European Journal of Education and Psychology (2017) **10**, 33–39

European Journal of Education and Psychology

www.elsevier.es/ejep

Concept maps and simulations in a computer system for learning Psychology

Javier González Marqués*, **Carlos Pelta**

Departamento de Psicología Básica II (Procesos Cognitivos), Facultad de Psicología, Universidad Complutense de Madrid (UCM), Spain

Received 17 January 2016; accepted 14 July 2016
Available online 17 January 2017

KEYWORDS
PSICO-A;
Computer system;
Educational psychology;
Concept maps;
Simulations

Abstract PSICO-A is a computer system for learning Psychology. It is specially designed for secondary school children. It is the first system in Psychology designed for learning didactic units of the subject. PSICO-A is based on many pedagogical influences, such as concept maps, free retrieval practice, effective feedback, simulations, digital games, and metacognition. A significant improvement has been shown in the conceptual performance in those children that constructed computer-generated maps using the system compared to those that have drawn them by hand. An evaluation was also made of the interactions between concept mapping and simulations, demonstrating that the first group of pupils performed better in simulations than the second group. Further studies are needed to study the influence of these two conditions of concept mapping on the performance of digital games.

PALABRAS CLAVE
PSICO-A;
Sistema informático;
Psicología educativa;
Mapas conceptuales;
Simulaciones

Mapas conceptuales y simulaciones en un sistema informático para la enseñanza de la Psicología

Resumen PSICO-A es un sistema informático para el aprendizaje de la Psicología. Está especialmente destinado a estudiantes de Educación Secundaria. Es el primer sistema integrado computacional concebido para la enseñanza de unidades didácticas de Psicología. PSICO-A combina diversas herramientas e influencias didácticas: introduce mapas conceptuales,

* Corresponding author.
E-mail address: javgonza@psi.ucm.es (J. González Marqués).

http://dx.doi.org/10.1016/j.ejeps.2016.07.002

recuperación libre del recuerdo, un mecanismo efectivo de ''feedback'', simulaciones, juegos digitales y explora la capacidad metacognitiva de los alumnos. Hemos confirmado una mejora significativa en el rendimiento conceptual en aquellos alumnos que construyeron mapas conceptuales a través del sistema frente a aquellos que tuvieron que trazarlos a mano. Además, hemos analizado la interrelación entre mapas conceptuales y simulaciones, comprobando que el primer grupo de alumnos rindió más en una simulación que el segundo grupo. Quedaría para un trabajo futuro demostrar qué sucedería si, después de realizar el mapa conceptual (en sus dos condiciones), los alumnos fueran expuestos a un juego relacionado con una unidad didáctica de la asignatura.

Introduction

PSICO-A is a computer system designed for teaching Psychology students of Secondary Education and first courses of University. Taking as reference agent-based systems like MetaTutor (Azevedo, Witherspoon, Chauncey, Burkett, & Fike, 2009), Betty's Brain (Davis et al., 2003) and REAL (Bai, Black & Vitale, 2007), it is a modular design system that introduces games and simulations inspired by Black's ''representational theory'' (Black, 1992), according to which, knowledge is best represented through images (Finke, 1989) and mental models (Gentner & Stevens, 1983) that configure virtual learning environments (Jonassen & Land, 2012). PSICO-A introduces teaching tools like concept maps (Novak, 1977), the free memory retrieval (Karpicke & Blunt, 2011), a mechanism of ''feedback'' self-generated (Slamecka & Graf, 1978) and the emphasis on metacognition (Dunlosky & Metcalfe, 2008) through the ideas of the global metacognitive model of Mayor, Suengas, and González Marqués (1993).

PSICO-A was developed as a system for the web in language PHP5 (Lerdorf, Tatroe, & MacIntyre, 2006) programming, but is also available as an accessible from the desktop of a computer program (the desktop version has been initially tested in Microsoft Windows XP and Microsoft Windows 7) operating systems. Our system has own hosting domain ''psico-a.org'' and the URL is http://psico-a.org/secure/login/.

PSICO-A consists of a ''front-end'' or user interface, which is the area in which the student interacts with the system and, in turn, of a ''back-end'' or teacher interface. For a detailed description of the system and its computational architecture can be seen (González Marqués & Pelta, 2013).

As is well known, one of the most interesting legacies of the educational constructivist theory of Ausubel (1963) is the concept of ''advance organizers''. It is an introductory-type of material located at a higher level of generality and inclusiveness than the material to be studied, and provides support for the incorporation of the material that students should learn. According to Ausubel (2002, p. 117), the role of the organizers is to ''provide an ideational anchor for the stable incorporation and retention of more detailed and differentiated learning materials.'' The organizers must explicitly relate to the specific fragment that follows and must also be linkable with the established ideas in cognitive structure. This process that connects new information with existing, relevant and higher-order informational segments, Ausubel (2002, p. 155) is called ''subsuming'' learning. Thus, the emergence of new propositional meanings reflects a subordinate relationship of the new material with higher-order thoughts, creating a hierarchical organization of the cognitive structure. It is precisely like this how the concept maps-like advance organizers – ''organize the new facts related to a common theme, integrating the elements of the new and the existing knowledge with each other'' (Ausubel, 2002, p. 156). Novak (1977) showed that concept maps were a very suitable technique to serve as advance organizers. Concept maps are graphical schemes consisting of concepts, word-links used to connect the concepts and propositions that form a semantic unit configured by the interrelated concepts. Concept maps are characterized by their hierarchical nature (the most inclusive concepts are at the top and the examples in the lower part), they are selective (they summarize the most important or significant) and promote visual memory.

The process of creating a concept map can be tedious and even boring for students. If pen and paper are used to build it, you often need some time when the complexity of the material to be learned is not minimal (Schau, Mattern, Zeilik, Teague, & Weber, 2001). In addition, revisions tend to be complicated and even frustrating (Chang, Sung, & Chen, 2001). The advent of information technology has enabled the introduction of computers into small schools. Computerized concept maps are easy to build and revise (Anderson-Inman & Ditson, 1999; Plotnick, 1997; Zeitz & Anderson-Inman, 1992). Errors in describing concepts can be easily modified and students can customize their maps more effectively than using pencil and paper. Indeed, the first authors to demonstrate the superiority of performing electronic or digital concept maps versus traditional technique were Anderson-Inman and Zeitz (1993) and since then, their results have been replicated by other authors. And so, Royer and Royer (2004) used the software ''Inspiration'' to confirm that students who used them, designed more complex and precise than that created using pencil and paper