An Implementation of Learning Environment for Problem-Changing Exercise

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Abstract: To make a new problem from the original one and to compare their solutions are promising activities to promote a learner to be aware of the structure of the problems. As an implementation to realize such exercises in physics, we have developed a computer-based learning environment that allows a learner to make a new problem by changing the original one and that diagnoses the problem change. In this paper, we introduce the implemented learning environment.

Keywords: Interactive Environment, Problem-Changing Exercise, Physics Learning

Introduction

An implementation of interactive environment for learning by problem-changing has been described in this paper. Several researchers have already suggested that problem-changing exercise where a learner is required to pose a new problem by changing the provided problem is a promising method to promote them to be aware of the difference between the problems and characteristics of themselves [1, 2]. However, because there are usually several ways to change the original problem, it is often very difficult to give effective feedback for the problem-changing. In order to make "problem-changing exercise" as more common and useful learning method, we have investigated interactive learning environment with a function of automatic assessment of learner's problem changes [3]. In this environment, the learner poses new problems by changing given problems. After the problem-posing, the learner is required to compare the new problems with the given problems or the solutions of the problems. Through an experimental use of the environment, we have confirmed that this exercise is a promising method to support a learner to understand the relations between problems.

2. Implementation of Learning Environment for Problem-Changing Exercise

Figure 1 shows the interface of learning environment for problem-changing exercise. At first, a learner is given a problem and is required to solve it. The problem is described by configuration of physical objects and their attributes. The next task of the learner is, then, to make a new problem from the original problem by changing the configuration or attributes. After that, the learner is required to solve the new problem. The system shows both of the problems and their solution methods, like shown in Figure 1. The learner is promoted to compare them and reflect the problem-change and the differences in the two problems and their solutions.

Figure 2 shows examples of problem-changing operations in this environment. In the original problems shown in Figure 1, there is no outer force on the block without gravity. In Figure 2(a), "outer force" is selected from the list of physical parts and put on the right side of the block with drag&drop operation. This means that the block is received the outer force in the new problem. A part in the physical configuration can be deleted by dragging it in the picture and dropping it on the garbage. In Figure 2(b), an outer force is deleted in the physical configuration. By clicking the right button of the mouse on an object, a list of attributes that

the learner can set on the object is shown. In Figure 2(c), the learner chose friction as an attribute to change. The learner is allowed to change the attribute value in the small window. In this case, the value is zero in the original problem. By changing the new problem again, the learner continuously carries out the problem-changing exercise.

References

[1] Polya, G. (1957). How to solve it: A new aspect of mathematical method, Princeton University Press.
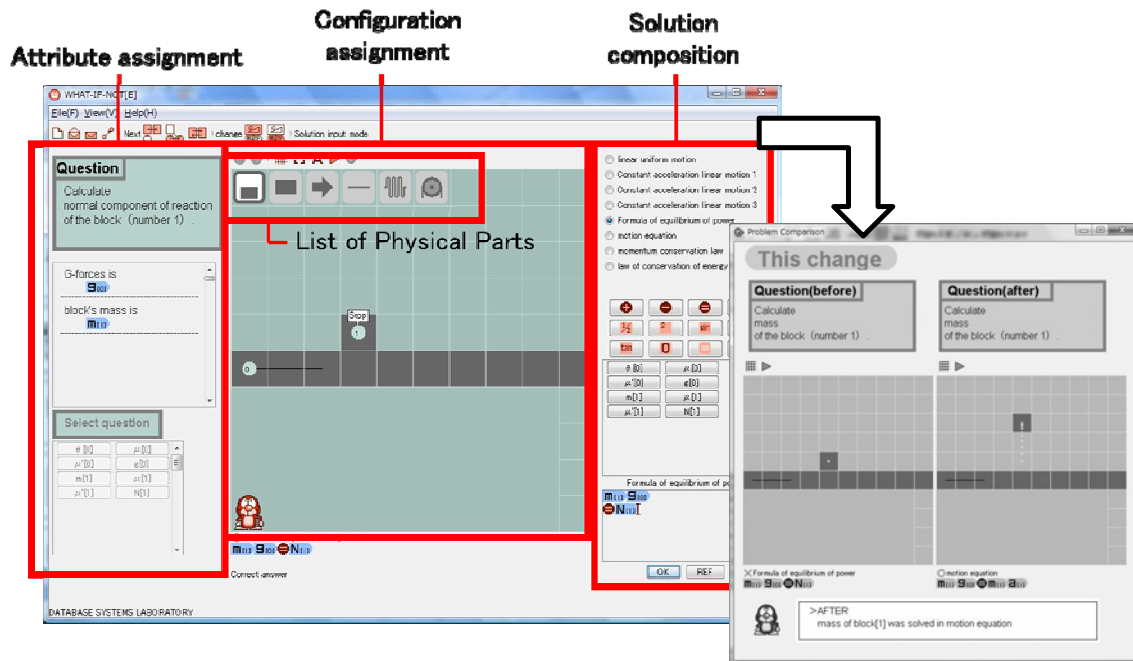[2] Brown, S.I., Walter, M.I. (1993). Problem posing: Reflections and applications. Lawrence Erlbaum Associates.

Figure 1. Interface of Learning Environment of Problem-Changing Exercise.

(a) **Addition of Physical Component.**

(b) **Deletion of Physical**

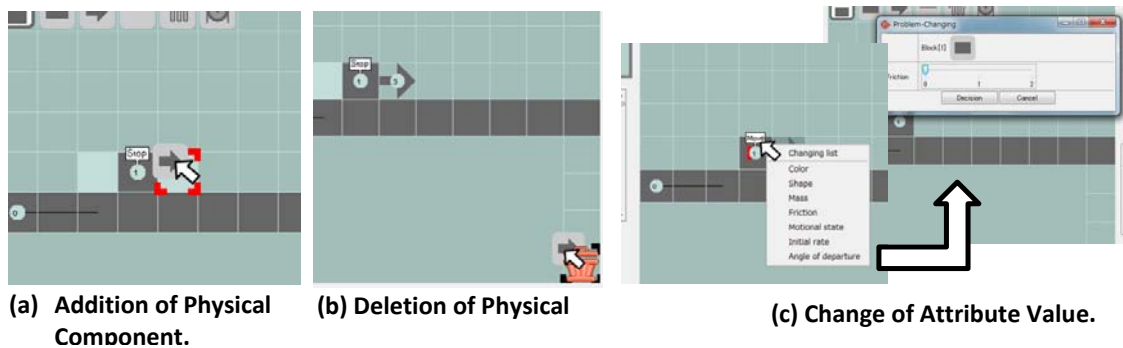(c) **Change of Attribute Value.**

Figure 2. Operations of Problem-Changing.

[3] Sho YAMAMOTO, Hiromi WAKI, Tsukasa HIRASHIMA: An Interactive Environment for Learning by Problem-Changing, Proc. of ICCE2010(accepted).