

# A Method to Embed Problem Solving Exercises into a Playing Card Game

Takanobu UMETSU<sup>a</sup>, Tsukasa HIRASHIMA<sup>b</sup>, Akira TAKEUCHI<sup>a</sup>

<sup>a</sup>*Computer Science and Systems Engineering, Kyushu Institute of Technology, Japan*

<sup>b</sup>*Department of Information Engineering, Hiroshima University, Japan*  
umetsu@ai.kyutech.ac.jp

**Abstract:** In this paper, we propose a concrete method to embed problem solving exercises into a playing card game. An educational game is designed in this method requires a learner is required to derive answers from problems to play the game.

**Keywords:** Educational Game, Authoring System, Design Methodology, Card Game

## Introduction

A method to make some educational games is proposed in this paper. An educational game is a game where the activity to play is not only attractive as a game but also useful for learning. However, it is difficult to develop an educational game. Although there are several investigations for the design methods of educational games, most of them deal with only restricted part of the design process [1-3]. Under these circumstances, we propose a concrete method to generate an educational game. We call this method as EPIC (Embedding Problem solving exercises Into a Card game) method.

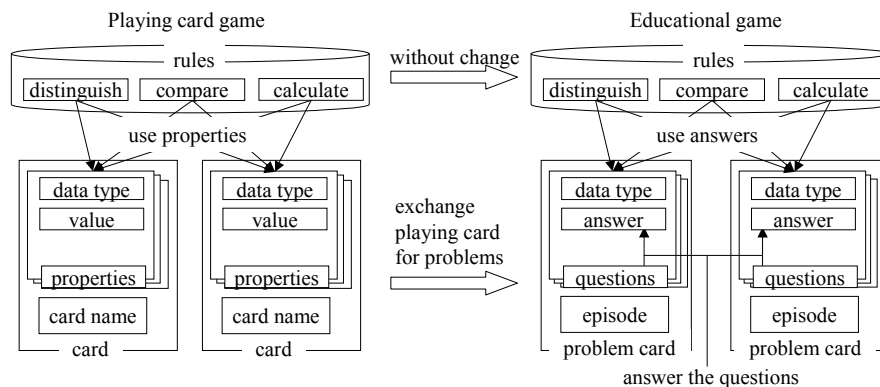
## 1. EPIC Method

EPIC method realize an educational game by exchanging the original playing cards for new cards including information of problem solving where the new cards have the characteristics required by the original game [4]. The game rules to operate the new cards are almost preserved, because the new cards have the required characteristics. Figure 1 shows a framework of EPIC method. In the following chapter, we explain this figure in details.

As a result of examination of rules in 72 playing card games, it was found that there were only three kinds of operations using the values of properties of the playing cards. The operations are (1)distinction, (2)comparison, and (3)calculation of values of properties of the cards. For example, a card called “seven of hearts” has “♥” as the mark (it is also known as suit) and “7” as the number. “Seven of hearts” is a card name. “Mark” and “number” are property names. “♥” and “7” are values of the properties. In a playing card game, a player distinguishes “♥” and “♣”, compares “7” and “8”, or calculates “7” + “8”.

Possible operations for each property are decided depending on nature of the property. We call the natures as “data type”. According to Stevens’ theory of scales of measurement [5], Stevens called the nature can be distinguished “nominal scale”, the nature can be ranked “ordinal scale” and the nature can be calculated “interval scale”.

In this paper, we deal with the learning activity that a learner derives unknown information (i.e., answers) from the given information (i.e., episode, question) by using his/her knowledge. We call the given information as “problem” in this paper. Here we could



**Figure 1.** Model of EPIC Method

show the similarity in the structure of problem and the playing card. The problem that has the similar structure doesn't have complete information included in the playing card, but the lacking information could be derived from the give information. The deriving process is so-called "problem-solving process". Therefore, we prepare new cards with problems and exchange playing cards for the new cards. The game made by the exchange is useful for learning, because a player is required to solve problems to use the cards. EPIC method includes the criteria to judge the similarity between the playing cards and problems from the viewpoints of "operations of the cards" and "required data types of the operations". Because of page limitation, the details of the method are omitted in this paper.

## 2. Evaluations of EPIC method

We first tried to confirm EPIC method could make enough number of playable educational games. It is a fundamental evaluation of EPIC method. We made 120 games by EPIC method, and played each game for 20 minutes. We confirmed all 120 games were playable.

Next, we have developed a system that generates computer-based educational games based on EPIC method. This is a prototype to demonstrate the possibility of EPIC method. We asked 34 subjects to play 8 game applications made by the system and to answer questionnaires. The result suggested that educational games made by EPIC method were useful for problem solving exercises while keeping the characteristics of the original games.

## 3. Conclusions

In this paper, we have proposed EPIC method to transform an existent playing card game into an educational game for problem solving by exchanging playing cards of the original game into new cards requiring problem solving activity to use them. This method is realized as a system that can generate useful educational games automatically.

## References

- [1] M.M. Klawe (1998). When Does The Use Of Computer Games And Other Interactive Multimedia Software Help Students Learn Mathematics? <http://www.cs.ubc.ca/nest/egems/reports/NCTM.doc>
- [2] Marc Prensky (2001). Digital game-based learning. McGraw-Hill.
- [3] H. M. Half (2005). Adventure Games for Science Education: Generative Methods in Exploratory Environments. *Proc. of AIED05 WORKSHOP5* (pp.12-20).
- [4] Takanobu UMETSU, Tsukasa HIRASHIMA, Akira TAKEUCHI (2006). Property Exchange Method for Automatic Generation of Computer-Based Learning Games. *Proc. of ICCE2006*
- [5] S. S. Stevens (1951). On the theory of scales of measurement. *Science* 103. 677-680.