

論文の要旨

題目 MODEL-BASED PROCESS ANALYSIS OF PROBLEM POSING AS SENTENCE INTEGRATION IN ARITHMETIC WORD PROBLEMS

(算数文章題の単文統合型作問についてのモデルベースのプロセス分析)

氏名 AHMAD AFIF SUPIANO

A slightly hidden potential of the problem-posing learning system that this thesis explores is that it can open new opportunities for capturing learner's digital traces of activity. These data can be analyzed through a variety of techniques, from statistical to data mining approaches that describe general aspects of learners' activity, learners' tendency in fulfilling problem requirements, and learners' impasse in thinking during pose the problems. We conducted studies to analyze log data gathered from a problem-posing learning system, called Monsakun, which is an interactive learning system that encourages learners in posing problems of arithmetic word problems via sentence integration. Previous studies investigate learners pose the problems are intended to analyze the pre- and post- test scores, examine the first selected sentence, and concerning the completed posed problems. Investigations in such research are limited in analyzing the result of the process. This thesis extends the analysis by involving the process of arranging the problem, which means every action of learners when they pose the problems on the system is examined to understand the learning process. Therefore, the purpose of studies in this thesis is to investigate and discover the learning process of learners who learn problem-posing as sentence integration in arithmetic word problems through the log of interaction data.

The key contribution of this thesis is a novel approach to the deep exploration of learners thinking processes in posing problems on Monsakun by applying statistical techniques associated with the cognitive model. Also, the discovering learners experience difficulties according to the changes in their thinking processes and design a sophisticated support system to help learners in problem-posing activity by automatically delivering proper tasks based on their bottlenecks in thinking. To achieve the above, this thesis presents a series of studies to understand how to trace, analyze and distil the log data of learners in learning by problem-posing using Monsakun. Problem-posing processes of Japanese first-grade elementary school students in an actual class were analyzed for the studies that are described in this thesis.

We begin with two series of studies investigate learners' problem-posing processes in term of satisfying the required constraints and avoiding the violated constraints. This analysis can show that learners didn't pose the problems in a random way but with some considerations. The next study proposed a method to visualize learners' problem-posing processes which can detect a situation in which many learners experience in difficulty to pose the problems. It can be shown to teachers or researchers to foster awareness and reflection. Finally, we conducted a study that is most strongly associated with the real practice is the design a computer-based scaffolding system. The system presents novel affordances, including tracking interaction log data in the real-time, detecting learner's bottleneck in thinking through evaluating the data collected, and generate a personalized task based on the bottleneck found.

In summary, while the approaches and studies presented in this thesis were mostly explored in the context of analysis of Monsakun log data, the findings are likely to be relevant to other forms of learning analytics. Through the approaches, the studies conducted to discuss the validity of problem-posing processes via sentence integration concerning learners' activity, extract some information from the process, and analyze the results to detect learners' difficulties from the data and the cognitive model perspective.