**Efficacy of Simulation-Based Learning of Electronics Using Visualization and**

**Manipulation**

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This study investigates the effectiveness of the activities of visualization and manipulation on learning. Within this article the author set out to find evidence and builds a convincing case to prove that visualization technologies have positive impacts on learning. The authors seek out tangible benefits of these technologies in the learning process disclosing that increasing interactions and opportunities for manipulation result in improved learning. This article endeavours to provide sufficient proof that “simulation based learning activities help learners to acquire knowledge through the process of observation, exploration, experiencing, and reflection.”

The main impetus for this study is that “A common problem faced by learners of electronics is being unable to fully understand the abstract concepts that underlie the system responses predicted by theoretical models”. This often results in learners being unable to see the link between models and actual circuits (Ronen & Eliahu, 2000). Learners frequently cannot understand the abstract concepts underlying the microscopic world of electrical circuits since they cannot see the flow of electric currents authentically, and many teachers find it difficult to explain the details of complex electronic processes using a 2-dimensional textbook explanation for dynamic concepts and active processes. The authors strive to explain that the traditional text book approach is unsuitable especially for this dynamic type of subject, it fails to provide real-time feedback of material leaving learners frustrated and discouraged when they are attempting to understand complicated abstract concepts. The authors continue to strengthen their contention, that simulated experience is better than no experience quoting, Ronen and Eliahu (2000) whom believed that simulation has great potential as a supplementary tool, with simulation as a medium helping learners to repair missing links between theories and actual electronics processes”.

The authors introduce a simulation-based learning model containing three phases: concept learning, simulative manipulation, and concept clarification. The back and forth nature of learning path achievable within this model allows students to gain a deeper understanding of the subject material.

Initially students are introduced to the concept learning stage; here learners conduct electronic learning tasks by using interactive visualized pictures with linking narrations, texts and symbols. It is at this point that learners are attempting to understand some of the difficult theoretical concepts that need to be continuously reflected over to gain a deeper understanding of electronics, the use of the models learning-reflection learning path helps to promote this goal.

Gordin and Pea (1995) and Ainsworth (2006) “found that visualized simulation helps learners to achieve a higher level of cognition by facilitating their interactions with multiple external representations and reflection on phenomena, as observed when learning a given abstract concept”. “Moreover, visualized learning also motivates learners and helps them to transfer concepts into long-term memory” (Colaso et al., 2002; Naps et al., 2003).

The authors review of research findings reveal that learning performance can be enhanced by employing a visualized learning environment as it promotes learner interactions and gives them opportunities for manipulation (Colaso et al., 2002; Jensen et al., 2002; Korhonen & Malmi, 2000; Naps et al., 2003; Tversky et al., 2002).

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