Proposed Principles for Context Development of e-Learning Training Courses

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Abstract: – Growing evidence suggests that the success of a learning system may critically depend not only on the nature of the environment in which the learner is placed, but also on the methodology for context development and for learners' evaluation. This paper is based on the learning factors and on the theories of classical instruction and proposes principles for context development of e-learning training courses.

Key Words: e-Learning, learning models, distance learning, taxonomies of instructional goals, learning operations and learning principles.

1 Introduction

It is commonly accepted within all kinds of educational communities (including businesses or organizations relative to education) that the labor market, in combination with the rapid development of new technologies, creates a need for "life-long education". This means that education/training should be provided more than once in the duration of one's career and most importantly, it should be provided quickly, easily and with a low cost.

Distance Learning and especially Electronic Learning (e-learning) can undoubtedly facilitate this kind of "life-long education". E-learning is called the process of learning/training, accomplished through modern technologies, such as computer programs, digital and network technology and so on.

The rate of learning progress is fully controlled by the learner, who is able to attain education in multiple ways (plurimedia modalities). The e-learner, free from time and space limitations, has an equal chance for knowledge, as well as a choice of the subject and the method of his education/training (what and how he will learn). E-learning follows an open and flexible learning philosophy, in which the e-learner constitutes the center of the learning process. Simultaneous help and support by the instructor/specialist is available at all times.

There are two kinds of e-learning: Synchronous and Asynchronous [1], [2]. Synchronous e-learning means instructor and learners are concurrently connected to the web and their communication takes place in real time. In Asynchronous e-learning, concurrent web connection of instructor and learners is not necessary, since all communication takes place through e-mail.

Various platforms (e-Learning Environments-WebCT [3], BlackBoard [4], Top Class [5] etc.) have been developed to support this kind of distance education. The success of an e-learning course depends very much on the learning environment in which it is placed [6].

Any kind of e-Learning Environment, that is available in the market, offers the functionalities, of Creating Courses, Creating Tests, Delivering and Management of Web-Based Training, Monitoring Students Progress

2 Knowledge- Learning- Instruction

As with the traditional learning method, the target of e-learning is to obtain knowledge. Knowledge is defined as the permanence of learning. According to Gagné [7], learning is the procedure that assists organisms to modify their behavior rapidly and permanently, so that the same alteration or change is not necessary to be repeated each time in an equivalent situation. Learning can be induced,

enforced and promoted through instruction (teaching).

Instruction can be defined as a system (model-methodology), which includes all kinds of organized actions that target to learning, independently of the place and the method in which these actions are performed (Smith**)** [8]. Thus, according to Smith's definition, instruction does not necessarily require the existence of an instructor, as defined in the traditional, face-to-face method of instruction. Instruction can therefore be defined as any effort, made through any means, with the aim to impart knowledge.

Although there are numerous methodologies applied to traditional learning, commonly accepted methodologies that apply to e-learning do not exist yet. It seems unfeasible to establish a sole methodology for e-learning in general. Preferably, several methodologies should be developed, taking into consideration various factors, such as the intention or goal (of education or training), the target group (children, adolescents or adults), the interaction of the factors of the instructive process, the cognitive processes of learning and the most representative from the classical theories of learning.

In this paper, e-learning content development principles for adult training are proposed. We propose the following model having in mind the Rézeau's interactive model [9] of the learning process (Figure 1).

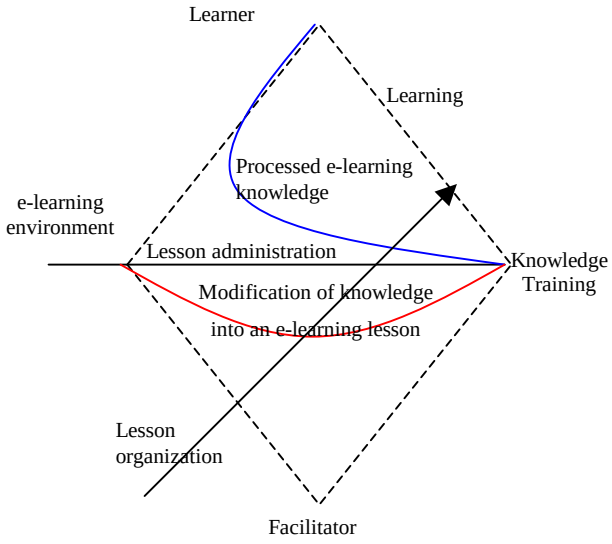

Fig. 1. Interactive model of the learning process

The learner is at the apex of the instructional procedure, in which the instructor-facilitator, the learning environment (the learning material) and the learning object also play an interactive role. It is worth noticing that the learner does not come in direct contact with the learning object, since the learning environment intervenes between the two. Knowledge is processed and adapted before it is administered through the learning environment in such a way so that the instructional procedure is rendered successfully. In addition, the role of the instructor is to intermediate between the learning object, the e-learning environment and the learner, by developing and organizing the lesson, bearing in mind the aforementioned parts of the learning procedure and adjusting the methodology accordingly. The concept of instructional transposition, according to Michel Verret (transposition didactique) means that the instructor shapes knowledge in order to make it appropriate for instruction.

3 The Basic Factors and Cognitive Operations of Learning

The basic factor and cognitive operations of learning are memory-oblivion, perception and understanding.

3.1 Memory – Oblivion

The basic pursuit of every instructive activity is to provoke learning of a relatively permanent form. Individuals should therefore be able to retain in their memory something they have learned for a long time, as well as be able to evoke and use this knowledge when required. This is would be simple if there wasn't oblivion, a function of the mind, which allows the partial loss of any learning experience, obtained through any method. In order to absorb and retain information from the environment, some cognitive processes function. The most important cognitive processes are perception and memory, which concern the intake, the recognition and the retention of information. (Figure 2)

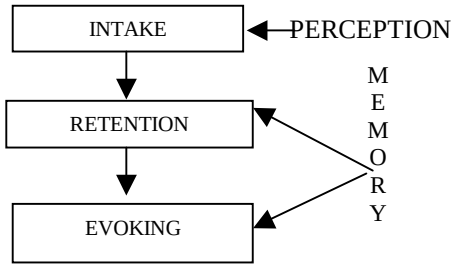

Fig. 2. The three phases of information processing

3.1.1 Perception

Perception is the cognitive process that helps us to intake, organize and recognize the stimuli (information transmitters) of our environment (Kagan & Havemann**)** [10]. More precisely, it is an active process of stimuli according to the individual's patterns of perception (previous experience, aspirations, needs, emotions, etc). Perception depends on the individual's molding of

external stimuli. That is why different people have a different learning ability (Empirical theory and Morphological theory of Learning).

The basic stages that take place during the perceptive process of stimuli and finally lead to its recognition are the selection and the recognition of information. During the stage of the recognition of information when stimuli are captured, a representation of them is formed. These representations are retained for a minimum of time in a kind of mnemonic retention, what Neisser [11] called iconic memory. After the stage of retention, most elements are advanced to the stage of coded representation where they are coded and can be retained for further processing and recognition. It is believed that recognition is the result of a series of procedures, the most important of which are the extraction of information (where the informative elements of a stimulus are extracted one by one in a successive order**)**, the organization of the information (for example, reading a text is based on the organization of the letters into syllables and words) and the interpretation of information (what we finally perceive is conditioned by what we already know – Nisser) [11].

A theoretical model of cognitive recognition is the specification of distinctive elements. This model is based on the activation of cognitive mechanisms while each cognitive mechanism (cognitive analyzer) is sensitized by a specific optical point (horizontal line, vertical line, left curve and so on). First the distinctive elements of a form are traced and transferred to the cognitive analyzers and then the information is organized and interpreted, thus leading to the recognition of the optical form. This hypothesis has also been applied to computers, (Selfridge, Neisser). Figure 3 presents a graphic representation of the cognitive recognition of optical information.

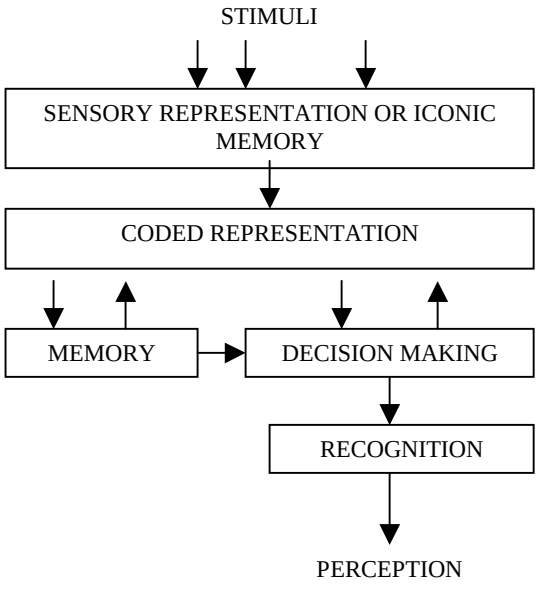

Fig. 3. Representation of the cognitive recognition of optical information

3.1.2 Memory

The two basic stages of memory operation are information retention and extraction. The retention of information in memory (what and how much will be retained) depends on:

- Innate cognitive factors (retention mechanisms and functional processes, which Atkinson named "control processes**"**) and
- Extraneous factors that refer to the nature and the structure of the information.

Figure 4 presents a multi-structural memory model.

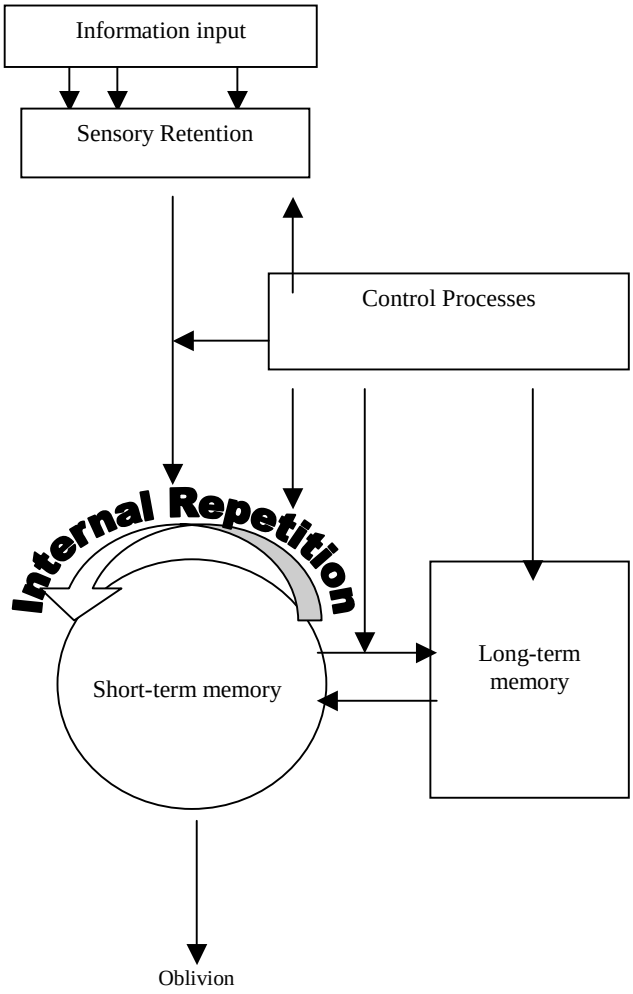

Fig.4. Graphic representation of memory system according to the multi-structural memory model

In the multi-structural memory model of figure 4, information is initially retained in the stage of sensory retention, which has the ability to retain a large amount of information but for a very short time (from several split seconds, up to a second). This is the stage of iconic memory and the identity of the information is not yet recognized. Part of this information reaches short-term memory, which has a limited storing capacity (retains between 5 and 9 elements, Miller) but has the ability to recognize the information. The retention duration is 30 seconds. Internal repetition (retention more that once) is required for longer duration. Short-term memory is

basically of an acoustic nature (it retains information in a phonetic rather that in a semantic or optical codification). Information not forwarded to long-term memory, is lost. Consequently, short-term memory is restricted to functioning as working-memory (Baddeley [12]). The information is then transferred to long-term memory, which possesses unlimited quantitative and temporal information retention abilities. In the case of linguistic information, it is believed that retention is done based on semantic codification.

3.1.3 Understanding and Memory

The degree of understanding the informative elements depends on both the nature of the information and on the level of activation of the individual's cognitive substructure. These two factors specify the level (depth) of elaboration that the retained information will undergo. For example, when reading a text, the elements that can be easily retained (and also evoked) are called main points. Main points contain the basic information of the text and by maintaining these together with the structure of the text, the human brain can retain the new information by "building" on top of already existing knowledge. So the learner must learn to detect the main points of a text, link them together and associate them to his previous knowledge. In this way, retention is more effective and the individual can move to reasoning and assessment.

4 Taxonomy of instructional Goals

In order to propose principles for the context development of e-learning training courses, we have to specify the general instructional goals, which learners must accomplish after the end of the educational procedure. There are various taxonomies (Bloom [13], Gagne [14]). Unlike instruction, one of the targets of assessment is to predict all possible circumstances and problems that may occur, by giving the learner prior information, presented as knowledge. In parallel, assessment aims to provide the learner not only with the training per se but also with the potential for comprehension and with the opportunity to apply the learning material into real circumstances.

Based on the above, the taxonomy of instructional goals, which serves the needs of the present research, is Bloom's taxonomy. More precisely, our interest is focused on the following instructional goals:

Knowledge: Knowledge is thought to be the base for all other instructional goals. Solving a problem presupposes that the learner knows how to predict and confront various circumstances. This requires the knowledge of certain axioms, terminology, methodology, principles, structures, and causative interactions of a series of specific incidents in relation to time.

Comprehension: The comprehension of effects, symbols and forms of written or spoken material is a matter of the learner's prowess and ability. After the end of the training procedure, the learner should be able to "translate" (in other words, be able to transfer communicative terms to another language or terminology or other forms of communication in general) and to "interpret" (re-classify ideas in his mind in order to achieve optimum understanding).

Application: The term application refers to the learner's application of knowledge onto new circumstances. Comprehending a concept does not necessarily verify the learner's ability to apply it, thus application should be included in the instructional goals.

5 Proposed Principles For Context Development of e-Learning Training Courses

Taking into consideration all the aforementioned factors (the target group, the computer –which to a great extent replaces the instructor– the interactive model of the learning process, the taxonomy of instructional goals, the basic factors and cognitive procedures of learning) we are going to propose a set of principles, which the facilitator can follow in order to develop the context for an e-learning training course.

The principle of result (Thorndike [15]). There is a tendency to repeat any kind of behavior that the organism finds pleasurable. Although Skinner and Vygotsky do not completely agree with this principle (referred by Rézeau [9]), we can suppose that a lesson with pleasing results, such as praise or any kind of encouraging remarks, is not only learned more easily but also motivates the learner to continue studying the next time (a typical and expected e-learning procedure).

The principle of practice (Thorndike [15]). The repetition of a response enforces its association with the stimulus that caused it. To use a well-known Latin maxim: "Repetio est mater studiorum", which means "Repetition is the mother of learning". Watson agrees with this principle (Watson [16]) but Guthrie (Guthrie [17]) claims that repetition does not cause learning but only reinforces it. In an e-learning environment, this principle is applied through a variety of exercises and means (rotative repetition or rotative forms of repetition) in order to achieve a better and less tiresome comprehension.

Principle of progressive differentiation (Ausubel [18]) Knowledge cannot be provided all at once, we have to continuously revert to former knowledge, adding something new each time. In this way, new

information is assimilated more easily. Bruner [19] refers to this idea as "the spiral progression" of the learning material. At the end of every major point of the lesson there must be procedures, which oblige the learner to apply the knowledge acquired previously in this lesson. Moreover, because in e-learning courses the learner may act according to personal needs and start the training in any time and at any point of the lesson, it is important that each chapter (part of the lesson) forms a complete and self-contained unit.

The principle of incentive motivation (Hull [20]). According to Hull, learning is influenced by drives and needs of the organism and other factors, which he named intermediary variables (Miller and Dollard also support this theory). The most significant intermediary variables are drives (D), incentive motivation (K), habitude (sHr), stimulus intensity (V) and response potential (sEr). Incentive motivation is triggered by external reasons, so in our case it can be the certification of knowledge, the potential to remain competitively active in the modern labor market or financial grants. Habitude accrues from the temporal affinity between the stimulus (s) and the response (r) and also from the enforcement of the association between the two (s and r), which in turn also means the satisfaction of drives. Finally, response potential represents the individual's ability to respond to various stimuli (learning). The following equation shows the relation between response potential sEr and the other variables:

$$sEr = D \cdot K \cdot sHr \cdot v$$

Response potential = drives x incentive motivation x habitude x stimulus intensity.

Thus, in every part of the lesson, knowledge should be enforced and supported with various motivations (Gagné), such as praise and encouragement upon the successful completion of a task or a test. In parallel, reactionary obstruction, meaning factors that intercept knowledge, should be avoided. For example, chapters should be kept short; pages should not be overloaded with (semantic) information, sophisticated language and dense style should be avoided (Bruner, Vygotsky).

The principle of imitation (Miller and Dollard [21], Bandura [22]). Most individuals learn by imitating others. In addition, memorization is easier when based on mnemonic symbols (Vygotsky [23]). This principle can be applied in e-learning by using mnemonic symbols in context development and video or graphics that represent imitable circumstances. In addition, when the focus of the lesson is on verbal expression or pronunciation, the human voice can be used as the imitable object. The process of imitation can be performed in simulation environments.

The principle of overall understanding of a situation. Everything we learn comprises an ensemble. Learning is better achieved when the learners know clearly and in advance the goals of their education. Thus, in the beginning of each course, chapter etc, it is useful to have a comprehensive and concise content summary as well as a clarification of the instructive goals and of the expected results. Tolman [24] refers to this idea when he discusses the "cognitive map", while Ausubel [18] mentions it in his discussion of the "advanced organizers of the lesson". The specific section of the lesson, which contains the summary, the instructive goals and results, should be accessible at all times, with the use of links or a navigation tree, so that the learner is aware of the outcome of education.

The principle of similarity and symmetry (K.Koffka [25]). As mentioned before, everything learned comprises an ensemble and thus it becomes understandable. Similar and symmetrical forms are more easily understood. Thus, in each e-learning course the lessons should be related. Every new chapter should be based on the previous. In e-learning, the learner is often provided with the ability to start and control the pace of the learning process, but it must be ensured that chapters are clear, self-contained and do not overlap. Each lesson should be clearly organized into units, which must be classified in a semantic order. Visual representations of various concepts have to be kindred and symmetrical. Furthermore, concepts should be presented in combination with their opposites and the learner should have access to the latter at all times (by using links, for example).

The principle of active participation and cooperation (Piaget, John Dewey, Vygotsky). In his work "Moral philosophy of Nikomachia" *(Ηθική στη Νικομάχεια, 1103$^{\alpha}$)* Aristotle, claims *"All things that must be learned, we must learn by doing them*". Instructive (or guided) teaching can help in the application of Aristotle's principle. E-learning courses ought to include group procedures, the successful completion of which should require active participation by every member of the group. Furthermore, alternative ways or methods to complete work should be proposed in critical parts of the lesson (where learners may find difficulties). Added to this, learners should be helped to choose the way or method most suitable to their own needs. The computer-instructor acts as a facilitator to this educational procedure.

The principle of authenticity. The instructive procedure achieves maximal results when the learner is involved in authentic situations of learning and

familiarization, that is, when the learner can apply his newly gained knowledge in a real or realistic environment. In traditional instruction this is accomplished through role-play or authentic sources of learning. In e-learning, it is feasible to create simulation environments by reconstructing an experiment or real life or an imaginary situation. This is usually based on interactive graphics and it gives the learner the opportunity to visualize a procedure as well as investigate the results that a change of the parameters may have on the function of the program. Furthermore, simulation is often associated to the idea of a game, so it can also act as motivation.

Conclusions

This paper proposes principles for context development of e-learning training courses. The purpose of the proposed methodology is to help those facilitators, who develop e-learning training courses, to be more efficient and to succeed in their goals, regardless of which e-learning platform they are using. Future work includes an e-learning evaluation method (regarding the accomplishment of goals from the learner's perspective) and also a methodology for the personalization of learning and/or training. The aforementioned principles ought to be evaluated and proved (and improved, if necessary) through statistical measurements and data tracking at the e-Learning environments. In the future, proposed techniques for this purpose will be investigated, such as Log File analysis and Database report elaboration. With the aid of these techniques, significant data are tracked, such as student performance, personalization of the environment, the user's moves and system specifications. All the aforementioned are thought to affect student progress and the operation of every e-learning platform in general.

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