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Departamento de Informática y Automática

RESUMEN DE LA TESIS DOCTORAL

ANALÍTICA VISUAL EN *eLEARNING*

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Resumen

La docencia universitaria ha experimentado cambios espectaculares en los últimos años debido al impacto de la tecnología en diferentes actividades cotidianas. El *eLearning* (o aprendizaje electrónico) y el *bLearning* (*Blended Learning* o aprendizaje mixto) nacieron gracias a este fenómeno, ya fuera como alternativa o complemento a la enseñanza tradicional. Esto ha producido cambios de paradigma en los últimos años en la docencia universitaria donde muchos profesores se han apoyado o han sustituido las clases presenciales de la enseñanza tradicional, entendiendo la enseñanza tradicional como cara a cara (del inglés *Face to Face,* F2F) por el aula virtual.

La Web 2.0 ha abierto nuevas posibilidades, que incluyen numerosas formas de aprendizaje y colaboración entre estudiantes y profesores. Por ello, ha surgido la necesidad, por parte de los educadores, de adoptar diferentes estrategias para obtener información sobre el rendimiento de sus estudiantes, así como plantear nuevas formas de evaluación basadas en el análisis de información educativa, que sean capaces de medir y cuantificar la cantidad de trabajo, así como el número y la calidad de las habilidades que han adquirido. Tales estrategias de comunicación requieren de nuevos métodos analíticos que hagan posible comprender y analizar la propia plataforma y el aprendizaje. Estas consideraciones arrojan nueva luz sobre la evaluación de los estudiantes, que ya no puede basarse únicamente en los resultados de los exámenes finales convencionales, sino en un proceso educativo integral que considere y evalúe otras competencias más allá de las académicas.

La disponibilidad y facilidad de uso de los recursos web ha permitido el uso extendido de los *Learning Management Systems*, o plataformas de *eLearning*. Sin embargo, los educadores que usan estos entornos se encuentran con graves limitaciones a la hora de evaluar las actividades de los estudiantes, de discriminar sus comportamientos *online* y de evaluar la propia plataforma y la utilidad de esta. Por ello, es necesario encontrar y desarrollar técnicas novedosas para obtener información sobre las pautas de aprendizaje y comportamiento de los estudiantes en un entorno electrónico.

En esta tesis doctoral se propone un modelo de visualización analítica en *eLearning* como base para construir una estrategia de seguimiento y evaluación de la información que proporciona, no solo a los profesores, sino también a gestores académicos y estudiantes, información necesaria para entender el proceso de aprendizaje de los estudiantes en una plataforma de *eLearning,* que sirva de guía para el alumnado y que proporcione métricas para los gestores sobre la plataforma y el desempeño, además de tomarse como base para desarrollo de futuros sistemas de analítica visual en *eLearning*. El modelo proporciona los elementos para crear un sistema de analítica visual en *eLearning* encaminado a perfeccionar el proceso de enseñanza/aprendizaje.

Este sistema se ha diseñado mediante una arquitectura constituida por distintas capas. La capa inferior está sustentada en un conjunto de servicios web que permiten la extracción de los datos a analizar del servidor. La siguiente capa, contiene la lógica de pre-procesamiento,

estandarización y análisis de los datos. Por último, una tercera capa, en la que se realiza el proceso de analítica visual, que permite al profesor, estudiante o gestor académico llevar a cabo un análisis más exhaustivo, completo e interactivo. Con la finalidad de poner en práctica y realizar una prueba de los alcances de este sistema, se ha desarrollado un prototipo plenamente funcional del mismo.

El desarrollo del prototipo se realizó por medio de un conjunto de iteraciones de investigación-acción para la mejora del alcance de las capacidades de análisis del sistema y de la usabilidad del prototipo de visualización analítica visual en *eLearning,* con el objetivo último de soportar el proceso de aprendizaje, el rendimiento académico y, a su vez, y como ya se mencionó, estas aplicaciones al tomarse como base para desarrollo de futuros sistemas de analítica visual en *eLearning*. Se utiliza como fuente de datos el sistema de gestión de aprendizaje Moodle. Los resultados obtenidos se complementaron y probaron con un estudio de los patrones de uso de las plataformas de *eLearning* en dos universidades con distintos contextos pedagógicos y sociales: la Universidad Politécnica de Madrid y la Universidad de Salamanca.

Esta valiosa experiencia produjo un caudal de nueva información y conocimiento y, por tanto, una importante fuente de realimentación que han contribuido a la mejora notable de las capacidades de análisis que ofrece la plataforma y cubre adecuadamente las necesidades y funcionalidades que se requieren en el modelo propuesto y descrito en esta Tesis Doctoral.

Palabras clave:

Visualización, *eLearning*, Análisis, Analítica Visual, Analítica Académica, Analítica del Aprendizaje, VeLA.

Abstract

University teaching has changed dramatically in recent years due to the impact of technology on different daily activities. eLearning (e-learning) and *bLearning* (semipresencial learning or blended learning) were born thanks to this phenomenon, either as an alternative or complement to traditional teaching. This paradigm shift has occurred in recent years in university teaching and many teachers have supported or have replaced the face-to-face classes of the traditional teaching with the virtual classroom.

The Web 2.0 has opened new possibilities, including numerous forms of learning and collaboration among students and teachers. Therefore, a need has arisen on the part of educators to adopt different strategies for gathering information about student performance and propose new forms of assessment based on the analysis of educational information, which enables the measurement and quantification of the amount of work, and the number and quality of the skills they have acquired. Such communication strategies require new analytical methods that make it possible to understand and analyze both the platform and the learning process. These considerations shed new light on the evaluation of the students, who can no longer rely solely on the results of conventional final exams, but in a comprehensive educational process to consider and evaluate other skills beyond academics.

The availability and usability of Web resources have enabled widespread use of Learning Management Systems, or eLearning platforms. However, educators using these environments have serious limitations when evaluating the activities of students, to discriminate their online behavior, assess the platform and its usefulness. Therefore, it is necessary to find and develop new techniques to obtain information on patterns of learning and behavior of students in an electronic environment.

In this doctoral thesis a model of visual analytics on eLearning is proposed as a basis for building a strategy for monitoring and evaluation of the information to provide, not only to teachers but also to academic managers and students, information necessary to understand the learning process of students in a eLearning platform which serves as a guide for students and provide metrics for academic managers about the platform and its performance, in addition to become the basis for future development of visual analytics systems in eLearning. The model provides the elements to create a visual analytics system in eLearning aimed at improving the teaching / learning processes.

The system has been specifically designed to achieve the mentioned goals, which consists of different layers. In the lower layer, the system is supported by a set of web services that enable the extraction of data to analyze from a server. The next layer contains the preprocessing, standardizing and data analysis logic. Finally, the third layer, where the process of visual analytics is performed, allowing the teacher, student or manager to conduct a more thorough, comprehensive and interactive analysis. In order to assess and run a test of the scope of the proposed model, a prototype of a visual eLearning analytics tool has been developed.

The development of the prototype was carried out by a set of action research iterations to improve the analytical capacity of the system and the usability of the prototype, with the aim to enhance the learning process, academic performance and in turn, as it was mentioned, these applications at the moment that these are take into account as a base of development of the future Visual eLearning Analytics Systems. Used as the data source the learning management system Moodle. The results were complemented and proved with a study of the patterns of use of eLearning platforms at two universities with different educational and social contexts; the Polytechnic University of Madrid and the University of Salamanca.

This valuable experience produced a wealth of new information and knowledge, and therefore an important source of feedback, which has enabled a significant improvement of the analytical capabilities that the platform provides and meets adequately the needs and functionalities, which are required to implement the model that is presented and is described in this doctoral thesis.

Keywords:

Visualization, eLearning, Analysis, Visual Analytics, Academic Analytics, Learning Analytics, VeLA.

Índice general

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