IGI PUBLISHING

ITJ 5005

701 E. Chocolate Avenue, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.igi-global.com

This paper appears in the publication, International Journal of Distance Education Technologies, Volume 7, Issue 3
edited by **Qun Jin © 2009, IGI Global**

A New Diagnostic Mechanism of Instruction:

A Dynamic, Real-Time and Non-Interference Quantitative Measurement Technique for Adaptive E-Learning

Pi-Shan Hsu, Ching Kuo Institute of Management and Health, Taiwan

Te-Jeng Chang, National Taiwan Normal University, Taiwan

Ming-Hsiung Wu, National Taiwan Normal University, Taiwan

ABSTRACT

The level of learners' expertise has been used as a metric and diagnostic mechanism of instruction. This metric influences mental effort directly according to the applications of cognitive load theory. Cognitive efficiency, an optimal measurement technique of expertise, was developed by Kalyuga and Sweller to replace instructional efficiency in e-learning environment for dynamically adapting instruction. But mental effort, a factor of cognitive efficiency, is assessed by a node mode measurement technique which discontinues instruction and causes interference. This research proposes a new adaptive e-learning measurement technique which assesses learning effort in a dynamic, real-time, and non-interference instructional process. The learning effort curve is a key diagnostic to enhance interaction between instructors and learners in an adaptive e-learning instructional process. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: *Adaptive E-Learning; Cognitive Load Theory; Diagnostic Mechanism; Measurement Technique; Non-Interference; Real-Time*

INTRODUCTION

Cognitive Load Theory (CLT) has been developed since the early 1980s and lays emphasis on the instructional design to reduce unnecessary mental effort. The level of a learner's expertise is highly correlated with mental effort according to CLT. Effective achievement by the learner in an instruction is strongly related to the learner's expertise in the associate domain. Over past decades, different measurement techniques and assessment factors have been developed to diagnose and assess a learner's expertise in order to enhance instruction. Adaptive e-learning has become a popular method of instruction as result of the progressive development of information technology. Adaptive e-learning methods typically monitor a learner's instructional condition in a dynamic, real-time, and non-interference manner, commonly called a process mode approach. Alternative, the node mode approach applies tests or assessment techniques after the instructional process. A literature review of previous measurement techniques and assessment methods is used to identify requisite elements in designing measurement techniques suitable for an adaptive e-learning instructional process.

STATIC ASSESSMENTS OF EXPERTISE

CLT inquires interaction between information structures and knowledge of human cognition to determine instructional design requirements. A key design requirement is to reduce unnecessary or extraneous cognitive load by providing learners with work examples rather than problems to solve. It's feasible to structure both worked examples and related instruction to further reduce cognitive load (van Merriënboer & Sweller, 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). 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, an effective instructional design for different instructional contexts should be developed with the consideration of expertise. Therefore, assessment methods are needed to measure the level of expertise of a learner in a way that cognitive load is taken into account. A review of past studies on measurement techniques of assessing expertise under static conditions is presented in this research. The measurements are taken at a specific stage of instruction instead of being conducted dynamically in the instructional process.

Assessing Expertise by Instructional Efficiency

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. For many practical cases, it is feasible for two people to achieve the same performance levels with one person working arduously through a process to reach the correct answers, whereas the other person reaches the same answers with minimum effort. Hence, both people have identical performance but expertise might be higher for the person who performs the task with less effort than for the person who devotes substantial effort. Higher cognitive load often results in lower test score and less performance (Paas & van Merriënboer, 1994). Therefore, performance is just one of the assessment dimensions of cognitive load. The other assessment dimensions of CLT 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 (Paas & van Merriënboer, 1993). The mental effort being expended by learners is considered essential to obtaining a reliable estimate of cognitive load. Therefore, an appropriate assessment of expertise should include measures of mental effort and performance.

Different measurement techniques for mental effort are discussed, including rating scales, secondary task methods and psychophysiological measures (Paas et al., 2003). Most recent techniques such as secondary task methods (Brunken et al., 2003) and psychophysiological measures (van Gerven et al., 2004) are using subjective rating scales. Paas et al. (2003) conclude that the use of subjective rating scales to measure mental effort and

Related Content

Instructor Satisfaction with Teaching Business Law: Online Vs. Onground
Louis B. Swartz, Michele T. Coleand Daniel J. Shelley (2010). *International Journal of Information and Communication Technology Education (pp. 1-16).*
www.irma-international.org/article/instructor-satisfaction-teaching-business-law/38980

Monitoring Student Performance Through an Agile Project-Based Assessment Strategy for Distance Higher Education
Sávio Resende Guadelupe, Danilo Pestana Freitas, Paulo Victor Rodrigues De Carvalhoand Alessandro Jatobá (2021). *International Journal of Distance Education Technologies (pp. 23-36).*
www.irma-international.org/article/monitoring-student-performance-through-an-agile-project-based-assessment-strategy-for-distance-higher-education/286739

Expanding Desktop Libraries
Edward D. Gartenand Donna K. Meyer (2009). *Encyclopedia of Distance Learning, Second Edition (pp. 995-1002).*
www.irma-international.org/chapter/expanding-desktop-libraries/11867

Bridging of Digital Divide in Africa
S.E. Igun (2011). *International Journal of Information and Communication Technology Education (pp. 11-20).*
www.irma-international.org/article/bridging-digital-divide-africa/49706

Simulation Experiment and Teaching Research of a Land-Based Ship Engine Room
Yan Cong, Baojun Wangand Taili Du (2023). *International Journal of Information and Communication Technology Education (pp. 1-9).*
www.irma-international.org/article/simulation-experiment-and-teaching-research-of-a-land-based-ship-engine-room/331801