

## Chapter 9

# A New Process Phase Diagnostic Technique: Visualized Interface for Diagnosing Learning Progress

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### ABSTRACT

*By improving the imperfections of previous diagnostic techniques, the new process phase real-time diagnostic technique is developed to be suitable for an adaptive e-learning instructional process. This new diagnostic technique combines measures of a learner's learning effort with associated performance in order to compare the efficiency of learning condition in a process phase, real-time, and non-interfering instructional process. The learning effort is represented as a visualized learning effort curve which is a user-friendly interface to enhance the decision making of learning path through the effective interaction between instructors and learners in an adaptive e-learning instructional process. The situated experiment was designed based on the new diagnostic technique and applied on 165 university students. In-depth group interview was conducted right after accomplishing the experiment. Results indicate that the learning effort curve is a capable real-time and non-interfering tool to diagnose learning progress in adaptive e-learning process.*

### INTRODUCTION

The learning effectiveness a learner can achieve in an instructional process is highly relevant to

the learner's expertise in associate domain. The level of a learner's expertise influences mental effort directly according to Cognitive Load Theory (CLT). Therefore, many diagnostic techniques of assessing expertise related factors had been developed over past decades. Under adaptive

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e-learning context a learner's learning condition is required to be assessed in a process phase, real-time, and non-interfering approach which is not fulfilled by those diagnostic techniques presented in past studies. Hence, the purpose of this research is to design a new diagnostic technique suitable for adaptive e-learning context by improving the imperfections of previous diagnostic techniques. Furthermore, this new diagnostic technique is demonstrated with a visualized learning effort curve which is an effective user-friendly interface to enhance a learner's decision making in an adaptive e-learning instructional process.

The literature review of past studies on diagnostic techniques of assessing expertise under static and dynamic conditions was conducted in order to identify the requirements and dimensions of a new dynamic diagnostic technique of assessing expertise under a process phase, real-time, and non-interfering base in the instructional process of adaptive e-learning. The requisite assessment mechanisms for individual dimensions of this new dynamic diagnostic technique were developed accordingly (Hsu et al., 2009). Based on this new dynamic diagnostic technique a situated experiment was applied on 165 university students. The experimental results were transformed into characteristic learning effort curves by the assessment mechanisms of this new developed process phase, real-time, and non-interfering diagnostic technique.

## **OVERVIEW OF DIAGNOSTIC TECHNIQUES**

### **Static Diagnostic Techniques of Assessing Expertise**

CLT inquires interactions between information structures and knowledge of human cognition to determine instructional design (van Merriëboer et al., 2005). The expertise reversal effect is an interaction between several basic cognitive load

effects (split-attention, modality, and worked example effects) and level of expertise (Kalyuga et al., 2003; Kalyuga et al., 2010). The effect is demonstrated when instructional methods that work well for novice learners have no effects or even adverse effects when learners acquire more expertise. In short, the level of expertise of the learner directly influences cognitive load; furthermore, an effective instructional design for different instructional contexts should be developed with the consideration of expertise. Therefore, the diagnostic techniques are needed to assess the levels of expertise of learners in such a way that cognitive load is taken into account. A review of past studies on diagnostic techniques of assessing expertise under static conditions is presented in this research. The assessments are taken at a specific stage of instruction instead of being conducted dynamically in the instructional process. The following different diagnostic techniques of assessing expertise related factors are presented.

1. **Static Assessments of Performance:** The traditional assessment in education primarily deals with learning performance which presents a learner's achievement measured by the test score or the time spent on task. Performance is one assessment dimension of cognitive load. Higher cognitive load often results in lower test score and less performance (Pass & van Merriëboer, 1994). The test score or the time spent is assessed at the stage of accomplishing a specific learning task, that is, the performance is assessed statically.
2. **Static Assessments of Mental Effort:** However, the other assessment dimensions of cognitive load are at least equally important for the assessment of expertise. They include mental load originated from the interaction between task characteristics and learner characteristics, which yields a priori estimate of cognitive load and mental effort (Pass & van Merriëboer, 1993). The

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