Turkish Online Journal of Distance Education-TOJDE October 2014 ISSN 1302-6488 Volume: 15 Number: 4 Article 4

REPRESENTATIVE MODEL OF THE LEARNING PROCESS IN VIRTUAL SPACES SUPPORTED BY ICT

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ABSTRACT

This paper shows the results of research activities for building the representative model of the learning process in virtual spaces (e-Learning). The formal basis of the model are supported in the analysis of models of learning assessment in virtual spaces and specifically in Dembo´s teaching learning model, the systemic approach to evaluating virtual learning by Badrul H. Khan, and the Cybernetic model for evaluating virtual learning environments. The e-Learning model is systemic and of feedback by nature. The model integrates the society, Institution of Education, virtual training platform, virtual teacher and students, and finally the assessment of student learning in virtual learning spaces supported by ICT. The model consists of fourteen processes. Processes are defined taking into account the following dimensions: identification, academic, pedagogical, educational, formative, evaluative, assessment of virtual learning and technological. The model is fundamental to the management of e-learning supported by ICT, justified by the fact that it is an operative model of the teaching-learning process in virtual spaces. The importance of having an operative model in virtual education is to project the management and decision in virtual education. Then the operational, administrative and decision phases will allow the creation of a set of indicators. These indicators will assess the process of virtual education not only in students but also in the virtual institution.

Keywords: **Virtual education. ICTs, virtual learning platforms, process virtual learning, virtual assessment.**

NTRODUCTION

The Information Technology and Communications - ICT in the context of the knowledge society are fundamental tools for an education which attempts to be: open, asynchronous, distance, anywhere in the world and in any language. Virtual education supported by ICT should be a high quality one in order to ensure virtual learning. Ensuring the quality of e-learning requires understanding the process of virtual learning. Then this article is the first phase of a research process. This phase, based on the analysis of the state of the art of virtual training process, constructs a representative model of the formation process in virtual spaces. Building the model required to: Understand the impact of ICT on the development of human talent of the XXI century.

Analyze the theories of learning and their relation to ICT. Build the concept of virtual learning assessment. Analyze existing approaches to virtual learning process. Analyze the process of virtual learning evaluation. Understanding virtual training process will allow the research to: Identify the relationship between the virtual institution and society. Understand the process of virtual learning with ICT.

THEORETICAL BASIS OF THE MODEL THAT REPRESENTS THE PROCESS OF eLEARNING

The main objective of the evaluation of e-learning education quality aims at ensuring the virtual student learning. In this way, different authors have researched the assessment of quality in e-learning. The main representatives, without doing a thorough analysis, have worked on:

Quality assurance in e-Learning, by means of;

- **applying accreditation processes to ensure the quality of an academic program in order to analyze "The eminent role of accreditation of online and distance learning programs on the transformation of quality measures in higher education" (Cabuk, Taner & Cabuk, 2013);**
- **using the concept of best practice as the "Use of ICT in Distance Education at Hanyang Cyber University: Possible Best practice for the Institute of Adult Education" (Mariki, 2013);**
- **ensuring the quality of e-Learning courses as is the case of "Which aspects of e-learning do students consider important for their learning achievements and course satisfaction?" (Paechter, Maier, & Macher, 2010, p. 222).**
- **using bechmarking to ensure the quality of on line courses as in the case of "A very positive example of the benchmarking approach is the development of European benchmarks for assessing the quality of e-learning in HE in the frame of the European project E-xcellence" (Hadzhikoleva, Hadzhikolev, Doneva, & Totkov, 2010); and**
- **using models such as "Models of e-Learning adopted in the Middle East" (Mirza & Al-Abdulkareem, 2011).**

Some of this cases have used intelligent systems as in "A web-based intelligent report e-Learning systen using data mining techniques" (Blagojević & Micić, 2013).

Ensuring the quality of;

- **e-Learning contents with check list using the e-Learning Courseware Quality Checklist (eLCQC) (Sung, Chang, & Yu, 2011);**
- **the course of e-Learning by interviewing participants (administrators, educational technologists, tutors and students) "taking into account the feedback for the student" (Jara & Mellar, 2010);**
- **e-Learning by using adaptative systems correlated with student´s learning styles as in the case of "Exploring the relation between learning style models and preferred multimedia types" (Ocepek, Bosnić, Nančovska Šerbec, & Rugelj, 2013);**
- **e-Learning transforming the traditional didactics in ways that extend beyond efficient delivery or entertainment value (Garrison, 2011); and**
- **course content of e-Learning certifying the quality of the information, as is the case of "Assesing information quality of e-learning systems: a web mining approach" (Alkhattabi, Neagu, & Cullen, 2011).**

Assessment of the e-learners:

- **The SEQUEL core quality framework (Dondi, Michela Moretti, & Nascimbeni, 2006, p. 44);**
- **"Assessment of student achievement with respect to the objectives of the Programme" (Flasdick, Michel, & Amaury Legait, 2006);**
- **The standard ISO/IEC 19796-1, used "…for assessment and evaluation of learning processes…" (Pawlowski, 2006, p. 72);**
- **The EFQM Excellence Model, which "…proposes different methods for the self-evaluation" (Stracke, 2006, p. 95);**
- **"Assessment of the learning sucess/progress" in Wirth (2006, p. 106); and**
- **Using rubrics in order to do assessment in e-Learning as in "Using wikis to develop student teachers´ learning, teching and assessment capabilities" (Lai & Ng, 2011).**

The model representing students' learning process in virtual spaces is supported theoretically on:

- **The Teaching-Learning Model (Dembo, 1988).**
- **The systemic approach to assessing student virtual learning by Badrul H. Khan (2005).**
- **Cybernetic model for evaluating virtual learning environments.**
- **In the next section, this theoretical support will be developed.**

Dembo´s Teaching-Learning model.

Regarding the selection of different methodological elements, Tomei (2005) states that

"The selection of educational objectives, instructional strategies and classroom activities by the teacher, are partially based on their beliefs about the nature of learning. Dembo (1988) shows the impact of teachers in the learning process in their model of teaching and learning" (Tomei, 2005, p. 23).

Analysing Dembo's model in Figure 1, it can be identified that when designing instructional objectives (3[1].), it is necessary to take into account both academic content (1.) and learners behavior (2.). This means that the fulfillment of learning objectives depends on both the design of the content and students behavior during the learning process, specially regarding to their interest and motivation for learning. Learning principles (4.), individual differences (5), and teacher behavior (6.) determine the planning and operation of an instructional method (7).

This means that pedagogic principles, didactics, and learning principles must support the method of instruction, but when the method is being in operation, it must necessarily consider students' individual differences. Thus, it is possible to have a method of instruction (or teaching) supported by technological resources, but if teachers, technically and academically, are not using those resources, it can be concluded that unused or misused technology is a waste. Both instructional objectives (3.) and the method of instruction (7.) converge in the teaching and learning process (8.), being understood that the fulfillment of the responsibility of teachers to teach and the student to learn converge in the teaching-learning process. Process that depends on the method of instruction to meet the learning objectives that necessarily requires compliance evaluation (9.), which includes the assessment of student learning.

Dembo's model is showed in Figure: *1* , below:

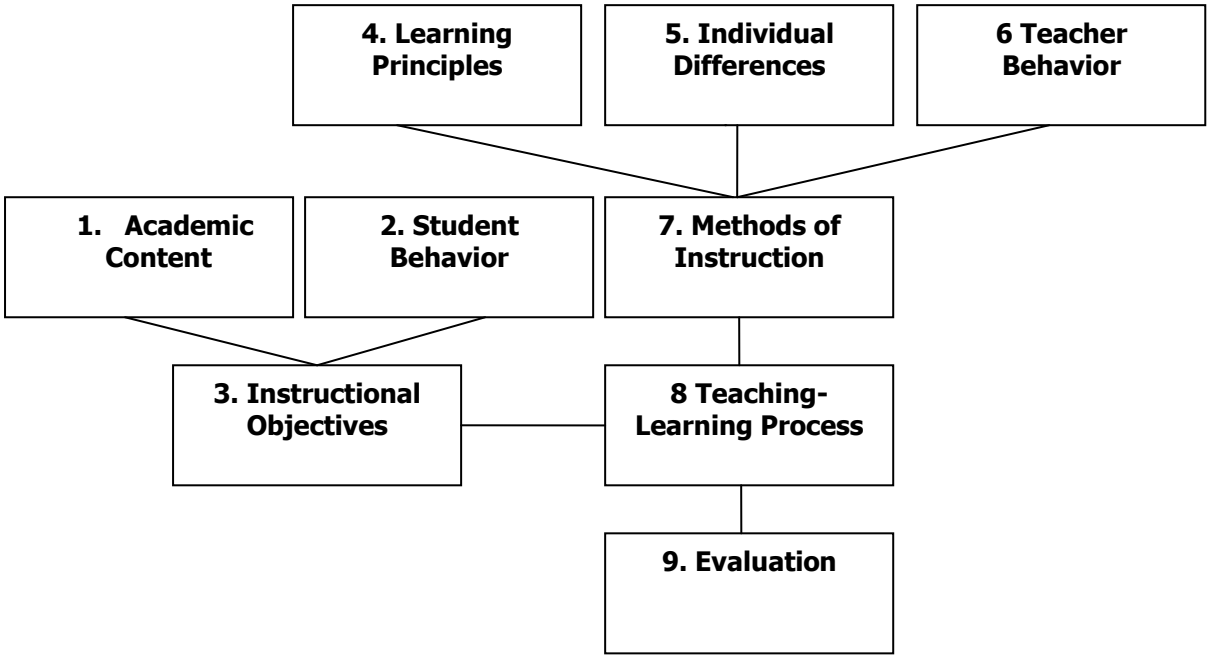

Figure: 1
Teaching-Learning Model created by Dembo (Source: Tomei, 2005, p. 23).

Dembo's model is applicable to the specific context of class attendance. The model represents the flow of actions in the process of a face to face class, which is one of its strengths. However, for virtual training in this model it should be considered:

- **The learning platform supported by ICTs.**
- **Training profiles that transcend specific virtual class.**
- **The integration of the virtual course or curriculum of the Institution of Virtual Education (IVE) to the external environment in their relationship with society.**

In summary, even though the Dembo's model is useful as a starting point for building the representative model of the learning of students in virtual spaces with ICT, the model must necessarily be improved with the relevant considerations in virtual education.

The systemic approach to evaluate e-Learning

The proposed e-learning evaluation by Badrul Khan, in 1997, integrates eight components that make up the evaluation system in virtual training-ICT. These are identified as "Eight dimensions of E-Learning" (Khan, 2005, p. 15). Keep in mind that for the construction of these dimensions, Khan was based on several studies of program

review, resources and elearning tools (Barry, 2002; Chin & Kon, 2003; Dabbagh, Bannan-Ritland & Silc, 2001; El-Tigi & Khan, 2001; Gilbert, 2000; Goodear, 2001; Kao, Tousignant, & Wiebe, 2000; Khan & Smith, in press: Khan. Waddill & McDonald, 2001; Kuchi, Gardner & Tipton, 2003; Mello, 2002; Romiszowski, 2004; Singh, 2003; and Zhang, Khan, Gibbons & Ni, 2001; quoted by Khan, 2005, p. 14).

The eight dimensions proposed by Khan (2005) are: Institutional, Pedagogical, Technological, Interface Design, Support Resources, Ethical Issues, Management, and Evaluation. Each dimension is composed of sub dimensions of eLearning in the systems approach. The dimensions and sub dimensions are as follows:

- **"Institutional dimension: Administrative Aspects; AcademicAspects; Students Services.**
- **Dimension of Management: People, processes and products; Computer Management; Administration and development of E-Learning content.**
- **Technological dimension: Institutional planning; Hardware; Software.**
- **Pedagogical Dimension: Analysis of content; Analysis of audience; Analysis of objectives; Design approach; Instructional strategies;**
- **Organization; Strategies (Blending) for hybrid classroom face to face virtual.**
- **Ethical dimension: Cultural and social diversity; Political problems; Geographical diversity; Diversity of learners profiles; Digital Diversity; Labelling; Legal aspects.**
- **Dimension interface design: Page and website design; Content design; Navigation; Accessibility; Usability and Testing.**
- **Dimension of support resources: Online Support: Resources; and**
- **Dimension of evaluation: Evaluation of content; Evaluation of E-Learning environment; Institutional Assessment Program levels and E-Learning; Assessment of students". (Khan, 2005, p. 5).**

This approach strength is its systemic cohesion structure by integrating class levels, program and virtual institution. These actions interact with content assessment and evaluation of virtual students. However, the weakness of the approach, despite being systemic, is that it doesn´t show, in a clear way, students' learning process in virtual learning spaces with ICTs. Therefore, if the weaknesses of this approach are improved, its systemic perspective is essential to represent the formation of students in virtual spaces. Then, Dembo´s model, being by processes, can be complemented with Khan's systemic approach, in order to have a more comprehensive process model that faithfully represents the actions performed on subject formation through virtual spaces supported by ICTs.

Cybernetic Model For Evaluating Virtual Learning Environments

One of the structural weaknesses of both Dembo's model (1988) and Kahn's approach is the lack of interaction between the model and the respective approach and the actions of the Institution of Virtual Education (IVE) and the Society. These relationships in the context of the knowledge society are critical.

This is justified because virtual organizations such as e-Learning, e-Training and e-Bussiness, use virtual programs offered by education organizations. In this sense the IVE should meet the needs of society, in terms of e-Learning. Meeting the needs of society demand for educational institutions continuously monitoring of both the performance of the graduates and the design of new offerings, or closing programs and virtual classes, which are not considered relevant to social needs at the levels of autonomous community, country, Union (European Union), national or intercontinental context. Cybernetic model is the solution to the weaknesses above mentioned. The Viable System Model-VSM is a feedback system that makes three systems interacts in an organized way. These systems are:

- **The student applying to the virtual institution.**
- **The Virtual Education Institution.**
- **The Society.**

The interaction process that takes place in the aforementioned systems is performed through key operational communication channels. Communication takes place between the administration of the virtual institution and social organizations (family, business and industry, state, etc.). Based on the definition of Cybernetics proposed by Nobert Wiener as "the science of control and communication between the animal and machine" (Wiener, N. quoted by Beltran, J., 1999, p. 18), the VSM is used to represent the process of communication and control between the subject and the computer via the learning platform supported by ICTs. Furthermore, based on the relationship established by Stafford Beer, who linked cybernetics to the organization.

"Cybernetics studies the problems of communication and control in complex systems. It studies the effectiveness of the organization [...]. Cybernetics systems are based on complex networks likely, interacting among themselves... How are such systems organized? They seem to be cohesive, self-regulating and stable but adaptable to change and able to learn from experience". (Beer, quoted by Beltran, 1998, p. 18). The interrelationship of Cybernetics with the organization in the Viable System Model – VSM is formal basis, which confirms:

Firstly, systemic components of the VSM: subject institution of education and society are complex systems. Secondly, as complex systems their effectiveness depends on their organizational structure, which confirms that complex but highly organized societies are effective, fulfilling the relationship between organization and effectiveness for other systemic components of the VSM. Thirdly, the communication and the control between components, in the VSM, are essential, justified in terms of the three cybernetics control principles:"Feedback, homeostasis and the black box" (Beltran, 1999, p. 19).

Feedback, in the VSM, must exist in terms of communication and control among components: Society should feedback actions of educational services offered by the institutions, but the institution must provide feedback to the students about their virtual

learning process, which is also double way process-student institution and institution-society. Homeostasis is also accomplished in the interaction among the VSM sub systems: students as a living sub system must be adapted to the virtual institution as a social sub system and the social sub systems institution and society also try to achieve homeostasis, ie, the institution must adjust to the changing conditions of society. The black box principle is also true in the VSM sub systems according to Cybernetics; in the sense that they are systems in which "it is very difficult to discover exactly how the inputs are transformed into finished products" (Beltrán, 1999, p. 19).This is the difficulty of assessing learning and virtual learning. To assess the fulfillment of the mission of an educational institution:

- **How teaching actions become learning in the student knowledge schemata?,**
- **how educational activities integrally formed students through the curriculum program offered by the institution?;**
- **to assess the accomplisment of standars or the constitution of a country.**
- **How ensure the right to education of its citizens by the state?**

These are not easy questions to answer in terms of inputs and outputs in the transformation process that is held within each subsystem.

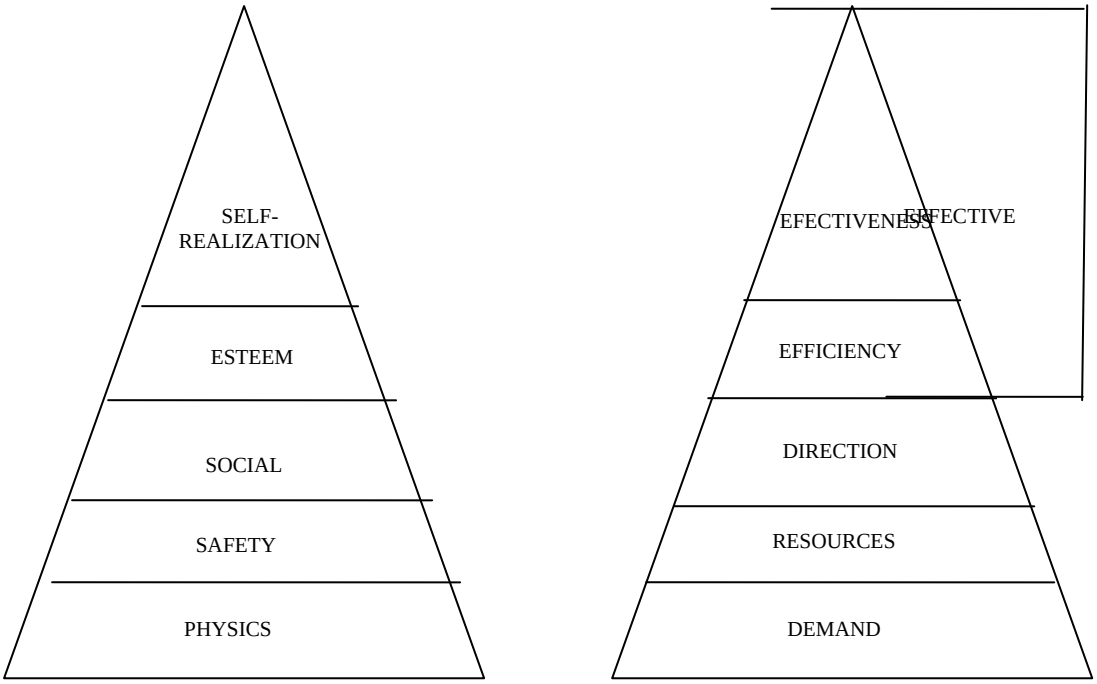

Figure: 2
Pyramid of individual needs proposed by Maslow, and pyramid of organization needs (Taken from Beltran, 1999, p. 12).

In summary the VSM and its components meet the needs in the different subsystems: student, institution and society, by using the key operational communication channels in the interaction between the institution and society, and in the interrelationship of the virtual institution with the student. The importance of considering the relationship between the organization and its needs is justified:

- **By the identification of the needs of the organization: resources, functions, processes and outcomes.**
- **By meeting the needs of the organization. This necessarily must use indicators to carry out the assessment. Based on the "individual needs proposed by Maslow, it is possible to perform a similar hierarchy in organizations" (Beltrán, 1999, p. 18), as it was shown in Figure: 2.**

According to individual needs pyramid proposed by Maslow, first, the human being must satisfy their basic human needs such as food, housing, health and clothing. Second, they have to meet the security needs which assure human survival because it is not possible to build social communities without necessary safety conditions. Third, people tend to meet their social needs as human beings which support their learning on communication skills and validation of truth conditions with the other; so family, school, church, the state, among others, are social organizations in which human beings must meet their needs. Finally, self-esteem is the basic condition for achieving motivation and consequently maintaining subject motivation and achieving self-realization. Meanwhile, the organization or institution (in the context of research, the Institution of Virtual Education (IVE)) must satisfy the following requirements:

Demand

The fundamental demand in the IVE is to provide the virtual educational service to society. This is done using human knowledge as products built on content and virtual actions stored in the platform. Only if the educational service is purchased by the society, the virtual institution will survive. Additionally, only if the virtual educational IVE offers quality service, it will meet the demands in virtual education, in this case, the virtual formation of society.

Resources

Providing an educational service to society implies the use of resources such as human, financial, technical, administrative, academic and organizational ones. Although, educational organizations are complex, the institutions offering the service of virtual education are even more complex. Then, in this sense the fulfillment of the IVE mission becomes more complicated and therefore the satisfaction of the needs of the resources required in the IVE becomes more complex.

Direction

"(...). When a company lacks a precise sense of direction, it becomes a reactive system that simply responds to the forces acting on it" (Beltran, 1999, p. 12).

The IVE cannot exist without government. This is justified because of the changing conditions of technological resources and educational approaches that can be applied in virtual learning. The direction in IVE refers to planning, organization, management, operation or performance of the function of VE, control, projection and prospective.

Be Efficient

The IVE must be efficient in administering the aforementioned resources. This means that virtual educational activities must be performed with the possible minimum number of resources of all kinds. If this is not met, the IVE does not fully accomplish its mission due to the lack of resources. Additionally, the IVE may disappear as an institution because of wasting resources.

Be Efficacious

Given that the service offered by the institution is an educational service, and being the research here reported educational in nature, in the management area, it necessarily requires the concepts of quality, service and price. It is clear, therefore, that in economic terms, if the educational service offered has a quality guarantee (international accreditation), it costs to the user, because it is doing what the institution should do, that is, teaching with quality.

Be Effective

The IVE is effective if it ensures the effectiveness and efficiency, in terms of satisfaction of the virtual students and society.

CONSTRUCTION OF THE REPRESENTATIVE MODEL OF THE LEARNING PROCESS IN VIRTUAL SPACES.

The theoretical basis of the representative model of virtual training process has been developed in the previous section. The model represents the learning process of the virtual student. This process is accomplished with navigation and the performance of activities of virtual teaching through a learning platform supported by ICTs. The model has the following characteristics:

- **It represents the process or virtual learning.**
- **The closed-loop model is fed back with a unidirectional input derived from the process and bi-directional braiding relations between the Institution of Virtual Education (IVE) and the needs of society input. Therefore, it is a model that is based on the Viable Systems Model-VSM.**
- **The model is systemic and is outlined in its general processes in**
- **Figure*:* 3.**
- **The model, in their internal processes, uses Dembo's teaching and learning model (1988) in their specificities of class attendance but adapted to virtual spaces with ICT training, and additionally takes foundations of systemic approach to assessing learning virtual student by Khan (1997).**

The model is shown schematically in Fig. 3. Figure 4 shows the model whit each of its processes numbered.

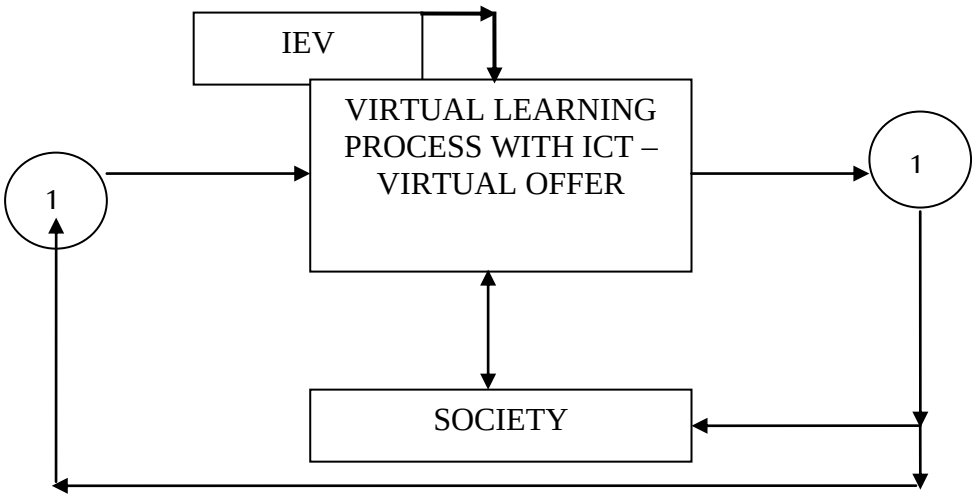

Figure: 3
Macro model representative of the virtual learning process.

The representative model of virtual learning shows the set of processes that supports the construction and operation of the virtual course and its educational and technological functional units in connection with the needs of society.

The model is presented in a sequential way (Figure 4), making it clear that as a close loop and feedback model, it does not follow a linear way in its processes, and any component of the model can be returned to its predecessor. Therefore, only for clarity purposes in the graphic presentation, components are presented in a sequential and numbered manner. The Figure 4 is described as follows:

- **Based on the Cybernetic model, the Institution of Virtual Education (IVE) identifies the needs of society (14^2), in terms of needs in virtual spaces. To meet these needs the IVE offers a set of programs or virtual classes. A bi directional interaction (↔) society - institution is presented. In the interaction, the society also recognizes the social and educational work of the institutions that provide the service of VE.**
- **Identified the social needs at the virtual level, the IVE proposes to construct the virtual course (1). The online course must necessarily define their identity (1). The course can be offered as an online class or a set of online courses that constitute a virtual curriculum. The online course is built with the participation of experts in: virtual education, computer and education, and graphic designers. It must be done according to manufacturing standards for online courses. These standards should be used in order to achieve specifications in building virtual environments. Some of these standards are those of the Institute for Electrical and Electronic Engineers Learning Technology Standards Committee (IEEE LTSC); the Advanced Distributed Learning (ADL), which has developed SCORM; the IMS Global Learning Consortium; and finally those of the Aviation Industry CBT Committee (AICC) (Hernández, 2002).**

- **Once the course has been created and the social system has interacted with the IVE, the IVE and virtual student systems start interacting. The IVE decides the stage of organization and administration of online course (2). This stage requires the course properly identified and cataloged as academic offerings in the academic structure of the IVE. Additionally, the course must ensure functionality in order to be provided to the virtual students. This, therefore, requires organization and management in computer education to ensure the functionality of the VC.**
- **As the organization and management of the virtual course have to be functional, the course must have learning profiles (3) for the virtual student. These profiles may be professional, occupational or skills. Professional profile refers to knowledge acquired by students of the content offered by the virtual course. Occupational one refers to what is required by the society for the operation of a professional in the industries. Competence (or skills) profile is the know-how acquired in context by the student in the virtual classroom.**

The next steps in the process of e-Learning are supported on Dembo's teaching-learning model (1988), adapted to e-learning supported by ICTs.

- **Achieving learning (or training) profiles of students through the online course requires the use of a virtual course pedagogical approach (4), which must be consistent with the Education Program Project (EPP), the Institutional Educational Project (IEP) and the curriculum frameworks that support the virtual course.**
- **With a clear pedagogical approach (4), the learning objectives of the virtual course (5) are defined. Subsequently the didactic to be used in the course should be designed. For this it is necessary to identify content and activities to be developed in the course, these are the pedagogical and didactic actions in the virtual learning process.**
- **The educational and teaching activities of the virtual learning goes ahead by using teaching strategies (6) regarding didactic, responsible for answering the question, How to teach some content in an online course?. At this point, the processes of teaching and learning intertwine as didactic (in the model, teaching practice) is applied (7). The teaching process is implemented on the platform of distance learning supported by ICTs, a process which allows the student to learn at virtual level. This is the formative component of the virtual student learning, because it is the point at which the theoretical foundation of structural learning theories and different learning approaches are used. Among the theories, it can be mentioned Conditioning (Ramnero, & Torneke, 2011, p 99; Weiner, Nelson, Randy, & Mizumori, 2012, p 19), Gestalt (Blunden, 2010, p 153; Wertheimer, Spillmann, & Wertheimer, 2012, p 79), Genetico-Social Psychology, and Dialectic Psychology (Mayo, Sharples, & Moen, (eds.), 2012, p. 10).**

At this stage is important to emphasize that the pedagogical, educational and training components of the process cannot be interpreted as elements disjointed, sequential and without any intersection in the process.

Conversely, they necessarily must be interpreted in a holistic sense, which integrates the theoretical and practical elements of teaching into the virtual learning process, where they are necessarily interacting with each other.

- **Once teaching actions are put into practice through the didactics (7) via virtual platform, student learning is assessed. The student evaluation is explicitly identified in the model as the << process of assessment of student learning (8)>>. At this stage the junction of the teaching and learning processes in the virtual course is concluded.**
- **Having accomplished the above processes, the expected results of the virtual learning (9) are obtained. These results are: i) The individual assessment of student learning, and ii) the use of assessment in the evaluation process of the virtual course. The processes of evaluating individual student learning (8) and expected results in the process of virtual learning (9.) make up the evaluation component in the virtual student formation process supported by ICTs.**

At this point in the building of the process of virtual learning model, the support of Dembo's teaching-learning model (1988) finishes.

- **Once achieved the student training at the virtual level, there is a social and professional integration of students (12) into the labor market, where it is really validated whether the virtual course was useful for the student. Student professional performance (13) for meeting society needs (14) depends upon their professional integration; and at this point, the process returns to the starting point of the model by interacting society ↔ IVE. The action of the IVE will be the reconstruction of the virtual course.**
- **The evaluation process of the technological platform (10) is actually done throughout the model, but it is presented at this point for purposes of clarity and its goal is to achieve better performance or operation of the virtual course in terms of hardware technology, software, communications (Comware) and organization of the computer center (orgware) at the level of human skills required for the operation of the virtual learning platform.**
- **Finally, there is an ongoing process of improvement of the virtual course (11), which becomes point back to generate a second version or subsequent versions of the virtual course, which would be interpreted as a reconstruction of the virtual course (1) returning to the starting point of the process of the model and thus ending the construction of the proposed model.**

The architecture of the representative model of the formation process in virtual spaces is presented at the chart in Figure 4, with their respective numbered components (1 …. 14.). Each Ci (1<=i <=15) is the indicator that is compared with other VEI.

FUTURE RESEARCH

The architecture of the virtual education process model (Figure No. 4) as a model of the process is the basis for building the operating model of evaluation of online learning for meaningful and active learning (e-Olal). The projection of the research is divided into three phases:

- **The construction of the core layer of virtual learning (represented by the operative model e-Olal).**
- **The construction of intermediate layer identified as operational management of virtual learning.**
- **Construction of the management layer of virtual learning (represented by the Systems Management Indicators Online Learning-SYMIOL).**

e-Olal Model validation is planned with the participation of universities and virtual education institutions, representing the continents of Europe, America and Australia. Finally, the three layers form the Management System of Virtual Learning. This system is an online information system developed with the support of technology databases.

CONCLUSIONS

The construction of the representative model of the learning process in virtual spaces allowed to:

- **Identify the steps of the virtual learning.**
- **Support the process of e-Learning with the following bases: A systems approach (Khan, 2005). An educational model (Dembo, 1988). A Cybernetic model.**
- **Integrate educational theories with the formation in virtual spaces supported by ICT.**
- **Project the ellaborated model through the following phases: operational management and e-learning management.**
- **View a Management System of Virtual Learning to be built in the future.**

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