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Rudolph J. Eichenberger
Southern Arkansas University

CAN CREATIVITY BE TAUGHT IN THE PHYSICS LABORATORY?

Student ability to think creatively or in a divergent mode is important in engineering and physics to generate ideas which might lead to new designs, ways to solve problems, or in new products. Several tests and methods to evaluate creative thinking have been developed, such as the Torrance Tests of Creative Thinking (Verbal and Figural), Harris' A.C. tests of engineering creativity and the Judgment Criteria Instrument, which I validated in an earlier study to be used in an educational environment (Eichenberger, 1978). Torrance, Guilford and others identified the factors of fluency, flexibility, and originality as being associated with creativity (Torrance, 1979). Some researchers reported that creativity can not be learned (Carlsson and Smith, 1987) while others report that creativity can be improved through education techniques (Parnes, 1984).

I decided to investigate whether a student's creative ability could be improved through practice of doing divergent thinking in the physics laboratory of an introductory physics course. The sample size was small, consisting of 10 students in each of two laboratory sections. No selection process or matching was done. Students were in the Monday or Tuesday laboratory sections by natural schedule selection. One section, the experimental group, was given creativity stimulation, divergent thinking and questions at the end of the laboratory. The other section, the control group, was given convergent questions from the end of the laboratory book. After a six week period (six laboratory sessions), both groups were tested on one creativity question with motivation provided by bonus points on the midterm practical laboratory exam. The practice question types for the two sections were switched for the second half of the semester. The original control group was given the creativity practice questions and became the experimental group. The original experimental group became the control group getting the regular, convergent type physics questions. Both groups again were given a creativity question at the end of these six practice (laboratory) sessions. Motivation was again provided by bonus points toward grades. The midterm and final creativity test questions were scored by two scorers using the Judging Criteria Instrument. The averages of individuals for the groups were compared using coefficients of correlation between the pretest and post test scores of the participants in the experiment. The correlation coefficient was computed and the suggested t-test applied. The significance level was preset; alpha = 0.1. The t-test equation is:

$$t = (M1 - M2)/(S1\uparrow 2/N1 + S2\uparrow 2/N2 - 2R[S1/N1\uparrow .5][S2/N2\uparrow .5])\uparrow .5$$

Where M's are group means, $S\uparrow 2$ are variances, S are standard deviations and N's are number of students in the groups (Best, 1981).

There were no significant differences between the group which had practice on creativity questions and the group which had not. The practice of creativity with stimulation questions did not significantly increase the student's creativity (Table 1). The experimental section which practiced creative thinking between pretesting and post testing showed the most gain. This method may have possibilities for future research, particularly when used with larger sections with specific instruction in ways of divergent thinking.

Table 1. Correlation of creativity scores

Comparison	Mean X Value	Mean Y Value	Correlation Coefficient	T-Test	N	Critical Value
Pretest (X) - practice - Post test (Y) Experimental Group	49.1	57.5	0.158	1.212	9	1.39
Experimental (X) vs Control (Y); Post Test*	56.5	49.1	0.120	0.810	9	1.39

*Indicates that the sections were matched on the basis of achievement test averages in the lecture theory part of the course.

Two examples of the creativity of divergent questions which were used are: 1) find as many applications as possible for Newton's first law, 2) find as many applications of physics as possible to medicine. The investigator observed that these types of creativity practice questions appeared to reduce the number of usual student questions of "how is physics used in his/her area of study?" which also suggests an area for further research.

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RUDOLPH J. EICHENBERGER, Department of Physics, Southern Arkansas University, Magnolia, AR 71753.