

# A novel design of an E-learning digital ecosystem

*Un diseño novedoso de un ecosistema digital para educación virtual*

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This paper shows the design of a digital ecosystem for e-learning in CONALTEL. The theoretical referents of models such as the TPACK and the Digital Ecosystem in learning are used, using them to support the construction of the proposed model and a digital ecosystem proposal for e-learning is presented that articulates seven components in the form of gears and whose function is to represent the proposed design through a dynamic system that is affected by the interaction of each component. The ecosystem model is being tested in the online learning environment <http://e-ducate.co/> and in a first stage it is focusing on the exploration of the dynamics of the digital ecosystem through the pilot test of web conferences and interaction of Technologists into online learning environment.

*Keywords:* E-learning, learning environment, technologists

El presente artículo muestra el diseño de un ecosistema digital para educación virtual en CONALTEL. Se toman referentes teóricos de modelos como el TPACK y el Ecosistema Digital en Educación, usándolos de apoyo para la construcción del modelo propuesto y se presenta una propuesta de ecosistema digital para educación virtual que articula siete componentes en forma de engranajes y que tienen como función representar el diseño propuesto mediante un sistema dinámico que se ve afectado por la interacción de cada componente. El modelo de ecosistema está siendo probado en el entorno virtual de aprendizaje <http://e-ducate.co/> y en una primera etapa se está enfocando en la exploración de la dinámica del ecosistema digital mediante la prueba piloto de conferencias virtuales y la interacción de los Tecnólogos en el ambiente virtual de aprendizaje.

*Palabras clave:* Ambiente de aprendizaje, educación virtual, tecnólogos

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## Justification

CONALTEL has one of its mission objectives: to offer training and complementary learning that raises the scientific level of the Technologists who are subject to the inspection, monitoring and control exercised by the entity. Given that resources such as costs, time and place are limited, and in order to extend this service to the entire CONALTEL community, it is necessary to use e-learning as a strategy of coverage, relevance, access and flexibility in learning policy complementary from CONALTEL. For this reason, the proposal of digital ecosystem for e-learning of CONALTEL seeks to create a model capable of satisfying the needs of complementary learning in online modality for the Technologists that are part of the entity. Therefore, when considering e-learning and the interaction of its participants in a online learning environment as an e-learning ecosystem, it allows exploring alternatives that facilitate learning through the use of ICT information and communication technologies in an efficient manner.

## Theoretical Framework

The TPACK model is an emerging form of knowledge that goes beyond the three components (content, pedagogy and technology). This knowledge is different from the knowledge of a discipline or advanced technology and also from the general pedagogical knowledge shared by the teachers in the disciplines (Mishra & Koehler, 2006). It is a model that starts from good teaching practices with ICTs, using the concepts and pedagogical postulates in the use of emerging technologies, where students can solve problems and build knowledge from the integration of technologies in the teaching. (Mishra & Koehler, 2006). The design of the activities is related to the use of technologies, in TPACK it is proposed that: *"the development of the TPACK suggests the use of specific types of activities according to the contents of each discipline and enriched with technology. These activities would be like bricks that, solidly embedded, serve to construct a strategic didactic planning"* (Almenara, 2014; Baran & Uygun, 2016).

The designs of the activities proposed are:

- The choice of learning objectives.
- Making practical pedagogical decisions about the learning experience.
- The selection and sequencing of appropriate types of activities, which are combined according to the expected learning experience.
- The selection of evaluation strategies that will reveal what students are learning and how well they are doing.
- The selection of the most beneficial tools and resources for students to take advantage of the planned learning experience.

However, the TPACK model alone is not an instrument that can guarantee the relationship between the participants, the learning environment and the objectives of the institution (Herring, Koehler, & Mishra, 2016; Pamuk, Ergun, Cakir, Bayram, & Ayas, 2015). It is necessary to consider e-learning in a bigger spectrum, therefore, a trend in the way of conceiving e-learning into the digital ecosystem, (Uden, Wangsa, & Damiani, 2007) mention that a biological ecosystem is a community of organisms that interact with their environment and a digital ecosystem *"is a self-organized infrastructure that seeks to create a digital environment for network organizations that have their support in cooperation, shared knowledge, development of open and adaptive technologies and evolutionary business models"*. This relationship between a biological ecosystem and a digital ecosystem allows us to infer that individuals who participate in a digital ecosystem behave in a similar way, that is, in a digital environment; it is possible to develop adaptation and development behaviors similar to a biological environment. This approach allows us to extend the proposal of the TPACK model to involve different processes of an ecosystem in a digital learning environment, which can be transformed into a more robust and reliable model, which allows to guarantee the development of an e-learning model proposal different and with focus on interaction between individuals and the digital learning environment, as well as, a community of biological organisms and their environment.

While a digital learning ecosystem is a community that interacts individually or collaboratively synchronously or asynchronously in a digital learning environment. (Chang & Guetl, 2007) define the digital ecosystem of e-learning as the interaction between *"interest groups, learning portals, ICT infrastructure and other learning processes"*. Among the benefits of considering an e-learning digital ecosystem are: access to information, the consolidation of knowledge through the use of technological resources, the appropriation of knowledge through self-learning and learning through others, and the creation of relationships with people who are in different places and who converge in a digital learning environment (Virgili, 2013).

In this sense, (Chang & Guetl, 2007) propose an ecosystem model of e-learning characterized by three components *"(a) Content providers, (b) Consultants and (c) Infrastructure"*. Content providers offer the right content to achieve the competencies that are required of learning and using the resources available for such a case. The consultants are interdisciplinary teams that seek to structure e-learning digital ecosystem to the needs of learning, are people specialized in different areas and support different processes such as curriculum design, content design, evaluation design, design of training plans of teachers, design of planning,

execution, evaluation and improvement of the processes of e-learning digital ecosystem. And the infrastructure is the component that deals with the technologies, resources, materials, software and other elements that give support to e-learning digital ecosystem.

Another proposed model is given by (Eswari, 2011), which shows an e-learning digital ecosystem focused on the learning environment and that interacts with six components: (a) The content of learning, (b) the management of stakeholders, (c) Roles in the environment, (d) Content repositories, (e) reports and evaluations, and (f) The process of collaboration of stakeholders. This e-learning ecosystem model focuses on the performance of the learning environment at a functional technical level and does not allow associating the interaction processes that the digital community can develop in the online learning environment.

### **Proposed model of e-learning digital ecosystem for CONALTEL**

What should be the e-learning digital ecosystem model for CONALTEL? Every model that is implemented by an institution must meet the needs and objectives that are sought to be achieved. (Ponti & Ferrás, 2008), therefore, in this process, CONALTEL performs an organizational diagnosis and identified needs that technologists have, resulting in the proposal of an e-learning digital ecosystem model. The proposed model can be seen in Fig. 1, which has as its core the Technologists and intends that they be the central axis of e-learning digital ecosystem in CONALTEL and interact bi-directionally with the six proposed components.

The proposed e-learning digital ecosystem is considered as a dynamic ecosystem, in which each component affects the ecosystem in different degrees or levels due to its form of gears. The following explains all the components and their relationship with the ecosystem:

1. Technologists Component: It is the central component and, therefore, the most fundamental. Technologists are the ones who first activate the digital ecosystem, since the demand and training needs start from how they are performing, learning and changing over time and their work experience. Likewise, the needs that society demands of them are directed towards the other components, which, in turn, interact with each other and in some way, affect society and the Technologists, which cause an impact to e-learning digital ecosystem proposed. Therefore, it is justified that the ecosystem has a dynamic behavior or cause and effect behavior.

2. Learning Models Component: This component is made up of different learning models (Avila & Meza, 2016), pedagogy (Adell & Castañeda, 2010; Schweisfurth, 2015), didactic (Alvarez, 2012; Kozhuharova & Ivanova, 2015), curriculum (Garcia, 2010; Sledgianowski, Gomma, & Tan, 2017), instructional design (Alvarado, 2003), assessment

(Bartolomé, Figueria, & Gonzáles, 2014), etc. This component has a cause and effect relationship on the other components, for example, in case of Technologists component; the learning model can impact on the development of new competencies and ways of using knowledge in the job and personal lives of Technologists. Likewise, the Technologists, having new needs, will require new learning models that can assume the generated paradigms and tendencies of society into e-learning digital ecosystem.

3. CONALTEL Component: This component contains all of processes, policies, guidelines, research and development management, strategic plans, etc., that allow the entity to guarantee the sustainability of e-learning digital ecosystem model. Its relationship with the other components is due to the fact that any change in CONALTEL component directly or indirectly impacts the other components, an example of this is the change of the institutional mission, this event can affect all the components, since could set a different policy for supplementary learning.

4. Technology Component: This component is very volatile, since technology is constantly changing (Adell & Castañeda, 2010), which, it is important to monitor their changes, since these can affect the digital ecosystem and the components of it (Hernández, Pedraza, & Martínez, 2016; Martínez, Martínez, & Montiel, 2014). An example of this is the technologies of Learning Management Systems LMS (Nicholson, 2007) they change requesting more technical requirements, the other components must adjust, both to obtain the knowledge to appropriate their management, as well as the infrastructure requirements of the ecosystem itself for its proper functioning.

5. Competences Component: This component is made up of the competences that are to be developed by the Technologists and which are articulated with the entire e-learning digital ecosystem. In this sense, for example, a competence that you want to develop is learning to learn (Calero, 2015), which seeks that the Technologist has the necessary tools to appropriate knowledge using critical thinking skills (Benton, Drage, & McShane, 2011) and self-learning (Salmerón & Gutierrez, 2012).

6. Human Capital Component: This component is made up of all the administrative personnel, tutors, collaborators, researchers, senior management and people who are immersed in the e-learning digital ecosystem and who contribute to its sustainability. In the human talent component, it should be oriented to three activities: (a) Institutional / organizational activities, (b) Teaching or tutoring activities and (c) Investigation-type activities. Research plays an important role in this component, since good research practices will be able to define solutions according to the needs that the productive sector requires of the Technologists.



Figure 1. Digital ecosystem model for virtual education at CONALTEL.

7. Infrastructure Component: This component is made up of all the elements of infrastructure that the digital ecosystem requires for its support (Martínez & Giral, 2017). The relationship with the other components lies in how the infrastructure supports the ecosystem, in terms of storage, connection, software, hardware, laboratories, technological resources, LMS, among other resources (Gonzales & Garcia, 2011).

### Findings

The e-learning digital ecosystem is developed for CONALTEL, which has seven components and of which six of them focus on the Technologists component. This distribution implies that Technologists are considered as a fundamental part of the digital ecosystem and that this component is the driving force of the entire digital ecosystem. The ecosystem model is being tested in the online environment <http://e-ducate.co/> and at first

it is focusing on the exploration of ecosystem dynamics through a pilot test of web conferences and the interaction of Technologists in the e-learning environment, today there are more than 600 enrolled in the learning environment. On the other hand, a course in e-learning mode of professional ethics is being built, which seeks to raise awareness of the responsibility of the professional practice of the Technologist and its role into society, and another course is project management for Technologists, in order to promote development of management skills and the ability to assume responsibilities inherent to their basic training.

### Conclusions

A novel e-learning digital ecosystem model is presented, in this case, applied to the needs of the CONALTEL entity. This seeks to guarantee efficiency in the proposal of complementary education in online modality addressed to Technologists who are part of the inspection, monitoring

and control of CONALTEL. The e-learning digital ecosystem model is proposed with seven components that interact with each other in order to give a solid sustainability to the e-learning proposal that CONALTEL wishes. Pilot tests from CONALTEL into e-learning digital ecosystem are being developed through the learning environment <http://e-ducate.co/> and which is exclusively aimed at the Technologists that are part of the entity. Within future works in this proposal of e-learning digital ecosystem, is the development of adequate indicators of the efficiency of the ecosystem and the mechanisms of timely estimation of the changes that e-learning digital ecosystem requires.

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