Analyzer of Sentence Card Set for Learning by Problem-Posing

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Abstract. MONSAKUN is software for learning by problem-posing in arithmetical word problems where a learner poses a problem by selecting and combining sentence cards from a given set of sentence cards. It is not easy task to prepare the sets of the sentence cards manually because it is necessary to evaluate all combinations. This paper describes an analyzer of a set of sentence cards. Experimental evaluation of the analyzer is also reported.

Keywords: Learning by Problem-Posing, Arithmetical Word Problem, Sentence Integration, Dummy Sentence Card.

1 Introduction

We have already developed several environments for learning by problem-posing that realize automatic assessment of posed problems by learners [1, 2]. We call this automatic assessment facility "agent-assessment" in comparison with "teacher-assessment", "self-assessment" and "peer-assessment" [3]. MONSAKUN [4] is a support system for learning by problem-posing where a learner poses a problem by selecting and combining sentence cards from a given set of sentence cards. A set of sentence cards includes necessary sentence cards and unnecessary sentence cards. We call the unnecessary sentence cards as "dummy cards". Because learner's behavior of problem-posing depends on the combination of necessary and unnecessary ones, to prepare an adequate set of sentence cards to each problem-posing task is an indispensable task to realize learning by problem-posing. In this paper, we introduce a method to analyze a set of the sentence cards. We evaluated the analyzer implemented by the method by using 48 sets of sentence cards that were practically used in problem-posing exercise in an elementary school, and found several defects that we should improve the card sets.

2 MONSAKUN

2.1 Task Model of Problem-Posing

Targeting arithmetical word problems that can be solved by one addition or subtraction, we have already proposed a task model of problem posing composed of following four

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tasks, (1) deciding calculation operation structure, (2) deciding story operation structure, (3) deciding story structure, and (4) deciding problem sentences [4]. It is necessary for learners to complete these tasks to pose a correct problem though the execution order of the tasks is not decided in the model. Problem-posing tasks in MONSAKUN are designed based on this model.

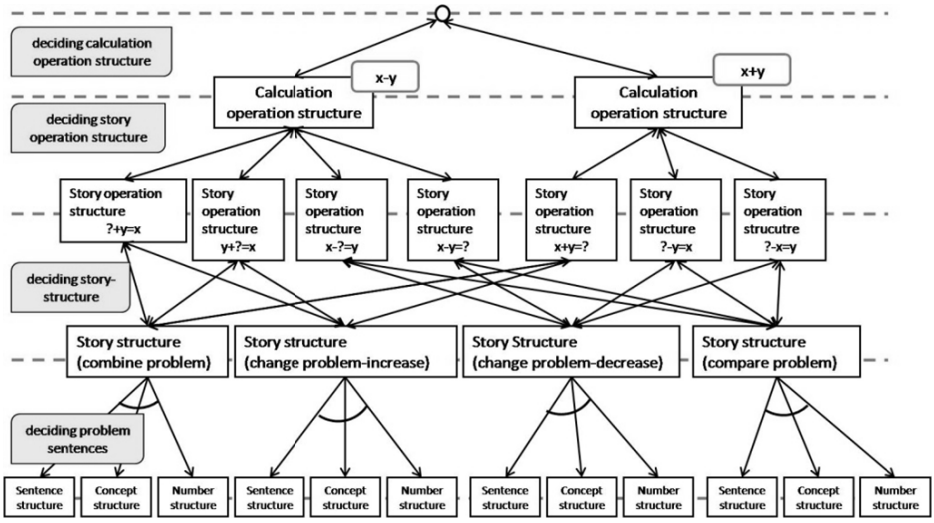

Fig. 1. Task Model of Problem-Posing

2.2 Overview of MONSAKUN

The problem-posing interface MONSAKUN is shown in Figure 2. In MONSAKUN, several sentence cards are provided to a learner. The learner poses a problem by selecting and ordering some of them. Then, MONSAKUN assigned a story operation structure or calculation operation structure is provided to the learner. This assignment is the condition that the posed problem should satisfy.

A sentence card is put into a blank in the problem-combination area. There are three blanks in Figure 2, a learner should select three cards from the card set at right side and arrange them in a proper order. A learner can move a card by drag & drop method in the interface. When a learner pushes “Check the Problem” under the problem-composition area, the system diagnoses the combination of sentences. The results of the diagnosis and message to help the learner’s problem-posing is presented by another window.

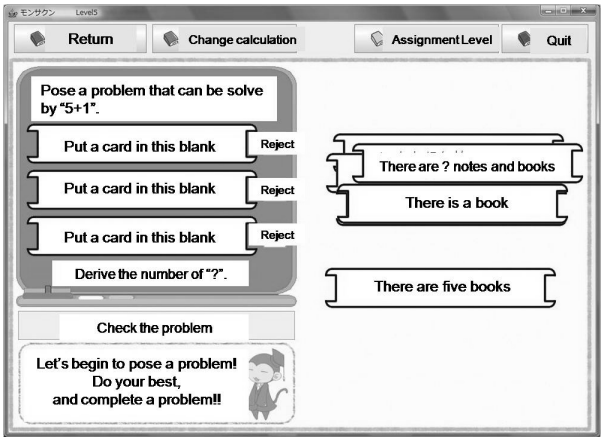

Fig. 2. MONSAKUN interface

3 Analyzer of Sentence Card Set

3.1 Card Set Analysis

Figure 1 shows tasks that learners must perform for problem-posing by the MONSAKUN. The specific purpose of the problem-posing activity is to enable learners to make proper decisions through these tasks. Decisions learners need to make depend heavily on the characters of card sets given. For example, setting the same concept for all the card sets available will make unnecessary a decision by learners on unifying the concept in the deciding problem sentences. Thus, it is of crucial importance for a card set developer to understand what kind of problem-posing activities the learners will engage in by using a card set made available. However, as the number of possible problems to be posed (including wrong problems) is determined by the permutation of the sentence cards, the number increases in series as the number of cards in a card set increases. Therefore, a tremendous amount of work will be required for a card set developer to manually check all the possible problems to be posed.

3.2 Analysis Flow

A card set developer enters a story structure, a story operation structure and a card set in the system. The developer selects from among 4 story-structures (multiple choices allowed) and selects addition or deduction and enters any value between 1 and 9 for the story operation structure. For the card set, the developer selects pre-arranged sentence card forms, which followed by the concepts and numerical values used for the cards, and adds them to the card set. A card set developer can enter card sets by repeating such steps.

The system creates all the possible combinations based on the card set entered, by considering each combination as a problem posed by learners, and performs check

similar to that actually performed by the MONSAKUN and classifies the combinations based on the check results. The results are displayed on windows which can be switched per classification

3.3 Experimental Evaluation of Analyzer

By using the analyzer, we have examined 48 sets of sentence cards that were practically used in problem-posing exercise in an elementary school. Only one story that specified in problem-posing task can be correctly generated from 42 out of 48 card sets. Then, from 6 card sets, it is possible to make a solvable problem covered by other story specified in problem-posing task. The developer of the card sets had not noticed the 6 cards sets. The analyzer also detected that in several card sets learner could not make several types of mistakes because of enough kinds of dummy card were prepared. We confirmed that these information was useful to prepare and sophisticate the sets of sentence cards.

4 Conclusion

In this study, we have developed a system to analyze possible problems to be posed from sentence card set based on the task model of problem-posing. Our major future issues include the development of a system to automatically generate effective card sets.

References

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