Development of Effective Education Systems by Integration of Educational Theories and Computer Technologies

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This thesis describes the development of an effective computer-supported education system. This system reflects educational theories and extended computer abilities to achieve its educational goals.

This study proposes an effective educational system through the use and integration of educational theories and computer technology. This study presents applied case studies in instruction and learning activities. As an example of an instruction system, this study proposes a design method for instructional materials, such as lesson plans and courseware. As an example of a learning system, this study developed e-learning systems that reflect educational models and individual difference theories, and then analyzed their learning effects.

The instructional design system assists in instructional materials design for designers using an ontological model of instruction that was constructed for this study. The expert knowledge and experiences of the instructional design were extracted and saved into the instructional ontology. Novice designers, therefore, can
design more easily using the expert knowledge and experience inherent in this instruction system. In addition, an instructional design method using an instructional model template was proposed that could be used without using the instructional ontology or computer. This method first asks for the design of frameworks using the instructional model template, and second asks for the design of the content by matching frameworks and real content. This method simulates expert methodology to the greatest extent possible without using the instructional ontology or computer. This proposed methodology was applied to an instructional design class of pre-service teachers in Korea. Its effectiveness was indicated in various ways: comparison and analysis of content, closed and open questionnaires, interviews, and an improvement in instructional model knowledge. Finally, the proposed methods indicated that they help to produce more fluent and systematic content in the instructional design of lesson plans and courseware.

E-learning systems were developed that reflected educational theories. In addition, adaptive learning systems were developed that considered individual differences. This study also applied Gagné’s Nine Events of Instruction to an e-learning system for advertising education. This study applied Keller’s ARCS (Attention, Relevance, Confidence, and Satisfaction) theory to mathematics courseware to improve the learner’s motivation when using the courseware. In addition, this study developed a web-based discussion system using Hill’s Group Cognitive Map to improve the efficacy of discussion learning and produce an effectiveness that could lead to active participants in an ethics education class in an elementary school in Korea. This study developed an adaptive learning system that took into consideration various individual differences, such as learners’ achievement, learners’ learning style, and learning task and learning style. This study developed an adaptive learning system that considers learners’ achievements by applying van Hiele’s Theory to geometry learning and supports learning dependent on the students’ levels. This study also developed an adaptive learning system that considers a learner’s learning style and applies Bruner’s EIS (Enactive, Iconic, and Symbolic) theory to mathematics study; it provides personalized learning. Especially, this adaptive learning system automatically diagnoses the learner’s style by analyzing the learner’s learning history and supports changes in the learner’s learning style to more properly reflect the learner’s learning style while the learner is learning. In addition, this study developed an adaptive learning system that considers learning tasks and the learner’s learning style and supports the adaptability of both the learning task and the learning style concurrently.

This thesis consists of the following six chapters.

Chapter 1 discusses the research background, objectives, research content and methods, and a set of definitions of terms.

Chapter 2 discusses the theoretical background of this study including educational theories and computer technologies.
Chapter 3 proposes a new method to develop instructional materials, such as a lesson plan and courseware. The proposed method in this study develops instructional materials, such as a lesson plan or courseware by utilizing an instructional model template and an ontological model of instruction. The proposed method in this chapter will be applied to designing, and its effect will be analyzed by various methods.

Chapter 4 discusses the development of an e-learning system that applies educational theories. An education model and individual difference theory are applied to the educational theories. The education model applies Gagné’s Nine Events of Instruction, Keller’s ARCS motivation theory, and Hill's cognitive group map, while the individual difference theory uses Achievement-Treatment Interaction, Aptitude-Treatment Interaction, and Task-Trait-Treatment Interaction theories.

Chapter 5 focuses on a discussion of the course of effective education system development and the results of an effectiveness analysis. The discussion is largely composed of computer-supported, instructional material design, computer-supported, learning system development; and the application of educational theories, and computer technologies.

Finally, Chapter 6 is the conclusion. Here, study results, the contributions of this study, and future studies will be discussed.