Class Activity on Experimental Design

1. Chris wanted to test the effect of diet pills on how tall the tomato plants in his garden would grow. He took two pots, filled them with dirt from the same bag, and planted four tomato plants in each. He watered one planter with tap water, and he watered the other planter with tap water mixed with dissolved diet pills. The plants were in the same location to ensure they got the same amount of sunlight, and the water was measured so that each pot received the same amount of water. He measured their height at the end of each week for eight weeks, and averaged the height of the four plants in each pot. He then graphed the results to show how the diet pills affected the height of the plants.

   a) Write a hypothesis for this experiment

   *The effect of diet pills on growth of tomato plants.*

   b) State the experimental design principles stated in this experiment

   *Control*

   c) List the constants in this experiment.

   *Location, Amount of water for each pot, Number of tomato plants in each pot*

2. At one large university, a group of education specialists wanted to test the effectiveness of a newly designed academic improvement course. Students seeking academic help at the university counseling center were asked to participate in this 6-week program. Only students who were judged to have deficiencies in reading comprehension and other study-related skills were chosen for the program. That is, students whose academic problems were judged to be the result of emotional difficulties of one sort or another were not enrolled in the program but were counseled in a manner more appropriate to their problem. A group of 30 students completed the program at the counseling center. A review of grades and teachers' comments revealed that a large majority of the students were doing better in school after completing the program than before. The difference between preprogram and postprogram performance measures was statistically significant. Identify at least two major threats to the internal validity of this study as it has been described. That is, show why there are at least three plausible hypotheses for the obtained effect other than that based on the effectiveness of the academic improvement course

   *Lack of control group*

   *How reliable is the instrument used to identify the students with reading deficiency? If it has poor reliability, then we see regression to the mean (improvement is credited to the program when it is not)*

   *Impact of teachers and tutoring services on students’ performance is not included (lurking variables)*
One possible threat to the internal validity of this study is maturation. Because the study includes no comparison group there is no way to refute the possibility that these students might have improved as part of their own development as college students (independent of the special program). A second possible threat to internal validity in this study is regression. This threat may be particularly likely given that students were selected for their poor performance. If the instrument used to identify these students as having reading comprehension deficiencies was not perfectly reliable, then the students' apparent improvement may have reflected their regression toward the mean. Finally, history could have posed a threat to the internal validity of this study. Perhaps the professors or teaching assistants in the courses in which these students were enrolled gave them additional tutoring or instruction in study skills. This could easily have gone on while the students were enrolled in the special program. The absence of a comparison group again makes it impossible to tell whether the program or their experiences in their courses was responsible for their improvement.
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