

# The Effect of Contrived Success in Calculation Tasks on the Self-efficacy of Junior High School Students

Akitoshi Uchida, Kazuo Mori

**Abstract**—This study examines whether contrived success on a task closely related to school subjects would promote students' self-efficacy. In our previous study, junior high school students who experienced contrived success on anagram tasks raised their sense of self-efficacy and kept it high for a year. We tried to replicate that study, substituting calculation tasks for the anagrams. One hundred eighteen junior high school students participated in this study, 18 of whom were surreptitiously given easier tasks than their classmates. Those students with easier tasks outperformed their peers and thereby raised their sense of self-efficacy. However, elevated self-efficacy did not persist, falling to the starting level after only three months.

**Keywords**—self-efficacy, contrived success, junior high school students, calculation tasks

## I. INTRODUCTION

THE theory of self-efficacy has been very popular among educational and psychological researchers as well as practitioners, including schoolteachers. Bandura [1] claimed that the most important source of self-efficacy would be a success experience. However, only a few experimental examinations of self-efficacy have been conducted using junior high school students [2]. One of the few experimental studies conducted with that age group was Mori and Uchida [3]. In that study, Mori and Uchida presented easier anagram tasks to some target students in a junior high class and presented more difficult ones to others by utilizing a presentation manipulation (the fMORI technique [4]). The target students were chosen from the 26-50 percentile range according to a recent achievement test conducted in their school. The target students given easier anagrams scored much higher than their classmates, and their performance was recognized and praised afterwards in class. This successful experience, though actually contrived, raised the students' sense of self-efficacy significantly, and that elevated sense persisted as long as one year after their successful experience. Furthermore, it even showed the possibility of improvement in their academic achievement due to their boosted sense of self-efficacy, though the improvement was not found to be statistically significant.

Almost all schoolteachers wish to know how to promote the self-efficacy of their students, because they would expect it to eventually boost their scholastic performance, as Bandura hypothesized. The present study examined whether a successful experience with tasks more closely related to school subjects

would have a correspondingly stronger effect on the promotion of self-efficacy and the improvement of the scholastic performance of junior high school students. Therefore, we chose calculation tasks in place of the anagram tasks used in Mori and Uchida. Calculation tasks are regarded as one of the basic mathematics skills in junior high school.

## II. METHOD

### A. Participants

Three classes of seventh grade junior high school students (118 in total) participated in this study. In each class, six target students were selected from the 26-50 percentile academic range as assessed by an achievement examination they had taken recently. Thus, there were 18 target students in total (10 boys and 8 girls). We also selected 15 control students (8 boys and 7 girls) from the same academic range as the target students, ones who had corresponding achievement scores.

### B. Experimental Apparatus

We used the same experimental set-up as that used in Mori and Uchida. The experimenters projected the calculation tasks on a half-transparent screen made of a plain ground glass pane (80 cm x 80 cm) with an LCD projector (Epson ELP730) connected to a personal computer (Apple iBook). The students were all seated in front of the screen and facing it. Two different arrays were projected on the same screen concurrently, but the viewers could see only one of them depending on which type of polarizing sunglasses they were wearing. (See Mori [4], for details of the presentation trick).

### C. The Calculation Tasks

Thirty calculation tasks were prepared. Each task consisted of four numbers and a blank represented by a square in the middle of the array that would make 10 in total (e.g.,  $-8 \ 8 \ \square \ 3 \ 4$ ). The purpose of the task was to find the proper number to be inserted into the empty blank. Of these, twenty tasks were used as Common tasks (all students observed them in the same way). Ten tasks were devised as Dual-level tasks arranged with two levels of difficulty but with the same correct answers. For example, both  $-8 \ 8 \ \square \ 3 \ 4$  and  $-8 \ 6 \ \square \ 3 \ 6$  require "3" to be put into the blank to make 10. However, it is easier to calculate the answer from the former array because the first two numbers cancel each other out, leaving just two numbers and a blank, while for the latter array, it is necessary to calculate all four numbers to find the correct number for the blank. It should be noted that the correct answer (3) is the same for both arrays.

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#### D. Procedure

The same procedure was employed as in Mori and Uchida. The students were led by their class teacher to the experiment room, and seated in front of the half-transparent screen. Prior to that, the experimenters had placed a pair of polarizing sunglasses on each seat so that only the target students would wear the different type of sunglasses and no one would notice that they were indeed different from the others. There were two types of polarizing sunglasses identical in appearance to the ordinary eye. The students were told to wear the sunglasses to protect their eyes from glare. Once the students were seated and had donned the sunglasses, instructions were given and the tasks were presented on the screen. The students were instructed to write down the answers on an answer sheet. After completion of all the tasks, the experimenter announced the correct answers and the students marked their own answer sheets. After that, the experimenter asked those who had high scores to raise their hands, starting from the maximum score (30) and counting down to 20.

#### E. Self-efficacy Ratings

Before and right after the calculation tasks, the participants estimated their performance level on a 5-point scale in answer to the question "How well do you think you will do on the mathematics puzzle?" These self-estimation ratings were used as self-efficacy scores. Additional self-efficacy ratings were done two weeks later, one month later, and three months later to assess how well the students had maintained their sense of self-efficacy after the performance. All the self-efficacy ratings were done in an ordinary classroom.

#### F. Academic Achievement Assessment

Standardized scores (Z-scores) derived from mathematics achievement tests were used for routine academic achievement assessment. We obtained the students' Z-scores on mathematics tests from three different periods: two months before the experimental tasks, one month later, and three months later.

#### G. Debriefing

We disclosed the experimental goal and the trick used in the task presentation to the participants about one month later. This debriefing procedure was approved in advance by all the teachers, including the principal, of the school that the participating students attended.

### III. RESULTS

#### A. Effectiveness of the Experimental Manipulations

As expected, the target students with easier tasks outperformed the control group students, echoing the results obtained in the previous study [3]; the average correct answers being 25.57 and 19.93, respectively (see Fig.1). Most of the target students raised their hands in the public recognition phase, but four of them scored less than 20 and failed to be applauded by the class. Therefore, we removed them from subsequent analyses. We then compared the remaining 14 target

participants with 15 control students. The difference between the scores of the target and control subjects was statistically significant,  $F_{(1,27)} = 4.43, p < .05$ .

#### B. Self-efficacy Ratings

The target students' self-efficacy did not rise immediately after the successful experience, but rose considerably when measured after two weeks and again one month later. However, it declined to the same level as the pre-test just three months later. The overall results were similar to those of Mori and Uchida but the magnitude of self-efficacy promotion was smaller and lasted less long.

We conducted a 2 (experimental groups; target vs. control)  $\times$  5 (rating periods; pre-test, post-test, two weeks later, one month later, and three months later) mixed ANOVA on the self-efficacy rating scores. No main effects were significant, but the interaction was itself significant,  $F_{(4,108)} = 2.51, p < .05$ . Post hoc analyses of multiple comparisons using the Ryan method revealed that the self-efficacy of the target students rose significantly between the pre-test and two-weeks-later test (2.63 vs. 3.57,  $t_{(108)} = 3.62, p < .05$ ), and the pre-test and the one-month-later test (2.63 vs. 3.36,  $t_{(108)} = 2.78, p < .05$ ). (See Fig. 2.)

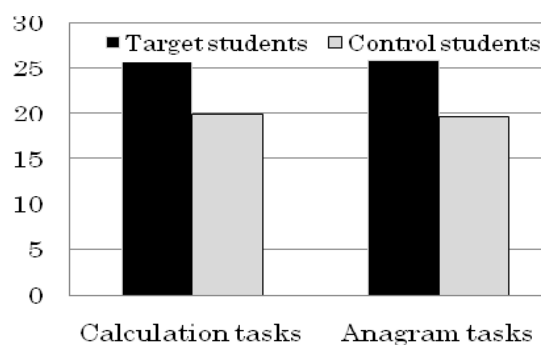


Fig. 1 Task scores of the present study (left) and those of the Mori and Uchida study [3] (right)

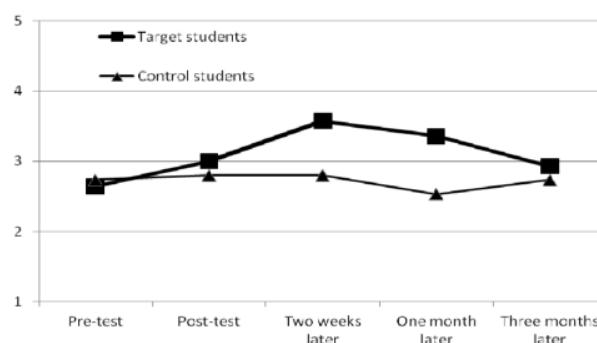


Fig. 2 Self-efficacy ratings of the two groups

### C. Academic Achievement

No remarkable improvement was found in the academic achievement of the target students. Nine out of 14 target students showed improvement one month later. However, it was not statistically significant. We conducted a 2 (groups: target vs. control)  $\times$  3 (periods: pre-test, one month later, and three months later) mixed ANOVA on Z-scores. Neither main effects nor interactions were significant.

## IV. DISCUSSION

Why did the successful experience on the calculation tasks have less effect than on the anagram tasks? We discuss two possible reasons here. Firstly, the self-efficacy estimation of the target students for the calculation tasks was relatively low before the contrived success experience. The other reason was related to their daily activities after their success on the experimental tasks.

### A. The Previous Self-efficacy Level

The target students were chosen from the 26-50 percentile level in mathematics as assessed in a recent examination. They had not been performing well in the mathematics classes before the present study. Therefore, they tended to have low self-efficacy estimations of their ability in mathematics. In the pre-test rating of their own self-efficacy, the average score was as low as 2.64 (3.0 being the neutral level) even though the tasks were unknown to them at that time. The target students who were given anagram tasks in the previous study rated their self-efficacy estimation to about the neutral level (3.0). It was presumably because the anagram tasks they were asked to solve were unfamiliar, causing them to estimate their ability in the neutral zone. We assume that it would be more difficult to raise one's estimation of one's own self-efficacy from a negative state than from a neutral position. Accordingly, that may have been one of the reasons why the target students in the present study showed less improvement in their self-efficacy.

Then, why would it be difficult to recover from a negative state? We think it must be related to the essence of one's feeling of self-efficacy, which is basically just a belief or perception. The target students scored high on the calculation tasks in the present study. It must have been an unusual and somewhat rare experience that would have seldom occurred in their ordinary school life. Therefore, they must have been surprised at their own extraordinary performance. It was highly plausible that they questioned how they could have done so well on the tests. We assume they must have attributed their success to mere luck rather than to their own ability. Thus, the successful experience did not raise their self-efficacy because they remained full of self-doubt. For those in the Mori and Uchida study, the successful performance could be attributed either to luck or to their own ability. Since the anagram tasks were unfamiliar to them, it was highly plausible that they might have attributed their unexpected success to their own previously unknown abilities. Therefore, it raised their sense of self-efficacy.

### B. The Effects of Daily Experiences After the Contrived Success

The target students experienced the unexpected success only once. Even so, it might have caused a boost in their self-efficacy in some ways. However, they probably encounter similar calculation tasks in their daily school lives quite frequently. We would assume they must have performed poorly in most of those cases. Consequently, their elevated self-efficacy would have become more in tune with their previous (normal) level sooner or later. On the other hand, the target students who scored high on the anagram tasks in Mori and Uchida might not have faced similar tasks in school because anagrams are not a part of any school subjects. Therefore, their self-efficacy might have remained high without having been adjusted downward to the reality level for as long as a year, or even longer afterward.

## V. CONCLUSIONS

Contrived success in a school related task showed a considerable effect on the promotion of self-efficacy of junior high school students. However, the effect was much smaller than when anagrams, which are not related to school subjects, were used. We originally hypothesized that success on tasks related to school subjects might have a strong positive impact on the improvement of scholastic achievement due to the mediating effect of a student's enhanced sense of self-efficacy. However, the results of the present study did not support our hypothesis and in fact implied the opposite. Perhaps if the success had been real rather than contrived, good performance on a school related task might have had a stronger effect of improving scholastic performance through promotion of self-efficacy. However, contrived success on a school related task tends to be attributed to mere luck and its effect may be diminished as a result of less-successful daily activities in school. Evidently improvement of scholastic performance can be attained long-term by means of elevated self-efficacy. Therefore, it would be appropriate to use tasks such as anagrams that are less closely related to actual school subjects to artificially promote the self-efficacy of students on the below-average levels.

## ACKNOWLEDGMENT

The authors are indebted to Ai Shimizu who conducted this experiment under the supervision of the second author while working at Shinshu University in Nagano, Japan. We express our thanks to the students of Shinonoi Nishi Junior High School who participated in the experiment, and the principal and teachers who kindly supported this study. We are also indebted to Rebecca Ann Marck for her help in editing the English manuscript. We appreciate their thoughtful comments from Steve Janssen of Flinders University and Emmanuel Manalo of Waseda University on an earlier draft of this paper. Correspondence should be addressed to kaz-mori@cc.tuat.ac.jp.

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