing human activity which use and increase technology, generating e-learning which is a new input for learning in an assisted instruction environment.

2 Theoretical framework

Scientific research is a continuously human activity which requires two categories of terms: working terms and scientific field's terms. Each group of terms exists and develops subjects in the context of a specific group of working terms, expanded as a meta-subject. The group of the working terms has a double function: a descriptive one

(knowledge function) and an explanatory one (understand function). Knowledge developed by scientific research is recorded in technology. Classical education includes instruction, as an interaction between student and teacher, while e-education assumes assisted instruction, as an interaction between teacher and student, mediated by personal computer; e-education includes the classical form, and it is developed as an extension of the previous one.

Considering the image presented in figure 2, it is useful to highlight an internal flow, where the working terms are aggregate or integrate as concepts into the theories or technologies, and an external flow, where scientific field's terms are applied or integrated recursive for a new iteration of the human action.

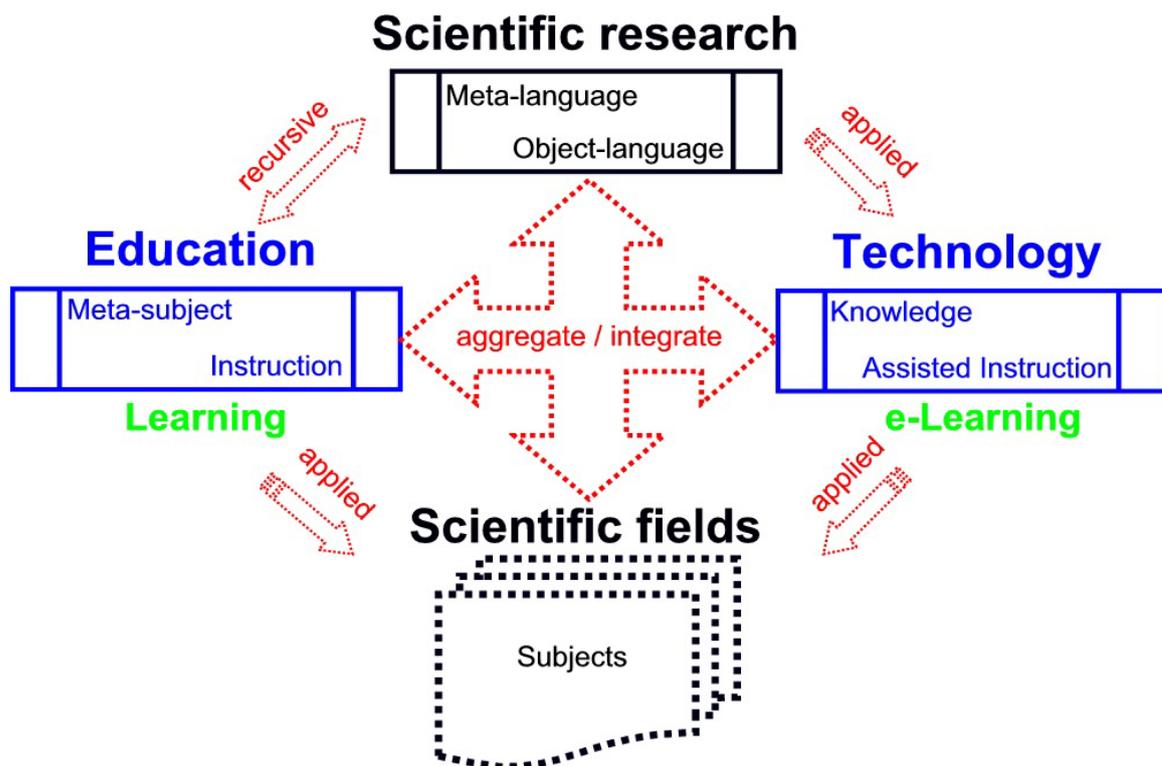


Fig. 2. A theoretical framework for scientific research in e-education, updated from [2]

Such an approach involve an assisted instruction paradigm, where the most important impact of technology to the social context was developing and implementing the standards; the result was the necessity of defining and training the standard user. On a generalized stage, the content of any

scientific field is gradually refined from data to information, then to knowledge and finally integrated in educational objects. This content is anchored in a glossary, permanently enhanced: as a pyramid of concepts for the three levels of the Bloom's taxonomy, and as a concepts map for

analysis, synthesis and evaluation.

In e-education, this new paradigm defines teaching as a complex cognitive skill, determined in part by the nature of the teacher's knowledge system used to explain patterns in participants' planning; post-lessons reflections are derived from assisted instruction designed for a personalized and interactive learning process. These two attributes of the teaching process make possible implementing the Zone of Proximal Development's Vîgotsky learning theory.

According with the theoretical framework for scientific research in e-education, as it is shown in Fig. 2, the concept of learning presents two viewpoints for analyze:

- The learner's point of view, when learning is a complex process, consisting of internalizing the terms of a specific language, in order to develop his cognitive infrastructure and externalize the outcome in a specific terminology; in this case, e-learning is usable if the support fits with the learner;

- The teacher's point of view, when basic learning is a sequence of three related activities: knowledge, understanding and application; in this case, e-learning is usable if the content is designed as an educational object, ready to be included in a pedagogical situation.

Comparing the two frameworks previously defined, we observe that the conceptual framework is a descriptive one, and it is founded on two words from the nouns class (*theory* and *technology*), while the theoretical framework is an explanatory one, and it is based on two words from the verbs class (*aggregate* and *integrate*). As a result, this paper presents the working terms of our approach through their functions, so the article is an application of the promoted theory.

A mechanism for this assisted instruction pattern presumes that a new term of the scientific field becomes an input in the framework as aggregation, and integrates in the content when it is confirmed as an application.

3 Analytical framework

Although we often view the term *technology* as a hardware item, it is actually a system of practical knowledge. Technology is derived from the ancient Greek word *techne*, which can be translated to refer to art, profession or skill. Plato viewed *techne* and scientific knowledge as being closely related, and Aristotle went a step further by asserting that *techne* was the systematic use of knowledge for intelligent human action [7].

Such a judgment concludes that technological infrastructure integrates content and develops skills. For the cognitive domain, technology registered a new concept labeled *Information and Communication Technology*. While information and communication technology can be a valuable aid to the users' activities, it does depend to some extent on users' skills and understanding [8].

Intending to explain the knowledge conversion process from tacit to explicit content in assisted instruction, [4] highlights the scaffolding in assisted instruction, based on constructs designed as a function of technology infrastructure, developed as data, information, knowledge and educational objects. This approach implies different forms of refined technologies: tutor, tool, tutee or context.

Next stage in this research is reflected in [2], when the model is designed as a knowledge cube in contextual assisted instruction. Based on the classic structure of levels in producing education (Pre-Assistant Lecturer, Assistant Lecturer, Lecturer, Senior Lecturer and Professor), we considered new specific competencies (information literacy, computer literacy, technologic literacy and education literacy), and now, the teacher processes data, structures information, systematizes knowledge, and develops educational objects. In this case, standard user's levels are: novice, advanced, competent, analyst and expert.

The main features of the contextual assisted instruction paradigm are that the teaching process is irrespective of technology version and of the initial cognitive level of the

learner.

Starting from the idea that assisted instruction is a special application of the global information system, the new system learning is developing as a laboratory labeled as workplace learning. Innovation in education has to be included in personalized and interactive application, based on pyramid of concepts and concepts map of the content. The main features of such kind of applications include three directions for actions:

A. focusing the student:

- Gradual statements for knowledge, so the student could understand, and as a confirmation, could apply, in a specific context;
- In the first stage, students run the application in the laboratory, where the teacher could explain or detail, when this is necessary; in the second stage, student could run the application at home, with online assistance;
- The applications need replay when these are abandoned;
- The applications consist of immediate and in context support when the action of the student is wrong;
- The applications are designed as units of learning, for the content of a subject.
- The applications record the timing of execution for each statement;
- The answers, generated as new applications are sent by email to the teacher in order to store the results for the whole group of students;
- When the contents are more complex, and the student activity is integrated in a project, such systems include dedicated applications for auto-evaluations.

B. focusing the technological infrastructure:

- The applications are designed in order to help the student to know, understand and apply the environment, so the computer is tutor and tool, while for the teacher the computer is the tutee; in teacher training activities the personal computer becomes the context;
- The applications are designed independently of the software version, so the

student learns the environment which is installed;

- The applications are designed using the resources of the same software which is the environment object to be learned using its own resources.

C. focusing the teacher:

- Working with numerous students, the applications sent by the students are checked using dedicated applications;
- The feedback of such kind of approach generates new versions of the educational applications;
- The teacher becomes the designer of the content based on the experience of using these applications.

This approach which consists of learning theories regarding assisted instruction in workplace learning has to be sustained with examples. This theories centre on high-end learning, collaborative learning, circular organizing and triple loop learning, the main features of the new educational organizations.

4 Case Study

It is important to recognize that not all learning takes place in a neat and ordered way. We learn best when we combine all four approaches to learning [9]:

- Theory input;
- Practical experience;
- Application of theory;
- Idea generation.

We all prefer to learn in slightly different ways:

- Activists learn best by doing;
- Reflectors learn best by observing;
- Theorists learn best by thinking things through in a logical and systematic manner;
- Pragmatists like to learn through putting their ideas into practice and testing them out.

Continuing the work based on the three frameworks previously described, we conclude that the four approaches to learning have to be completed with learning design based on the pyramid of concepts and on the concepts map, and at the same time, including different ways to proceed in educational applications.

The pyramid of concepts considered for the next examples refers the electronic spreadsheet, one of the most flexible environments of the worldware. The image presented in figure 3 highlights a simplified

version of the main concepts involved in designing the learning process dedicated to know, understand and apply the spreadsheet for solving problems in assisted instruction.

PERSONAL COMPUTER

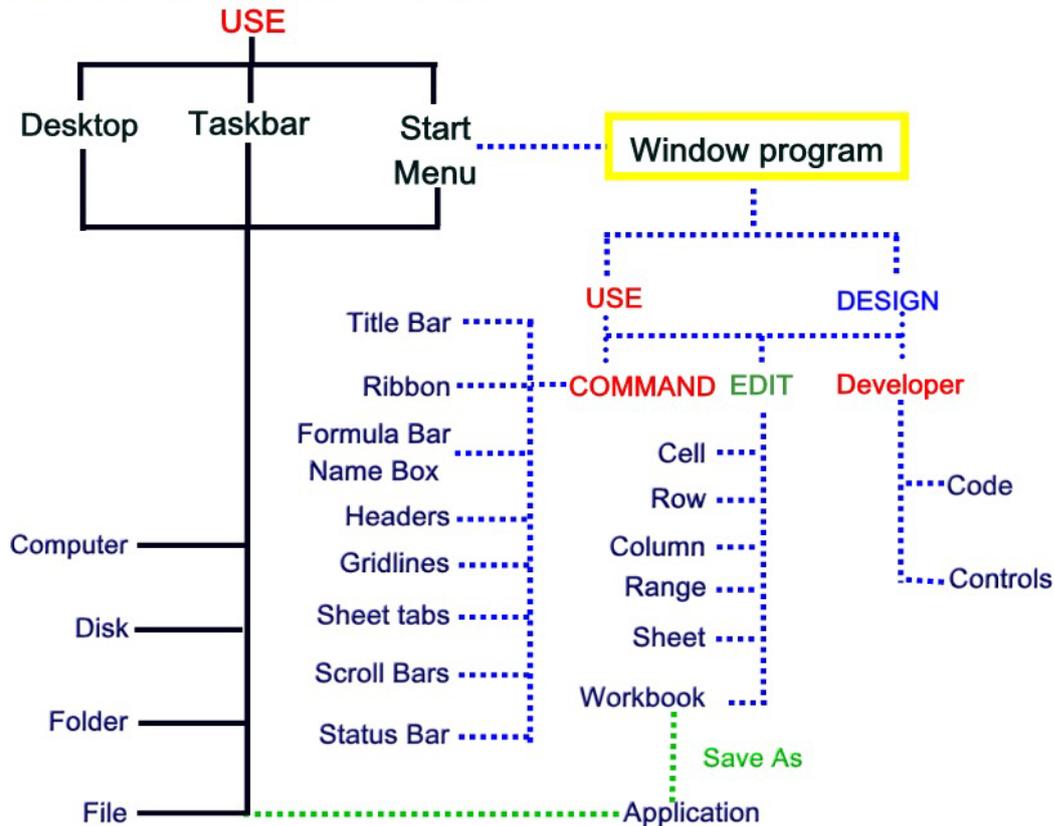


Fig. 3. The pyramid of concepts for electronic spreadsheet (simplified version)

Earlier researches on developing the electronic spreadsheet as an environment in order to learn through the seven stage of the Bloom's taxonomy are presented in [10]. A paper book could be no longer an adequate solution for an interactive, personalized and dynamic learning process because of the continuing technology's versioning.

Storing spreadsheet data is only the beginning as far as Excel is concerned. The wide range of features it contains let the user manipulates and presents his data in almost any way the user chooses. This environment can be an accounts application; it can be used as a scientific calculator capable of utilizing complex mathematical formulas; it can be a diary, a scheduler, and more [11].

A paper book could be a complete

description of a computer as a tool or tutor, even a tutee, but the applications designed in order to teach and learn become the dedicated environment developed as a contextual learning based on understand and apply. Such an approach transforms the application into an engine used to perform through the zone of proximal development of the learner which assumes a specific cognitive infrastructure.

Consider the next description of an application designed in order to teach and learn basic concepts of the electronic spreadsheets using the same environment.

The student opens the application, edits his/her names and finds in the first worksheet the first statement. The user has to select a range, and then click a button for check.

When he is wrong, the application displays a solution. When the student solution is right, the application generates a new statement in a new worksheet. Now, the user has to select a range and then he has to move the active cell in the selected range. Then, the student has to select a range and then he has to apply different attributes for the selected range. Then, he has to work with two ranges in the same time, and so on; the complexity of the application is increasing gradually. Finally the application is saved as a new one, renamed with the name of the student, in order to account his activities during the labs.

The student receives the application by e-mail and sends the result to the teacher. The application is design for working in laboratory, and the student is assisted by the teacher. He could ask any moment any question about his activity, in order to understand and apply the concepts he had learned.

The image presented in figure 4 reflects a new statement when the basic concepts of the environment are passed. The user has to apply them in a geographical subject, using statistical formulas, a native tool for a spreadsheet.

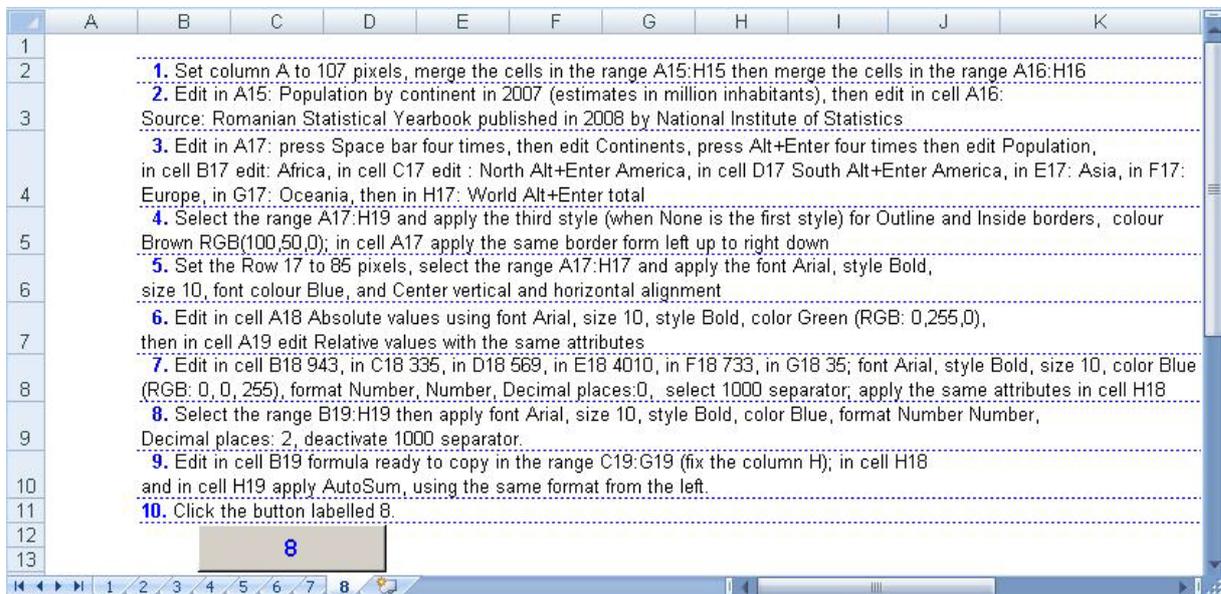


Fig. 4. A spreadsheet as a tool and nine steps as a tutor for an interdisciplinary subject

The result of this application is presented in Fig. 5; the range A1:A9 in figure 4 is de-

signed as a control panel, dedicated to assist the user during his activity.

Population by continent in 2007 (estimates in million inhabitants)
Source: Romanian Statistical Yearbook published in 2008 by National Institute of Statistics

Continents	Africa	North America	South America	Asia	Europe	Oceania	World total
Population							
Absolute values	943	335	569	4,010	733	35	6,625
Relative values	14.23	5.06	8.59	60.53	11.06	0.53	100.00

Fig. 5. The result of the statement presented in Fig. 4

Next example, see figure 6, uses the same basic concepts, but the user has to apply them in a different subject, far away from numbers, finally, the required result being an

optical illusion. The terms used in the statement offer the student an optimal action in order to solve the “tool” problem and develop a psychological statement.

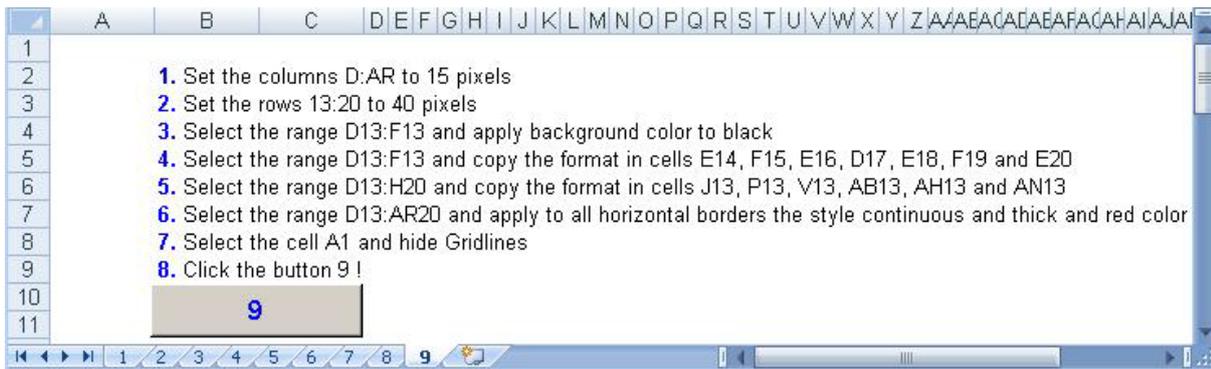


Fig. 6. A spreadsheet as a tool and seven steps as a tutor for a psychological subject

The result of the application (applying the mentioned attributes in the range D13:AR20) is presented in the image included in figure 7.

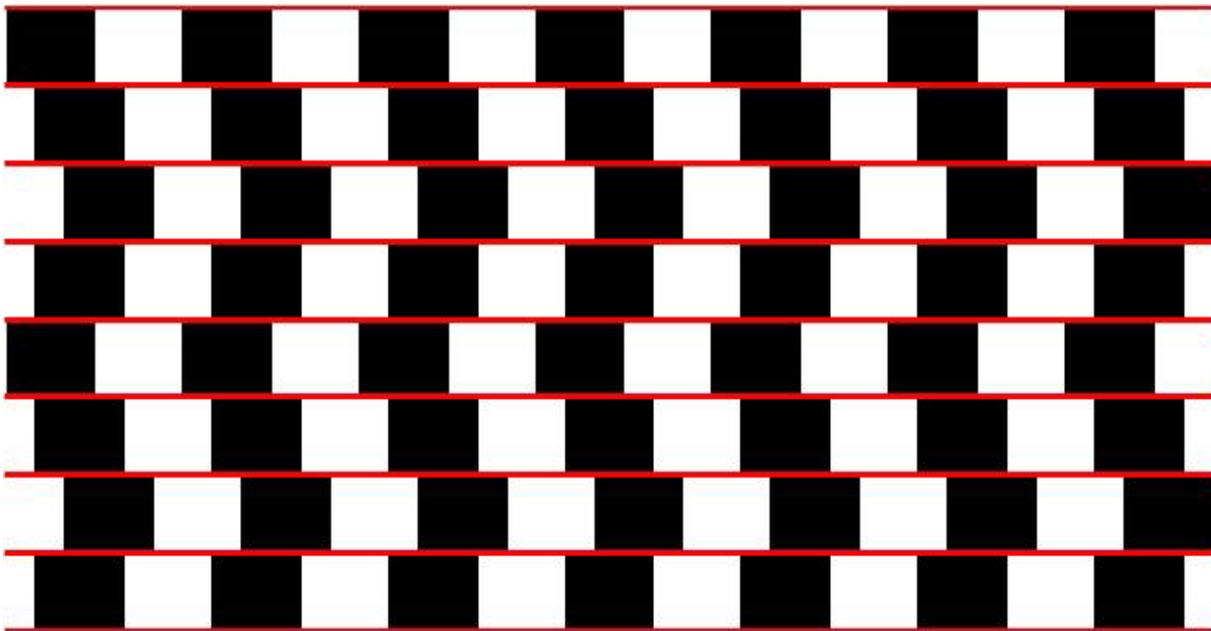


Fig. 7. The result of the statement presented in Fig. 6

Next example presents a classical memory test (see the figure 8) which was transferred from a printed book in an electronic spreadsheet, applying new dimensions.

Which is the number you can see twice in the next square and which number from 1 to 25 is missing?

10	3	20	15	7
12	14	1	11	25
2	8	22	19	16
13	18	6	24	4
5	23	12	17	9

Fig. 8. A classical memory test

This method develops the idea that the electronic spreadsheet could be transformed into an eBook. The goals are: to simplify the user's action and to demonstrate that the personal computer is an academic extension of the learner. In this case, we have to understand that the pyramid of concepts become a concepts map and the learner pass through different levels of computer literacy. The classical statement presents a square of values in the page of a printed book, the reader sees the image for a while, and then he has to reveal which is the number he can see twice and which is the number from 1 to 25 is missing.

The application was designed to offer three types of solutions while we consider different dimensions of the square (see the image in figure 9).

First solution is based on basis concepts the user already knows about the electronic spreadsheet; he has to copy the first column of the square (the range E3:E15) in A1, then he has to copy the second column of the square (F3:F15) in cell A14, and so on, until

he fills the range A1:A169. Then, the user has to sort the range A1:A169 (smallest to largest), and finally, he has to compare the rows heading with the content of the first column, in order to observe a number twice and which number from 1 to 169 is missing.

A second solution is based on filling the range with the series 1 to 169 (see, for example, a quick solution: Ctrl+G, A1:A169, OK, =ROW() Ctrl+Enter); then, the user can apply the function MODE(), which returns the most frequently occurring, or repetitive, value in an array or range of data: in cell B1 he edits =MODE(E3:Q15); the number from 1 to 169 which is missing will be =SUM(A1:A169)-(SUM(E3:Q15)-MODE(E3:Q15)).

The third solution is dedicated to the missing number, which can be display using the next formula:

=FACT(169)/(PRODUCT(E3:Q15)/MODE(E3:Q15)), where the PRODUCT function multiplies all the numbers given as arguments and returns the product.

Which is the number you can see twice in the range E3:Q15 and which number from 1 to 169 is missing?

36	147	162	140	57	91	123	58	159	34	85	87	169
145	89	28	17	146	79	56	47	61	40	48	155	83
6	39	148	101	13	55	167	41	134	4	43	107	103
113	132	122	59	144	62	166	161	75	65	151	73	128
117	108	21	80	168	130	27	18	88	133	129	12	60
84	143	158	114	154	118	37	165	71	110	82	90	15
163	100	95	22	152	97	68	53	115	19	14	104	139
136	78	137	105	45	125	38	8	2	72	42	63	26
153	135	150	50	81	11	94	67	156	32	120	66	49
126	77	46	112	29	7	96	3	124	33	157	142	69
138	92	64	102	54	51	74	1	111	99	44	52	149
109	70	25	5	23	10	30	116	121	98	89	31	24
119	141	16	160	86	9	127	93	76	20	35	164	131

Fig. 9. An IQ test, from book to eBook

Next application is based on a classical IQ test developed on the series of magic squares [12]: Swap four values in order to change the

square into a magic one: the sum for each horizontal, vertical or diagonal array is 34 (see the image in figure 10).

4	14	8	1
9	16	6	12
5	11	10	15
7	2	3	13

Fig. 10. A classical IQ test

While the square was placed in the range F5:I8, the application offers eleven steps in order to solve the statement, transforming the initial square into a magic one. The range

A12:A22 will contain **OK** or details about the user's work when he clicks the button **Check**.

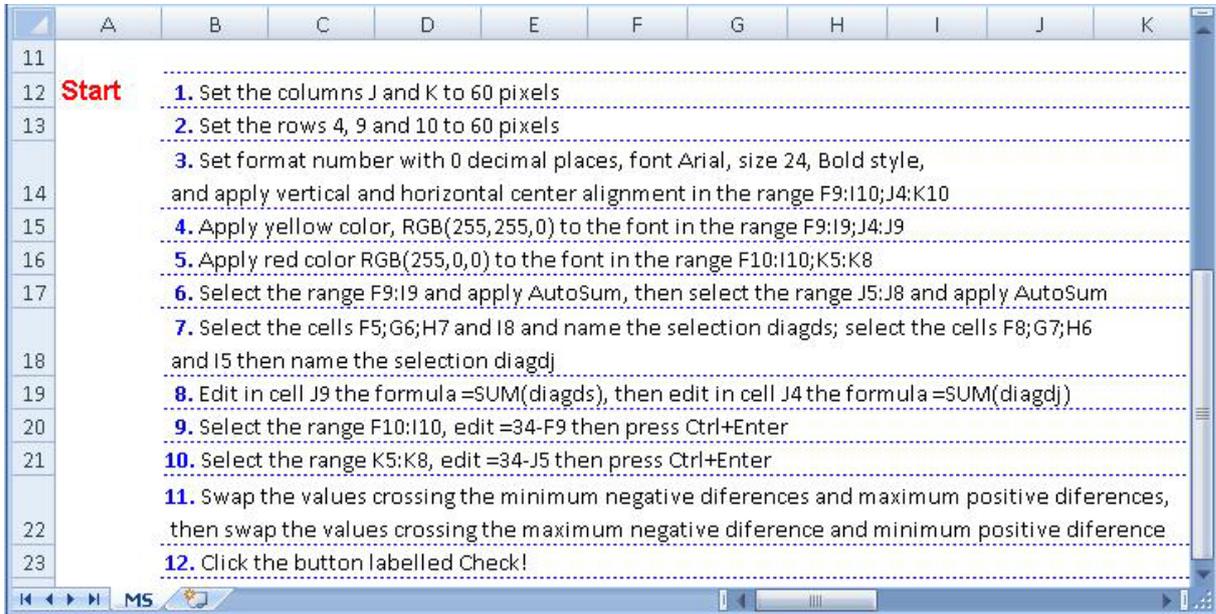


Fig. 11. Tool, tutor and tutee for an interdisciplinary approach

5 Conclusions

Based on the theories highlighted in previous works of the assisted instruction [13, p. 154-162; 14, 279-348], e-learning presumes interactive technologies, centered on student and dedicated to develop the user competencies in computer literacy in the first stage, then using them in solving problems of different subjects, on the second stage. An explanation for this approach is sustained by the interactive and centered on student applications, which facilitate internalizing (see figure 1) and develop cognitive infrastructure of the user (as data, information, knowledge and educational objects). In this model, the personal computer can be understood as an intellectual extension, and it has to be placed between the student and the professor, in an assisted instruction environment.

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