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# The Characteristic of Reward in Computer Assisted Learning

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**Abstract** Computer Assisted Learning (CAL) is quite different from in many aspects. CAL provides individualistic learning environment and facilitates autonomy of the learner. Thus the learners who uses CAL program has more sense of control and engages in more strategic learning than conventional learning environment. In this experiment, we used KORI (KORea university intelligent agent) which is a new type of ITS adopting TA (Teachable Agent) that fosters learning by teaching. So, we investigated the critical motivational factor that have influences in CAL learning and the effects of reward in CAL are another area of our interest. Thus, we divided two conditions that presence of reward and absence of reward. The 174 elementary school students(5th) were participated and they are randomly assigned the one of the reward conditions. Before entering the experimental instruction, all participants measured about metacognition, self-efficacy and goal orientation questionnaire as independent variables. Then, Participants were instructed of method of using KORI program and asked to study for ten days with KORI program at least 20 minutes everyday in their home, about 10 days. After 10 days, they were rated interest and comprehension. Regression results suggest that regardless of the presence of reward, metacognition is a positive predictor in interestingness. It indicate that metacognitive skills are required in CAL learning situation irrespective of reward. But on comprehension in the absence of reward, only self- efficacy appeared to be a positive predictor. In the presence of reward, performance goal orientation showed as a negative predictor of comprehension, whereas self-efficacy was a positive predictor. This result suggest that presence of reward especially interferes learning process of performance goal orientation in CAL learning situation. It could be interpreted that reward interferes the learning process of performance goal orientation by debilitating intrinsic motivation.

**Key words:** *CAL (Computer Assisted Learning), ITS (Intelligent Tutoring System), TA (Teachable Agent), Learning by Teaching, Metacognition, Self-efficacy Performance goal orientation*

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## 1. Introduction

CAL (Computer assisted Learning) is one of the learning tool utilizing computer and network technologies. Among the CAL, especially ITS is a powerful and effective tool in human learning (Chen, 2004). ITS makes new environment in learning situation, which is adaptive to each learner's level. Through ITS, learner can learn by doing, receive feedback and understand new knowledge adaptively (Barron et al., 1998). Most of the ITS have mainly focused on developing and enhancing cognitive aspect in learning. But, technologies of ITS has more complex aspect, it means that recent ITS has been focusing on reflecting individual differences with consideration of motivational factors. And the developed ITS would be an adaptive system to maximize the motivation to learn by providing appropriate information and affordance to each user.

In this experiment, we used KORI to investigate motivational factors which influence on learning process and outcome. Also we tried to examine the effects of reward under CAL learning situation. First of all, we should speculate the individual cognitive factors. And next this study examined the motivational factors needed in CAL learning situation. There are many methods and skills to enhance learners' motivation in learning situation. Recent theories of motivation such as self-efficacy and goal orientation are found to be a good predictor for learning behavior (Yi, 2003).

## 2. Individualization

### 2.1 Individual differences in cognition

**MetaCognition** Metacognition is often simply defined as thinking about thinking (Brown, 1987). Metacognition refers to higher order thinking that involves active control over the cognitive processes engaged in learning. Meta cognitive process is composed of planning, monitoring, strategy use, and evaluation. Metacognitive awareness is essential in individual learning, for making plan and keep tracking on the plan during learning (Perkins, Simmons & Tishman, 1989). Because metacognition is an essential factor in effective learning, it is important to measure meta cognitive ability in determining how students can be taught to better apply their cognitive resources through meta cognitive control (Livingstone, 1997).

And Metacognitive skill are important in CAL learning situation, because in CAL learning context, learner are required to engage in self-directed learning with self-regulation strategies.

### 2.2 Individual differences in motivation

**Self-efficacy** Self-efficacy is a student's evaluation on his or her ability to perform a given task (Bandura, 1997). Self-efficacy affects behavior, choice activity, effort, persistence and achievement of individual learner (Bandura, 1991). The higher self-efficacy the learner has, the better performance

and the higher learning motivation the learner shows. High self-efficacy learners prefer to engage in the challengeable task and persist at task even in the face of difficulty. Many researchers reported the relation of self-efficacy and leaning outcome (Pajares, 1996). CAL should provide more complex tasks and choice situation. Thus, highly self-efficacious learners might have more competence in learning process.

**Goal orientation** According to Dweck and Leggett (1988), learners can be divided into two types of goal orientation: mastery and performance goal orientation. Learners with a mastery goal orientation do not tend to be afraid of failure, and experience of failure does not hurt the learners' competence or self-efficacy. On the other hand, Learners with a performance goal orientation tend to demonstrate their self and concerns about social comparison with others. In addition they do not stay on the task if the task is difficult. Also they focus on extrinsic reward and grades they get from others. So, to make adaptive CAL learning situation, CAL program should provide appropriate feedback and avoid severe comparison.

### 2.3 Situational Interest

**Reward** Reward is one of the situational factor. Reward can be divided into two types: intrinsic and extrinsic reward. Depending on the intrinsic motivation level of the learners, reward has various aspects (Deci, Koestner and Ryan, 1999). Some researchers have reported the positive effects of rewards whereas others pointed out negative consequences of excessive rewards (Lepper, 1973). The discussion of effects of rewards are still controversial.

However, the rewards given in CAL learning environment could be different with those offered in traditional classroom environment.

## 3. Experiment

### 3.1 Method

#### 3.1.1 Subject

Participants were 174 of 5<sup>th</sup> grade of elementary school students (94 males and 80 females). They were randomly assigned to one of conditions (absence of reward vs. presence of reward).

#### 3.1.2 Task

In this experiment, the material was KORI (Korea University intelligent agent). KORI is the new type of TA (teachable agent) that is developed to enhance the user's motivation to learn and facilitate learning. TA is a kind of ITS, which is a computer based learning system. TA has a unique aspect, which is an interaction with agent through learning by teaching. While the user teaches TA, user learns the basic

knowledge or concept incidentally? through the interaction with interface tool. KORI's main contents are 'rock and rock cycle' in science subject for 5<sup>th</sup> graders in elementary school. They teach KORI while on a trip, collect rocks through final stage where they can make village with collected rocks. When the user has hard time to teach, they could refer to the resources by the KORI program, which contains information about 'rock and rock cycle'.

KORI consists of several independent stages: planning stage, teaching stage, confirming stage, comprehension of rock cycle stage and constructing the building stage.

In planning stage, the user makes the specific teaching plan for teaching KORI and selects the region from whole map of Korea. In teaching and confirming stage, learner teach KORI based on their prior knowledge and get help from rock expert who have the resources. In confirming stage the learner answers to KORI's question and confirmed the knowledge.

As the learner proceed to the next stage, the learner builds up more complex knowledge about 'rock and rock cycle' and use the knowledge in comprehension of rock cycle stage. Finally the learner constructs the building in constructing the building stage with using collected rocks.



Figure 1: The interface of confirming stage

What is noteworthy in KORI compare to previous TA is that it contains a narrative structure and various learning activities, which are designed to enhance the motivation to learn. Also, KORI has an adaptive interface system depending on learner's individual characteristics in order to motivate learner. KORI is expected not only to maximize the user's motivation and cognitive ability, but also to increase their self-efficacy and responsibility through various interactions and immediate feedbacks.

### 3.1.3 Procedure

Before the instruction, all participants rated their own self-efficacy, metacognition and goal orientation questionnaires. And participants were instructed of method of using KORI

program, and asked to study for ten days with KORI program at least 20 minutes everyday, to prepare science knowledge for next grade(6<sup>th</sup>). And then, according to condition, instructions are divided to two types. In presence of reward condition, instructor stressed that upper half of the participants in the class who has done a hard work will be given a reward with presenting the actual reward (stationery set for elementary school students). On the contrary, participants of absence of reward group, didn't received any information about the reward. Experiments were executed individually with participants' private desk top at participant's home. Participants installed the KORI program in their desk top at home, accessed the KORI program by themselves and studied 'rock cycle' with KORI program. After 10 days, all participants rated task-interestingness and comprehension on rock and rock cycle.

### 3.1.4 Measure

For individual measure as independent variables, self-efficacy, goal orientation and metacognition were measured. Self-efficacy measure (Kim and Park, 2003) was consisted of 10 statements, and they were adjusted for scale ( $\alpha = .87$ ) elementary school students. Goal orientation scale was modified form Park and Lee (2005) and meta cognition measure ( $\alpha = .89$ ) of 14 item (Pintrich & De Groot, 1990), transformed and validated to adaptable elementary school students. And dependent measure were interestingness and comprehension. Ratings of 14 items on the task-interestingness ( $\alpha = .90$ ), included items like the task enjoyment of task, fun, interest in task questionnaire. Comprehension measure ( $\alpha = .77$ ) was composed of 15 multiple choice and short answer type questions on 'the rock and rock cycle'.

## 4. Results

To investigate the effect of reward in CAL learning situation, regression was conducted on interestingness and the comprehension test scores were attained.

### 4.1 Absence of Reward

**Correlation.** First, we performed the correlation with all variables. There are some positive correlation between independent and dependent variables. It was metacognition, self-efficacy and learning goal orientation.

Table 1: Correlations in the absence of reward

	Meta cognition	Self-efficacy	Learning Goal orientation
Interestingness	.335(**)	.248(**)	.265(**)
Comprehension		.299(**)	.219(*)

\*p<.05, \*\*p<.01, N=124

	Beta	t	R <sup>2</sup>
constant		6.608***	
Interestingness	Metacognition F=15,446***	.335 3,930***	.112
Comprehension	Self-efficacy F=11,985***	.299 3,462***	.089

**Regression analysis.** Based of correlation result, we performed multiple regression analysis. Metacognition significantly explained 11% of the variance in interest ( $F(1,123) = 15,446, P<.001$ ). And Self-efficacy explained 8% of the variance in comprehension, ( $F(1,123) = 11,985, P<.001$ )(see table 3).

#### 4.2 Presence of Reward

**Correlation.** We performed the correlation matrix with all variables in same way. There are found positive correlation between independent and dependent variables. It was meta cognition and self-efficacy.

Table 2: Correlations in the presence of reward

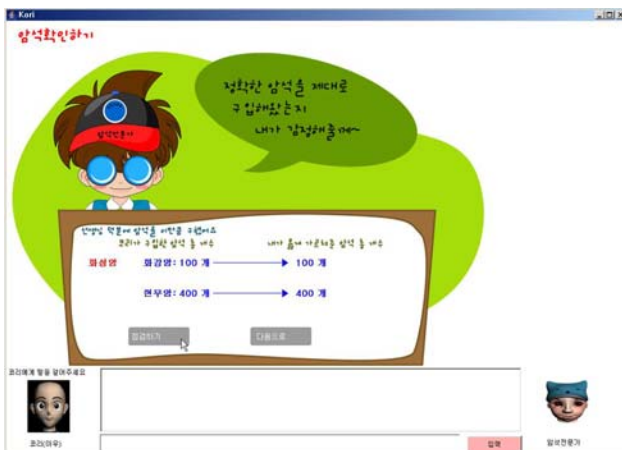
	Metacognition	Self-efficacy
Interestingness	.346(*)	
comprehension	.325(*)	.522(**)

\*p<.05, \*\*p<.01, N=50

**Regression analysis.** Based of correlation result, we performed multiple regression analysis. The interestingness , metacognition significantly explained 12% of the variance, ( $F(1, 49) = 6.547, P<.05$ ). And Self-efficacy significantly explained 27% of the variance, ( $F(2,49) = 12,941, P<.001$ ) and performance goal orientation negatively explained 35% (  $t = - 2.454, p<.05$ )(see table 4).

Figure 2: Interface of KORI  
(The confirmation of gathering rocks)

Table 3: The result of regression analysis in absence of reward



\* p<.05, \*\*p<.01, \*\*\*p<.001

Table 4: The result of regression analysis in presence of reward

	Beta	t	R <sup>2</sup>
constant		4,680***	
Interestingness	Metacognition F=6,547*	.346 2,559*	.120
Comprehension	Self-efficacy Performance goal orientation F=12,941***	.548 -2,454* -2,454*	.272 .355

\* p<.05, \*\*p<.01, \*\*\*p<.001

Participants plan whole learning process and often employ adaptable strategies according to previous learning process. And they evaluate their learning process by themselves. So, participants who present interestingness in KORI

program might have higher metacognitive skills. Along with KORI program constitutes of challengeable stage depends on participants knowledge levels, participants can take adaptable stage according to their levels. In the process participants experience interest in learning. Metacognitive knowledge and skills are developed after many challenging learning experiences (Ormrod, 1995). So, participants who showed interest than others, might have enjoyed the learning process of autonomy and situation controlled by themselves.

Second, in comprehension there are some different aspect in the results whether reward was given or not. In absence of reward condition, self- efficacy positively represented a significant factor. Self-efficacy is defined as people's beliefs about their capabilities to produce outcomes. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave (Bandura, 1997). also, self-efficacy is useful for predicting what problems and sub-problems a learner will select to solve , how long a learner will persist on a problem , how much overall effort they will expand , as well as motivational traits (McQuiggan & Lester,2006). Many researches reported that self efficacy has an effects on learning outcome. Researchers have been very successful in demonstrating that individuals' self-efficacy beliefs powerfully influence their attainments (Stajkovic and Luthans, 1998).

So, it is interpretive in CAL learning situation, the learners who has higher self- efficacy comprehend more thoroughly. But, in presence of reward, performance goal orientation was found to be a negative factor predicting comprehension while self-efficacy was found to be a positive significant factor. It means that the presence of reward affects learners' with performance goal orientation negatively in learning process. This result supports the previous

findings mentioning rewards have negative influences on performance oriented learners.

Performance goal orientation tends to demonstrate their worth and concern the social comparison with others (Dweck & Elliot, 1983). In particular, those who have performance goal orientation and low ability show learned helplessness and they try to avoid failure and challenging task and seek easy, simple tasks. And performance goal orientation have a tendency to concentrate on the extrinsic reward and feedback. Even though they access KORI program by themselves by a rule, deep learning doesn't occurred at that time, because they focused more on the extrinsic reward and feedback. So, they concentrated extrinsic factor rather than KORI program's contents, thus deteriorating the learning process.

Thus, In CAL leaning situation, learners who have performance goal orientation will not take learning seriously, because CAL learning usually occurs by individual without social comparison. Therefore, it is needed that optimal CAL learning environment should be provided to motivate individuals like the performance goal orientation.

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