TAG: THREE DIMENSIONS AS BASIC REFERENCES FOR THE CONSTRUCTION OF UBIQUITY LEARNING ENVIRONMENTS IN A UNIVERSITY CONTEXT

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Abstract: This article introduces a set of conceptual guidelines for the construction of the model "TAG", in Spanish: *Tecnología, Aprendizaje y Gestión* (Technology, Learning and Management). The model seeks to determine the levels of ubiquity in higher education institucions. This proposal arises from the review of experiences in the development of strategies for the construction of environments intervened by technologies and the elaborated conceptualization about the term Ubiquitous Learning.

1 INTRODUCTION

In the early 90's, Mark Weiser (1991, 1993, 1994, 1994), introduced the concept of ubiquitous computing as the third computational wave. After the Mainframe and the PC, where surrounded by a huge number of "invisible" devices – "you focus on the task, not the tool" (Weiser, 1993) (Poslad, 2009) – the user can utilize services that, aside from the access to information, they give the possibility of creating and sharing information without time-space barriers.

The development of technology has brought implications in the educational environment, which has implemented many changes in: the way of teaching, the ways through which the process is conducted and the opportunities of learning for teachers and students. The learning paradigms e-learning (Zea, 2005), m-learning (Hellers, 2004), b-learning (Bersin, 2004), t-learning (Päivi, 2006) and, recently, u-learning (Cope & Kalantzis, 2009), are seeking to potentiate learning by using the facilities inherent to ICT. The later highlights advantages as giving the possibility to offer and receive distance education, the customization of content, the low dependence to physical space, the real time interaction with exhibitors and experts, and the connectivity coverage range which should allow the free movement of the user.

Nevertheless, among the afore mentioned modalities, Ubiquitous Learning - U-Learning - must be highlighted because it is the one that aims to have an educational process outside the traditional classrooms (or at least a part of it), not completely independent of the context, but taking advantage of it to give the best content, representational modes, interactions among others and giving access to information in the right place, moment and form (Bomsdorf, 2005). This way, the context awareness and the adequate technological infrastructure (devices and connectivity) which also offers mobility, suitable and competent formative personnel and appropriate, opportune and personalized digital contents, as characteristics that make the Ubiquitous Learning a solid cornerstone to support a better and more powerful student-centered learning.

Therefore, the necessity of building a model as a referent that contributes to the achievement of ubiquity on a higher education institution is identified. To achieve the latter, the TAG model is proposed to evaluate three dimensions: technology, learning and management.

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2 TAG, IN SPANISH: TECNOLOGÍA, APRENDIZAJE Y GESTIÓN (TECHNOLOGY, LEARNING AND MANAGEMENT)

In order to adopt the learning paradigms that involve technology, it is necessary to attack the problem from different points of view allowing a full coverage of relevant aspects inside a specific model. Multiple authors, Zea et. al. (2000, 2005, 2007) and Williams (2003), have identified some edges or relevant dimensions to the conceptualization, design and construction of technology-based learning environments.

Zea et. al. (2005) in *Características de los procesos de gestión en los contextos E-Learning* differentiates 'between the technical, institutional and pedagogical aspects, with the intention of avoiding possible reductionisms regarding […] the construction of knowledge in e-learning environments'. Also, in the project Conexiones (2000), they define pedagogical, didactical, technological and management areas, as pertinent to the formation of a teacher in this kind of environments and at work. Finally, in 'Hacia una comunidad educativa interactiva' (2007), the authors set out three pillars over which an interactive educative community holds: technological pillar, pedagogical pillar and community pillar.

In addition, Williams (2003), in his work on roles and competences for the distance learning in higher education, gathers thirty competences identified in four groups: communication and interaction, administration, technology and, learning and instruction.

Given these precedents, the use of three dimensions as compasses is proposed to propitiate environments of Ubiquitous Learning in a university context: Technology, Learning and Management (TAG). This will allow the assessment of the level of ubiquity for a higher education institution, helping to solve the current problematic that different authors face when trying to define this new paradigm of learning, so that, what they focus on is the establishment of ubiquity levels replacing the dichotomous vision of its existence as an all or nothing situation.

Each of the dimensions of the cube is composed of characteristics and properties, and these ones with metrics and indicators that will allow the determination of the ubiquity level of a specific institution in order to generate strategies that will allow it to advance in its transformation towards an ubiquity university.

Figure 1: Cube TAG.

Further information of each dimension will be given.

2.1 Technology Dimension

From the technological dimension, the model focus in three areas of work based on relevant properties for the generation of processes and environments of Ubiquitous Learning: capacity, ubiquity and infrastructure.

2.1.1 Capacity

Kwon et. al. (2005, 2006) presented the design of a methodology that allows the assessment of a specific technology service in a few levels of established ubiquity. Based on the identified properties and using the family of procedure Square-ISO/IEC 25000, categories have been configured as it is shown below.

Table 1: Definition of categories and properties of technological capacity – Based on ISO/IEC 25000.

Usability	Accessibility, Adoptability, Understandability, Interpretability, Invisibility, Learnability, Predictability, Proactiveness, Sensibility, Usability
Configurability	Configurability, Customizability, Reconfigurability, Personalization
Compatibility	Interoperability, Compatibility, Integrability
Reliability	Reliabiility, Credibility
Security	Security
Maintainability	Analysability, Modifiability, Testability, Maintainability, Reusability, Decomposability, Tailorability, Extensibility, Flexibility, Adjustability
Portability	Scalability, Adaptability, Portability
Manipulability	Sharability, Downloadable, Embeddedness, Wearability
Mobility	Mobility, Ubiquity, Nomadicity, Connectivity.

2.1.2 Ubiquity

In the ubiquity front, there are differentiated three principal categories for assessment defined as:

Table 2: Categories and properties of the Technological Ubiquity - (Kwon et. al. 2005, 2006).

Situation Sensing / Decision (S)	Solves the problems through a situation analysis and the intention inference of the user
Autonomic Computing (A)	Reaches the objective through autonomous solutions and reconstructions without need for human intervention
Self-Growing Intelligence Engine (G)	Learns the goals or objectives of the user

These axes are assessed from the unique list of properties in Figure 2 but with a different weight in each case.

3 keywords S	A	G	Items	3 keywords S	A	G	Items
1	6	3	User preference	1	3	6	Fault tolerance
1	6	3	User profile	1	6	3	Negotiation
3	5	2	User context	2	6	2	Trust
6	3	1	Location tracking	1	6	3	Self-control
6	3	1	Time tracking	6	3	1	Authentication
6	3	1	Identity tracking	6	3	1	Authorization
6	3	1	Entity tracking	1	3	6	Usability
1	3	6	Context reusability	3	4	3	Ease of use
6	2	2	Inferred context	2	5	3	Seamlessness
2	2	6	Service coverage	6	2	2	Response time
1	3	6	Learning	6	2	2	Scalability
2	6	2	Reasoning	6	2	2	Durability
2	6	2	Autonomy	4	3	3	Standardization
1	6	3	Automation				

Figure 2: Properties of Ubiquity – Taken from (Kwon et. al. 2005, 2006).

2.1.3 Infrastructure

Finally, it is important to have as technological compasses the infrastructural aspects suitable for each case that, although they should not be converted into a straight jacket to establish e-Learning, m-Learning and u-learning environments, they are parameters that generate an approximation towards a required investment, guiding solution design or defining the interaction possibilities, collaboration, evaluation, and accessibility possibilities.

Table 3: Categories and Properties of the Technological Infrastructure.

Networking	Wifi, GPRS, 3G, 4G, Bluethoot, NFC, WiMax, etc.
Architectonic Styles	N-Layer, N-Tier, Component Based, SOA, etc.
Devices	Smartphones, Tablets, Sensors, etc.

2.2 Learning Dimension

The processes that take place when an individual prepares to learn are characterized by the model, the resources, the role of the actors, the strategies, and the involved environments (Feldman, 2005) (Schunk, 1991). Here is where the statement of "Ubiquitous Learning Institute" (Cope & Kalantzis, 2009) is encouraged, which refers to the term "ubiquitous" as the notion of "anywhere / anytime". Now, “A focus on learning, and on the increasing prevalence of knowledge construction activities being conducted in online environments by experts and novices alike, however, suggest that the definition of ‘ubiquitous’ be expanded to include the idea that learners can engage with knowledge about ‘anything’, and that this learning can be experienced by ‘anyone’.”

Here, learning is approached from three different categories: Types of learning (Gardner, 1999), (Perkins, 1992), (Wiggins and McTighe, 1998), (Bandura, 1997); learning methodologies according (Barrows, 1986), (Johnson et.al, 1999), (Panitz, 2001), (Bruner, 1988) and (Bricket et. Al, 1993), and technological mediation (Hellers 2004), (Zea, 2005), (Marton, 1996) and (Cabrera, 2004)

Table 4: Categories and Properties of the Learning Dimension.

Types of Learning	Repetitive Learning, Receptive Learning, Observational or Modeled Learning, Appreciative Learning and Meaningful Learning
Learning Methodologies	Problem-based learning, project-based learning, collaborative and cooperative learning, learning by discoveries, and autonomous learning.
Technological Mediation	M-learning, e-learning, multimedia learning, and collaborative learning mediated by ICT.

2.3 Management Dimension

The concept of Third Generation Universities monopolizes the wills and challenges to which higher education must be submitted in order to achieve major levels of equity in the system, opening in the conditions of accessibility, major relevance to the investigation and innovation with a purpose of transforming the environment and the involvement of labor, personal, civil and professional competences, when approaching education in order to manage a educational model.

Nowadays the universities are competing inside an international market to acquire the best industrial contracts, the best academics and the best students.

The winners will be the universities that manage to be positioned as centers of knowledge where the scientific environment will be dynamic and will incorporate all kinds of investigation, education and commercialization of its Know-How; where the university collaborates with the stabilized firms of technological base firms as well as the emergence ones (Wissema, 2009).

Under this perspective, three fundamental categories are proposed to approach university management: The Curricular Management is developed from (ANUIES, 2011), (Chikering and Gamson, 1997) and (Filmus, 2003); Organizational Development from (Gibbons, 1998), (Beckhard, 1969), (Schein, 1988), (Rosario, 1994, 2003, 2005), (Marianov and Von, 2006) and Engineering Education from (Paquette, 2005), (Reigeluth, 1999), (Roth, Patterson and Mumaw, 2001), (Novak, 1984) and (Scacchi, 2001), among others.

Table 5: Categories and Properties of the Management Dimension.

Curricular management	Types of Curriculum, inter- and transdisciplinary research, skills, innovation management
Organizational Development	Internationalization management, resources management, governance management, change management
Engineering Education	Educational modeling, cognitive engineering, information systems engineering

3 CONCLUSIONS

The Ubiquitous Learning are composed of more elements that the implantation of devices, networks or digital contents alone. The Technology, Learning and Management (TAG) should be analyzed for every case. On one hand, the usability and the mobility. On the other hand the meaningful, autonomous and mobile learning; and the leadership and the strategic planning as relevant support for management, have a high value for ubiquitous learning environments. For other learning paradigms they will be needed of other characteristics and properties for its development.

That is why TAG becomes relevant. Each dimension properties are combined to form respective mathematical equations that will allow measuring its specific level, allowing the graphical representation in a point inside a three-dimensional plane formed in the cube (TAG). See Figure 1.

As future research, it is proposed the development of metrics and indicators associated to each dimension that allow the assessment on the part of a higher education institution of the ubiquity levels in its mission activities. This way, there is a reevaluation of the dilemma on being or not ubiquitous and transforms it in terms of how much ubiquitous it is.

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