

# Chapter 9

## PAUL: An Adaptive Electronic Learning Environment to Develop Teacher Expertise and ICT-Related Technological Pedagogical Content Knowledge (ICT-TPCK)

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### ABSTRACT

*Adaptive e-learning systems can be extremely valuable tools in developing innovative learner-centered environments in any content domain. One area that can benefit greatly from adaptive e-learning systems is teacher development in the educational uses of computers. In this chapter, we discuss the design of PAUL, an adaptive computer-based learning environment for the development of ICT-related pedagogical content knowledge, a unique body of knowledge that teachers need to develop in order to be able to teach with ICT. PAUL combines two opposing trends in adapting instruction, namely instruction that is both controlled by the learner and the system. We expect the impact of PAUL to be significant as it will provide a venue for effective teacher professional development situating learning in virtual communities of practice and supporting teacher thinking about the educational uses of ICT in teaching and learning.*

### INTRODUCTION

Over the last ten years, the use of technology in education has exploded. From mobile phones, to MP3 devices, to social networking sites, technology is employed in varied environments in an attempt to

enhance not only educational outcomes, but also the nature of instruction and learning. While technology usage for educational purposes in both formal and informal settings has been rapidly expanding, questions about its pedagogical underpinnings and quality remain. The focus of the present chapter is not on technology per se, but on technology-enhanced learning experiences. In particular, the authors aim

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to show how a powerful pedagogical framework (i.e., ICT-TPCK) requires a technological solution to satisfy the needs of teachers, and therefore to exemplify not only the importance of developing powerful e-learning applications, but most importantly the need to provide valuable educational experiences with these tools.

Researchers have noted that many e-learning systems are simply designed in the same way as traditional forms of instruction—that is, they focus on information dissemination and disregard the capabilities of technology for education. As a result, such systems are often ineffective (Kirschner, Strijbos, Kreijns, & Beers, 2004), disconnected from recent developments in instructional design and human cognitive architecture (Sweller, van Merriënboer & Paas, 1998), and entangled in dated debates of whether technology influences learning (Clark, 1994; Kozma, 1994; Tracey & Hasting, 2005). Equally important, numerous courses, learning applications, and educational interventions are dominated by the so-called learning management systems (LMS). Despite the fact that LMS are considered powerful systems that offer multiple possibilities for learning, they are also based on the “one size fits all” notion, highlighting efficiency and template-driven education (Wilson, Parrish, & Veletsianos, 2008). More specifically, all learners enrolled in LMS-based courses receive the same educational materials, and tools regardless of their knowledge, goals, expertise, and interests. As educators and researchers, we are surprised to discover that one of the most important features of effective and engaging teaching – namely personalized, individualized, and adaptive teaching – has been largely disregarded in the e-learning sphere.

While “adaptive e-learning” has been explored by computer scientists, the capabilities and possibilities of adaptive learning environments are not prominently explored in the education, instructional design, and educational technology literatures. While recent research on adaptive e-learning educational systems has sought solutions

to the “one size fits all” approach with promising results, various issues still need to be addressed for the field to arrive at a holistic understanding of the instructional and pedagogical design of such systems. A related issue concerns the fact that designers and researchers seem to replicate traditional notions of adaptive instruction. Specifically, obsolete views of adaptive learning focus on how the system can control both the content and the learning process ignoring, for the most part, the learner, even though learner control appears to be an important determinant of success in e-learning (Singhanayok & Hooper, 1998). Approaches to adaptive learning should strive to enable and balance system *and* learner control. Such shared control between the learner and the system enables (a) the system to ensure that the learning process is effective, efficient, and engaging, and (b) the learner to feel empowered and motivated to continue learning.

Adaptive electronic learning environments can be extremely valuable tools in developing engaging learning environments for any content area. One area that can benefit greatly from adaptive e-learning systems is teacher training and development. Educating teachers on how to effectively integrate ICT in classroom practices for the purpose of improving education and reforming curricula has been one of the main goals of national and international school reform efforts in various countries (Kirschner, 2003). A variety of approaches have been adopted over the years to prepare and support teachers in ICT integration, but the results have not always been positive, with technology increasingly been seen as having done little to change the ways students learn and the ways teachers teach (Cuban, 1993, 2001). The failure of teacher development programs to adequately prepare teachers to integrate ICT in teaching and learning can be attributed to various factors. Amongst others, the limited amount of time that is usually devoted for traditional ICT training courses and teachers’ different needs, skills, knowledge, expectations, expertise, subject-

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