

## The Nature of Science > Scientific Investigations

### Research on Student Learning

Upper elementary- and middle-school students may not understand experimentation as a method of testing ideas, but rather as a method of trying things out or producing a desired outcome. [1] With adequate instruction, it is possible to have middle school students understand that experimentation is guided by particular ideas and questions and that experiments are tests of ideas. [2] Whether it is possible for younger students to achieve this understanding needs further investigation. [3] When engaged in experimentation, students have difficulty interpreting covariation and noncovariation evidence. [4] For example, students tend to make a causal inference based on a single concurrence of antecedent and outcome or have difficulty understanding the distinction between a variable having no effect and a variable having an opposite effect. [5] Upper elementary-school students can reject a proposed experimental test where a factor whose effect is intuitively obvious is uncontrolled, at the level of "that's not fair". [6] "Fairness" develops as an intuitive principle as early as 7 to 8 years of age and provides a sound basis for understanding experimental design. This intuition does not, however, develop spontaneously into a clear, generally applicable procedure for planning experiments. [7] Although young children have a sense of what it means to run a fair test, they frequently cannot identify all of the important variables, and they are more likely to control those variables that they believe will affect the result. Accordingly, student familiarity with the topic of the given experiment influences the likelihood that they will control variables. [8] After specially designed instruction, students in 8th grade are able to call attention to inadequate data resulting from lack of controls. [9]

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