

# An E-Learning Adaptive System for Teaching Teachers How to Teach with Technology: A Perspective from Technological Pedagogical Content Knowledge

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**Abstract:** While systematic and worthwhile research efforts have been undertaken regarding the conceptualization, development, and assessment of technological pedagogical content knowledge (TPCK) within the context of face-to-face learning experiences in higher education and teacher professional development settings, the authors herein posit that the framework of TPCK requires a technological solution, because the limited amount of time that is usually devoted in conventional teacher education courses and one-time only ICT training courses, as well as teachers' different needs, skills, knowledge, expectations, expertise, subject-matter area, and in general readiness, render traditional face-to-face learning experiences inadequate for providing ongoing TPCK development. On the basis of the above rationale, in this paper the authors introduce the design and development surrounding e-TPCK, an adaptive electronic learning environment that teacher educators, teacher trainers, and in-service and pre-service teachers can use to foster ongoing TPCK development.

**Keywords:** Technological-Pedagogical-Content-Knowledge, ICT-infused design scenarios, teacher training

## 1 Introduction

Technological Pedagogical Content Knowledge (TPCK) has been introduced to the educational research community during the last decade to address the perennial issue of what teachers need to know to teach effectively with ICT in their respective classrooms [1-4]. The aim of the e-TPCK environment, discussed herein, is to promote teachers' ongoing TPCK development by personalizing the content presented to them in the form of design scenarios. e-TPCK provides visual analytics for activity tracking, adapts the learning path of its users based on ratings concerning their perceived mental effort about a design scenario, their preference on the technology tools used in the design scenario, and the difficulty level of the design scenario.

## 2 Description of the e-TPCK functionality

Succinctly, when a teacher logs into the system, he or she is asked to select a tool and the difficulty level of the design scenario (see Figure 1). The technology tools involved in the design scenarios are Kidspiration, Inspiration, Model-It, and Microworlds Jr. The goal of each design scenario is to guide the teacher through a sequence of instructional design decisions about how to teach a particular topic with specific computer tools. Concerning the difficulty level of the design scenarios, there are three different types of design scenarios, namely, worked-out design scenarios, semi-completed design scenarios, and new design scenarios. The three types of design scenarios differ in the amount of scaffolding that is made available by the system to the teacher to complete a design task. In particular, each design task contains information about the learning context for which it is intended (connection with national curricula, known learning difficulties or learners' misconceptions about the content, etc.) and is based on a constructivist model that is comprised of seven learning phases, which describe in chronological order all activities. The amount of scaffolding is related to the number of phases described in the design scenario. There are in total 44 design scenarios in the system, two per tool at the first level of difficulty, one per tool at the third level of difficulty, and eight per tool at the second level of difficulty.

Every 15 minutes the system asks the user/teacher to rate the amount of mental effort that he or she currently experiences (see Figure 2). The ratings of teachers' perceived mental effort are measured with a 7-point Likert scale ranging from very very small mental effort to very very high mental effort. Also, the e-TPCK system gives teachers the opportunity to reflect upon their trajectory in each session through the feature "Check your progress" (see Figure 3). This system affordance was designed and implemented in order to support teachers to make more informed choices of scenarios and it provides visual analytics that track their activity by harvesting

data that rest in the system’s database (what tool or difficulty level the teacher has chosen, whether she had declared low or high cognitive load, etc.).

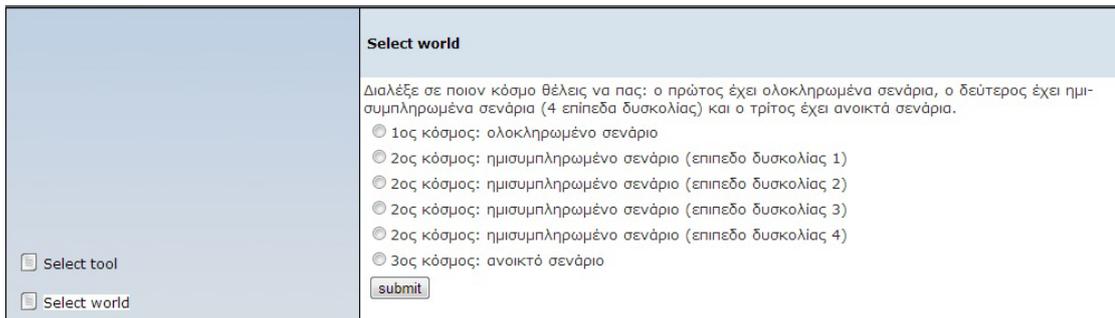


Fig. 1. The teacher chooses the design task

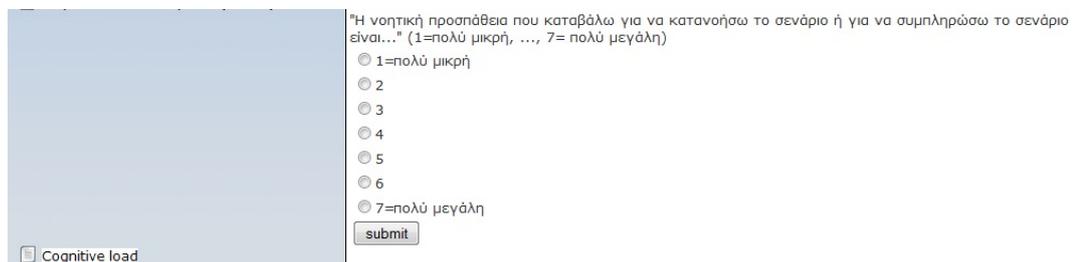


Fig. 2. The teacher reports cognitive load.

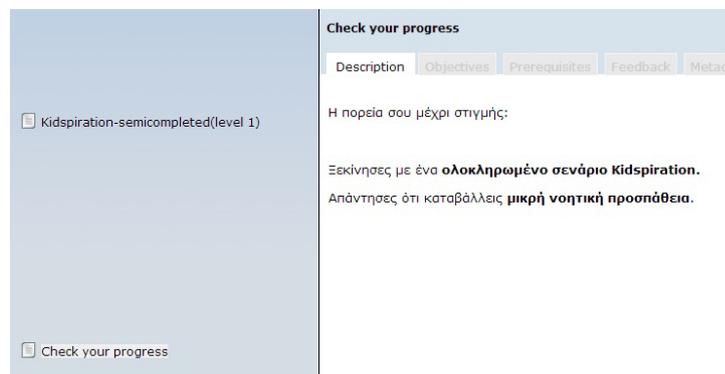


Fig. 3. The “Check Your Progress” feature.

Through the system’s relational database all needed information can be extracted in order to infer the teachers’ interactions with the system. Technically speaking, the inference of the learning path is enabled through the values of two tables (namely, “Property definition” and “Property lookup”) combined with a few simple SQL queries to the database.

The visual analytics are enabled through the visualization of various properties values (stored at the “Property value” database table) that were defined by the designers (definitions are stored at “Property definition” database table) for the scope of learner tracking. These properties constitute a subset of the system properties. All system properties are in the form of IMS-Learning Design properties (<http://www.imsglobal.org/learningdesign/>) and embedded in a number of IF-THEN-ELSE rules. The system design forms a set of Finite States Machines (FSMs) whose implementation, through the execution of the conditional rules, provides the adaptivity of the system. In figure 3, two properties related to the teachers’ progress were referenced in the corresponding webpage. The values of these properties are shown in bold.

### 3 Acknowledgements

In order to implement the e-TPCK system, the corresponding adaptive Learning Design was developed with the use of ReCourse Learning Design editor (<http://tencompetence-project.bolton.ac.uk/ldauthor/>). In order to access the e-TPCK environment, the Astro Learning Design player (<http://tencompetence-project.bolton.ac.uk/ldruntime/index.html>) was configured (by enabling time-related events) and consequently used.

### 4 References

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