Chapter 15
A Multiplatform E-learning System for Collaborative Learning
The Potential of Interactions for Learning Fraction Equivalence

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ABSTRACT

A multiplatform e-learning system called the "Graphical Partitioning Model (GPM)", with the separate versions for desktop computers and mobile devices, was developed for learning knowledge of fraction equivalence. This chapter presents a case study on the use of the mobile version GPM for the learning of the targeted topic in a mobile technology supported environment. The interactions between a dyad of Primary 5 students and the GPM were analyzed in order to understand the feasibility of the design of the mobile version e-learning system. The results show that the interactions between the students and the GPM have the potential to enhance the learning effectiveness of the targeted topic. The mobile version GPM demonstrated a possibility to integrate with collaborative learning strategies such as reciprocal tutoring and peer discussion. The case study also reveals that there is a potential for the flexible use of the dual-version GPM to foster deep learning.

INTRODUCTION

Knowledge of fraction equivalence is a fundamental element in the learning of the mathematics topic "mathematical fraction". This knowledge, which comprises the concept of fraction equivalence and knowledge of the computation of equivalent fractions, both of which are of equal importance, is a prerequisite for the further conceptual development of the targeted topic such as the procedural knowledge about the operation of mathematical fractions (Kong & Kwok, 2005). Researchers suggest that computer-supported learning environments that provide graphical supports facilitate the knowledge generation about fraction equivalence (Ohlsson, 1991; Steffe & Olive, 1996). In this regard, a desktop version of a web-based e-learning system for learning the knowledge of fraction equivalence was

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designed (Kong, 2008a; Kong & Kwok, 2003).

Previous evaluation study shows that the interactions among learners, for example in the form of reciprocal tutoring, in a collaborative learning environment have the potential to increase learning effectiveness in this domain (Kong, 2008a, 2008b; Kong & Kwok, 2005). As the portable and versatile nature of mobile devices offers the opportunity to promote reciprocal tutoring in a mobile technology supported environment, the desktop version e-learning system for comprehending knowledge of fraction equivalence was adapted to create a mobile version for collaborative learning (Kong, 2008b). This chapter presents a real case on analyzing the interactions of learners who used the mobile version e-learning system in a mobile technology supported environment for the collaborative learning of fraction equivalence.

THE MULTIPLATFORM E-LEARNING SYSTEM

Researchers have suggested that visualization plays an important role in learning mathematics. Visualization is a "cognitive technology" using visual means, such as visual representations in terms of diagrams or graphs, to "see" abstract concepts and ideas (Arcavi, 2003; Borba & Villarreal, 2005). Visualization encompasses four elements, namely mental images, external representations, visualization processes and visualization abilities. In mathematics, visualization is a process requires the ability to interpret and understand figural information and the ability to conceptualize and translate abstract relationships and nonfigural information into visual terms.

Visualization is considered as a helpful tool for mathematical comprehension because many concepts and processes in school mathematics can be tied to visual representations. By virtue of the concreteness of visual representations, visualization becomes an essential factor for learners to create a sense of self-evidence and immediacy (Arcavi, 2003; Borba & Villarreal, 2005). The integration of visualization with e-learning, which refers to the use of computer technology to access digital resources on the Internet for learning purposes (Holmes & Gardner, 2006), plays a relevant role in this educational context because computer is a rich source of visual and computational images that makes the exploration of mathematical concepts possible. It is suggested that e-learning systems in the nature of computer-based graphical tools are able to support the dialectic reasoning of learners in the mathematics classroom by providing opportunities for exploring hypothetical queries and making mental manipulation of concepts easier (Sedig & Liang, 2006).

Researchers suggest that computer-based graphical tools are particularly suitable for the topics that emphasize visualization, such as mathematical fractions. Early studies on computer-supported learning environments for learning fractions used graphical presentations or representations, or operators in a micro-world to help learners to develop the conceptual understanding and procedural knowledge of fraction equivalence (Ohlsson, 1991; Steffe & Olive, 1996). The purpose of the graphics was to link fraction symbols with pictorial presentations or representations in order to coordinate the internal mental models of learners with the external visual representations, thereby increasing understanding of the concepts (Sedig & Liang, 2006). With the aim of providing graphical supports for the knowledge generation about fraction equivalence, a desktop version of a web-based e-learning system called the "Graphical Partitioning Model (GPM)" was developed for individual learning of the targeted topic (Kong, 2008a; Kong & Kwok, 2002, 2003, 2005).

The GPM is a graphical model of a rectangular bar for representing fractions, of which each fraction being represented by displaying shaded fractional parts of an equally partitioned rectangular bar according to the value of the fraction. This e-learning system was designed as a model of affordances to support the learning of mathematical fractions. Gibson (1979) introduces the notion of affordances

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