Chapter 2.7
The Effectiveness of Scaffolding in a Web–Based, Adaptive Learning System

Mei-Yu Chang
National Hsinchu University of Education, Taiwan

Wernhuar Tarng
National Hsinchu University of Education, Taiwan

Fu-Yu Shin
Chien-Kuo Elementary School, Taiwan

ABSTRACT

This study combined ideas from learning hierarchy and scaffolding theory to design a web-based, adaptive learning system to investigate the effectiveness of scaffolding for elementary school students having different levels of learning achievement. The topic chosen for learning was the Three States of Water. A quasi-experiment was conducted. In this experiment, students were divided into three groups: control group (without scaffolds), experimental group A (scaffolds providing by on-line conversation) and experimental group B (scaffolds providing by face-to-face conversation). The experimental results showed significant improvement for students after they had studied using the web-based, adaptive learning system. Specifically, scaffolds in the form of face-to-face conversations greatly enhanced the learning of high-achievement students. However, there were no significant differences between the low-achievement students with or without the provision of scaffolds. It was also discovered that the web-based, adaptive learning system could help students develop their learning responsibility.

INTRODUCTION

The purpose of science education is to provide students with scientific knowledge, concepts, attitudes and methods for application in their daily

lives. The role of a teacher is to assist students in learning and solving problems. At the beginning, students are usually interested in learning science, but to some extent, they lose it or become confused, especially when learning abstract concepts. The Three States of Water is a learning unit containing abstract and complicated concepts for elementary students.

Use of the Internet and instructional technology can help teachers and students in many ways. It is easier for students to understand abstract concepts if their learning process is assisted by instructional technology. This study combined with ideas of learning hierarchy and scaffolding theory to the design of a web-based, adaptive learning system to improve the quality of web-based learning.

The major purpose of this study was to investigate students' learning via a web-based, adaptive learning system where scaffolds were provided to help the students to study the concept of the Three States of Water. This study also tried to find out whether students' learning responsibility was being developed during their learning process.

The concept of *scaffolding* is based on Vygotsky's social constructivist view of learning (1978). Vygotsky proposed that there were two major factors, i.e., culture and social context, which influence learning. He claimed that every mental function in a child's development first came from the social interaction with an adult. This kind of interaction provides a supportive environment in which children can extend their current knowledge and skills. The supported situation occurs in what Vygotsky referred to as the *zone of proximal development*. That is the area between what children can do independently and what they can do with assistance, such as they get from teachers and other students. The assistance that other people provide is a *scaffold* for a child. Given repeated experiences, children can internalize the supported situation of the mental processes, and can engage in them in new contexts (Clark & Graves, 2005).

Two sources of knowledge are suggested by Vygotsky. The first is *everyday knowledge*, i.e., gut knowledge, instinctive knowledge and spontaneous knowledge. This type of knowledge is influenced by peer interaction, language and experience of the individual who tries to understand his or her environment. The second is from formal education in the classroom, which is called *formal knowledge* and it possesses strict logic and clear definitions. Therefore, learners construct meaningful knowledge through both their daily lives and school experiences.

However, some scientific concepts are very abstract and difficult for students to grasp. In addition, they may often be influenced by different cultural and social environments. For example, the concept of "The sun rises in the east and falls in the west" generally exists in textbooks and daily communication, and students have this *misconception* before they are educated with *formal* knowledge. Students may think the experiences they have in daily life constitute their full knowledge base. Therefore, it is important for them to know if the knowledge they have received is formally right or not.

According to scaffolding theory, teachers should hold continuous and active conversations with students to find out the possible levels of their potential development (where they are) and to control their learning environments (where they should be) by providing proper support to make the concepts they acquire consistent with scientists' current definitions.

Empirical Studies on Related Topics

Osbome and Cosgrove (1983) discovered in their study that students lacked the support of substantial scientific concepts when they explained changes in the states of water. The finding was that they had only superficial knowledge of the terms and expressions. For example, some students would think that a solid changing into a liquid will lose weight or condensation will

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