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Artigo

KNOWLEDGE FLOW IN THE PRODUCTION OF VIRTUAL LEARNING ENVIRONMENTS

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ABSTRACT

The article aims to identify and discuss knowledge flow results in the production of Virtual Learning Environments (VLE) applied to distance learning. This mapping was carried out based on a review of the literature on distance learning services and processes focusing on the work done by multidisciplinary teams involved in DE projects and programs. Thus, the purpose of this article is to assist the teams involved in knowledge management and sharing so they may aim for and achieve the consequent improvement in quality and organization of DE processes and services.

Keywords: *Virtual Learning Environments. Distance Education and Knowledge Sharing.*

RESUMEN

El artículo tiene por objetivo identificar y discutir los resultados del flujo de conocimiento en la producción de Ambientes Virtuales de Aprendizaje (AVAs) aplicados a la Educación a Distancia. Este mapeo se realizó a partir de la revisión de la literatura,

orientada a los servicios y procesos de EaD con enfoque en el trabajo de los equipos multidisciplinarios involucrados en proyectos y programas de esa modalidad de enseñanza. Así, la propuesta de este artículo es auxiliar a los equipos involucrados en la gestión y compartición de conocimientos, para anhelar y alcanzar la consecuente mejora de la calidad y organización en procesos y servicios que involucran la EaD.

Palabras clave: Ambientes Virtuales de Aprendizaje. Educación a Distancia y Compartición del Conocimiento.

RESUMO

O artigo tem como objetivo identificar e discutir os resultados do fluxo de conhecimento na produção de Ambientes Virtuais de Aprendizagem (AVAs) aplicados a Educação a Distância (EaD). Este mapeamento foi realizado, a partir da revisão da literatura, orientada aos serviços e processos na EaD com foco no trabalho das equipes multidisciplinares envolvidas em projetos e programas desta modalidade educacional. Assim, a proposta deste artigo é auxiliar as

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equipes envolvidas na gestão e compartilhamento de conhecimentos, a fim de almejar e alcançar a consequente melhoria da qualidade e organização em processos e serviços que envolvem a EaD.

Palavras-chave: Ambientes Virtuais de Aprendizagem. Educação a Distância e Compartilhamento de Conhecimento.

INTRODUCTION

The quality of distance education (DE) services depends on their circumstances and educational and organizational backdrop to meet the cultural, social, and economic needs of the environment where they will be operating. Despite some resistance against online education, many (public and private) organizations have been gearing up to make intensive use of the different types of educational technologies or virtual learning environments (VLEs) as a way of offering “virtual and interactive classrooms” (SILVA, 2001) whose purpose is to train and refresh skills in the organizational environment. In the case of public institutions, their challenge is to expand education in the country via undergraduate and graduate programs. In turn, companies focus on the growing search for accommodating training and development needs in the corporate world. (VALENTE; ARANTES, 2011).

In this study, the VLE production process follows the ADDIE (analysis, design, development, implementation, evaluation) model, specifically oriented to distance education. According to Pinheiro de Lima et al., (2005), these environments’ production and management process requires that strategies are put together so that knowledge may be used as a relevant asset for the organization, while making intensive use of the organizational knowledge in management systems and processes.

VLE research is a pertinent topic to be discussed as it points out aspects related to sharing the existing knowledge between multidisciplinary teams and their actions and activities in the design phase of courses or educational products.

1. MATERIALS AND METHODS

VLEs are considered knowledge sharing spaces advantageous for learning as they enable ample participation by actors and enhance the pedagogical process in a more dynamic, creative manner (FRANKLIN; HARMELEN, 2007; FERGUSON; BUCKINGHAM, 2012). In this education context, VLEs include contents that allow for greater or lower interactivity and access to educational resources and tools and learning objects. The combination and use of each element characterize the type of educational environment to be put together, according to the paradigm and pedagogical model.

Therefore, each educational environment features characteristics defined according to the pedagogical model, educational design, study resources and materials, and technical configurations that make it possible to identify the levels of interaction and interactivity.

Hence, five different types of VLEs have been characterized, according to the learning strategy, educational design, and pedagogical goals, as shown in the table (02) below (OLIVEIRA; TEDESCO, 2010; PEÑAHERRERA, 2011; KOHLER et al., 2010; OSGUTHORPE, 2003; MATSUMOTO et al., 2010):

Table 1: Classification of the different VLE types.

TYPE	STRATEGY DESIGN
COLLABORATIVE ENVIRONMENTS	Use of collaborative resources, emphasizing the culture of collective participation and knowledge sharing as a fundamental aspect of learning. Design is customized, user-centered, and meant to meet students' needs and expectations (OLIVEIRA; TEDESCO, 2010).
AUTONOMOUS ENVIRONMENTS	Use of tools for solving educational problems (assignments and activities) where students are free to do tasks which comprise working in the environment without the teacher's central presence in the process. The focus shifts largely to students' interaction with the interface or system (TEJEDOR 2010; PEÑAHERRERA, 2011).
EXPERIENCE ENVIRONMENTS	Design focused on student experience, emphasizing their motivation and expectations based on emotional, aesthetic, and sensory aspects. They tend to rely on immersive environments and the use of 3D technologies, personas, avatar and/or fictitious characters (KOHLENER et al., 2010).
HYBRID ENVIRONMENTS	Use of face-to-face and online resources largely found in higher education institutions as they open up their programs' educational resources. Students choose how they wish to learn, depending on their needs and skills (OS-GUTHORPE, 2003).
ADAPTIVE ENVIRONMENTS	Consider a student's level of knowledge acquisition by making use of Artificial Intelligence (AI) techniques to tailor the system's actions and reactions to said student's profile (MATSOMOTO et al., 2010).
INCLUSIVE ENVIRONMENTS	These virtual environments include hearing and/or visually impaired users and gives them access to learning and interaction (OBREGON; 2011; VANZIN; 2005).

Source: the authors (2016).

VLE design involves a host of factors which are decisive for their technical and pedagogical quality. **The Collaborative Environment** (PEREIRA et al., 2007; OLIVEIRA; TEDESCO, 2010; MANDAJI, 2012) is defined by activities and assignments collectively done. Each user adds a given part of the collectively done activity or assignment, which at the end is brought together and compiled to make a whole. The same principle is used in a knowledge-sharing wiki environment. Fostering collaboration in a VLE contributes to greater cooperation among students and provides more activities, assignments, and also feedbacks to coordinators.

Autonomous Environments are strategically devised for "co-learning," where students are responsible for learning in an independent

manner that does not rule out their instructor's role, though. These environments are designed to offer students the most autonomy to do the activities proposed, in which interaction takes place more intensely with the advanced system developed for students to work as co-actors. The levels of autonomy are encouraged by contents, methods, and techniques developed following the teaching strategies, according to the various learning contexts, and based on the use of information and communication technologies – ICT (TEJEDOR 2010; PEÑAHERRERA, 2011).

Recent studies have sought to understand how **Educational Experience Environments** work. These environments are based on user-centered design adapted to their needs and

preferences. Experience environments are characterized by the use of resources, such as characters, games, interactive illustrations, animations, and other graphic pieces that provide a type of viewing with high levels of interactivity and immersion (KOHLER et al., 2011). One such example is Second Life (SL), an open, virtual 3D environment that simulates some aspects of humans' real and social lives, personified by avatars, i.e. a sort of graphic representation or entity in a given medium where other users can see or interact with them (CASTRANOVA, 2005). This virtual environment is designed to afford cognitive and sensory experiences by means of unique, deep manners for users to interact in the environment (KOHLER et al., 2011).

Blended Learning Environments, depending on their pedagogical nature and technical characteristics, may include both face-to-face and online resources. The balance between online and face-to-face components will vary according to course requirements (OSGUTHORPE, 2003). Hence, the environment is designed as an alternative to complement the activities done in the classroom and boost the intervention of school practices towards using a hybrid model of teaching (BROD; RODRIGUEZ, 2009).

Contrary to most environments that use static mechanisms and contents and provide all students with the same design and contents from the beginning to the end of the course, in **Adaptive Environments** the knowledge acquisition level is based on students' profile dynamically updated by the system. That way, the environment creates conditions for students to steer their learning in a personalized manner (BRUSILOVSKY, 1996).

Inclusive Environments tackle the issue of finding the most suitable pedagogical framework to be used for people with special needs. This type of VLE needs to follow accessibility criteria to make sure people with a disability can participate in activities

and access study materials and products, thereby ensuring greater quality and access to services considering everyone's needs (OBREGON; 2011; VANZIN; 2005).

It should be noted that each environment features distinctive and complementing particularities and similarities. For instance, an environment may be collaborative and autonomous at the same time. Collaborative as it encourages actors to share their knowledge in group activities, where each individual creates a part of the exercise. Autonomous as it restricts instructor mediation to have student interaction focus more on other course mates or the system as a whole.

With respect to analyzing the VLE production process, this study used the ADDIE model, which is a reference instructional design system widely used by instructional designers and built on solid theoretical grounds. The ADDIE (analysis, design, development, implementation, evaluation) model was set up as a useful framework for examining, creating, developing, and putting training programs in place. Figure 1 shows the process phases below (GUSTAFSON; BRANCH, 1997)

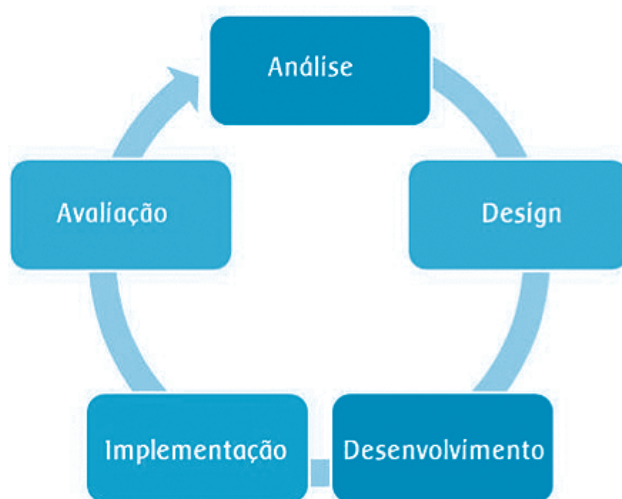


Figure 1: ADDIE Model.

Source: (GUSTAFSON; BRANCH, 1997).

The ADDIE model is an effective instructional product development concept comprising five stages, namely: analysis, design, development, implementation, and evaluation, characterized by a set of activities, may vary depending on the context or the different instructional circumstances, attributed by the customization and pattern of technology use.

According to Molenda (2003) and Mayfield (2011), the ADDIE model is seen more like an “umbrella” process that develops specific steps for creating a training program. The model became a popular framework for the creation of training programs. Since the first publication about the model in 1996 to date, a massive number of papers, books, and essays have discussed ADDIE in the fields of both education and business, even though it is relatively recent in the academia. Details on each ADDIE phase are provided below, according to (MAYFIELD, 2011):

1.1. Analysis

This phase defines the learning goals and strategies according to the learning model to

be designed. A striking characteristic of this phase is the specific learning targets resulting from sharing the competencies, knowledge, and skills involved. Therefore, this phase requires deterministic knowledge mining resources available to implement the learning model according to the characterization of participants and alternative delivery methods, including defining the instructional problem to design an approximate solution. That is done by means of characterizing the user/client profile, surveying their instructional needs, and putting the multidisciplinary team together. This phase provides clear instructions about what needs to be done and what is possible to do in the project.

1.2. Design

This phase defines the learning strategies and activities, maps the activities, and sets content sequence. Contents are usually viewed by means of conceptual maps and the choice of media befitting the use context. It establishes the instructional elements that must be associated with the course’s conceptual elements. The instructional elements correspond to

complementary information used to explain a given concept or set of concepts. These elements allow learners to navigate the field of knowledge while practicing the concepts addressed. Evaluation elements make it possible to assess learner performance and the consequent effectiveness of the solution.

1.3. Development

This phase deals with the activities that make up the instructional product's lifecycle. At this point, the most significant differences between software production and instructional modules can be found (BARBOSA; MALDONADO; MAIDANTCHIK, 2003). This is the phase in which developers create the learning contents. These contents include the overall learning framework (research as an e-learning system), assignments, lectures, simulations, and other suitable training materials. This phase classifies the tangible product to be used for the training program.

1.4. Implementation

This phase asks students for their valuable feedback on the project. Such feedback stands as contributions by students to the online learning process. Study materials are provided to students and the learning module is used for this purpose. The main point of this phase is to implement the learning process. Its relevance lies in detecting discrepancies or gaps between the desired and the actual knowledge development so future improvements may be made. Filatro (2008) divides this phase into two separate stages: the **publication** of the contents in the virtual learning environment and **execution**, the phase in which students then have been cleared to access the modules and units in the study environment.

1.5. Evaluation

In the final phase of the process, the managers evaluate the learning goals, activity

efficiency, technical issues that compromise learning, and any new learning opportunities detected. This phase is vital because it provides information for improving the next iteration of the training program and may suggest new paths and opportunities for the course. It defines the final adjustments according to the feedback obtained, reviews the strategies for conducting evaluations, revising the learning, and closing the activities, and then begins to manage the course.

RESULTS AND DISCUSSION

The conceptual basis for post-modern DE production is characterized, according to Peters (2006), by product innovation and high process variability. Lengthy courses are no longer produced as they used to be in the 1960s and 1970s. Instead, shorter, albeit constantly updated, courses are offered. This model adds innovation to production and process variability with a high level of responsibility by the multidisciplinary teams, while the courses are produced “on demand” and constantly updated.

Peters (2006) says this shift has forced organizations to change their work processes and flows. Instead of development and production being divided from centralized work, small decentralized work groups are set up and given their own responsibility and greater autonomy.

The relevance lies in changing the classic forms of teaching and learning in DE (standardized courses, standardized assistance) which are being replaced with or complemented by more flexible, interactive forms with respect to curriculum, time, and place (process variability). Hence, in this study we adopted the reference DE model known by its acronym ADDIE (analysis, design, development, implementation, evaluation), which is an instructional design system widely used by instructional designers and built on a solid, updated theoretical framework.

Based on the ADDIE model and eight specialists in the field of distance education, the research instrument can be evaluated and validated. The research instrument was based on face-to-face interviews recorded with the specialists about the relevance and authenticity of the knowledge flow presented. This flow, in table format, contains input and output information on the activities and actions, people, and technologies involved in each phase of the process.

This investigation is part of a more comprehensive study comprising the results from a Doctoral Dissertation in a Knowledge Engineering and Management Graduate Program completed in 2015 and whose topic is related to knowledge management and aspects involved in DE. The visual results from the knowledge flow mapping are shown below in table 2):

Table 2: Knowledge flow in the VLE production process

INFORMAÇÕES DE ENTRADA		INFORMAÇÕES DE SAÍDA			
	Coordenador/Gestor	Designer Educacional/ Professor Conteudista	Designer Gráfico/ Programadores	Designer Gráfico/ Programadores	Usuário/aluno
ANÁLISE					
Coleta de dados do usuário/estudante	Analisar as necessidades do cliente/usuário e o contexto de aprendizagem				Requisitos dos usuários e contexto
Objetivos e metas pedagógicas	Construir metodologia do curso				Metodologia do curso
Processo de trabalho, atividades e cronograma	Construir Plano de Gestão				Plano de gestão
DESIGN					
Conteúdo + Plano de Gestão	Definir estratégias e atividades de aprendizagem				Atividades de aprendizagem
Estratégias e atividades de aprendizagem	Mapear as interações dos conteúdos				Design Educacional
Mapeamento das interações	Escolher as mídias adequadas ao contexto de aprendizagem				Mapa das interações
DESENVOLVIMENTO					
Design Educacional	Criar esboços dos conteúdos e interações				Storyboards e roteiros
Design Gráfico	Criar Objetos de Aprendizagem - AO				OA criados
Objetos de Aprendizagem	Design do AVA e dos materiais didáticos				MEDs revisados
IMPLEMENTAÇÃO					
Materiais didáticos produzidos	Publicar unidades e módulos				Unidades/módulos publicados
Teste com usuários	Analisar as interações/interatividade				Unidades/módulos publicados
Feedback dos usuários	Ajustes finais no design do AVA				Interações revisadas
AVALIÇÃO					
Tratamento dos dados dos usuários	Analisar a efetividade da solução				Validação do AVA
Produto educacional	Considerar os feedbacks dos usuários				Acompanhamento dos estudantes
Acompanhamento geral do curso	Revisar objetivos e metas pedagógicas				Objetivos e metas revisados

Fonte: the authors (2016).

Based on the interviews with experts in the field we were able to adjust and confirm the flow's input and output information. The input information comprised in the first phase of the model or **analysis** includes the following activities and/or actions inherent to the process: a) collecting user/client data and the context in which learning will take place; b) setting the pedagogical goals and targets; c) organizing the work process, the team's activities, and schedule. Input and output information comprised in the **design** phase includes: a) structuring the contents and design management plan; b) devising the learning strategies and activities;

c) mapping the Interface-Human-Computer – IHC interactions. In the **development** phase, the activities and actions include: a) the instructional design, preparing video and hypermedia scripts and storyboards; b) the VLE graphic design and the interface design; c) the learning objects and activities. Input information comprised in the **implementation** phase includes: a) producing and publishing the learning objects; b) tests with students, teachers, tutors; c) feedback from students. Input and output information comprised in the **evaluation** phase includes: a) the instructional product being finalized/fine tuned; b) presenting/introducing the

course to students; c) monitoring the overall course progress.

Based on the knowledge flow, the learning model may be more easily implemented and the feedback more easily obtained. Adjustments may be made in the appropriate phase and the modules can be updated to better meet the instructional goals, which helps the team share knowledge and ensures the organization's competitive performance is successful in critical planning and action areas.

FINAL CONSIDERATIONS

Organizations working in distance education depend on more effective knowledge flows to improve their capabilities and how they carry out activities related to producing study materials, instructional products and resources, and learning objects. According to Zandrea (2014), studies about the flows of knowledge from a sender to a recipient are essential because knowledge is hardly ever evenly distributed and shared between people.

Understanding how knowledge is characterized in the organizational environment (and in the online environment as well) makes it possible to draw up motivational actions meant to heighten the level of knowledge sharing between students and multidisciplinary teams involved in the production of VLEs.

Therefore, the knowledge flow presented in this study can be easily implemented in knowledge-intensive organizations interested in DE-created products and services. The flow is meant to help the multidisciplinary team more share knowledge more efficiently, based on the feedback obtained more easily via mapping to better meet learning goals, thereby impacting the quality of courses produced specifically for distance education.

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