Designing Effective Projects: Using Knowledge
Experimental Inquiry and Investigation

Creating Knowledge

Experimental Inquiry is a special kind of problem solving that is governed by rules of process and evidence. Marzano (2000) describes experimental inquiry as a "process of generating and testing hypotheses for the purpose of understanding some physical or psychological phenomenon" (p. 57).

The most well-known type of experimental inquiry is the "scientific method," a way of answering questions about nature. There are six steps to the scientific method.

1. State a question or a problem.
2. Gather some information that is relevant to the problem.
3. Create a hypothesis that explains the problem.
4. Test the hypothesis by conducting an experiment or collecting more information.
5. Abandon or modify the hypothesis to fit with the results of the experiment.
6. If the hypothesis is found to be true or not true, "construct, support, or cast doubt on a scientific theory" (Shafersman, 1997).

Investigation is a way of using knowledge that is similar to experimental inquiry. It is "the process of generating and testing hypotheses about past, present, or future events" (Marzano, 2000, p. 47). The definitions of these two processes may sound like they describe the same kind of thinking, but there are significant differences.

Experimental Inquiry

Experimental inquiry is built on empirical evidence. This is evidence that can be examined through the senses. Theoretically, there should be no disagreement about what empirical evidence says because it is looks the same to everyone. The fact that the sun rises in the east is empirical evidence. People may disagree about why it rises in the east, but few would quibble with the fact that it does. The children measuring bean plants in the Unit Plan, The Great Bean Race, are collecting empirical evidence by measuring their bean plants. Scientific thinking requires that people figure out what kind of empirical evidence they need to prove or disprove their hypotheses.

A high-school psychology student may hypothesize that students who start school later in the day get better grades than those who start early. She can collect the empirical evidence of which students take early classes, which ones take late classes, and what their grades are. These are facts and no one could disagree with what she finds out. Like a student who measures a shadow at different times of the day, the numbers she finds are empirical evidence.

Now, of course, other things will need to be figured into experiments. Maybe in the high-school study, all the smart kids take early classes, or maybe just by coincidence this semester there happen to be a lot of good students who start school late in the day. Maybe the child measuring shadows is measuring them on a cloudy day where he can't really see the edges clearly or maybe the tool he's using to measure has blurry marks on it. All kinds of factors must be considered in experimental inquiry, and scientists and others who do this kind of inquiry know what the rules are. They know there is a right way to go about collecting and analyzing evidence. And that is what makes what they do officially experimental inquiry.

Investigations

In an investigation the students are not observing nature directly or collecting their own evidence. They are interviewing people, examining documents, and reading what others have said about a topic. Then they draw some conclusions based on what they have learned.

Just because they are not collecting original evidence does not mean that the quality of the evidence is not important to them. They need to be careful to use reliable sources and truthful information. What students have after performing this kind of process is not a scientific theory. Rather it is an argument.

For example, a sixth grader is investigating the Battle of Little Big Horn. He reads several accounts by Native Americans and by soldiers. He also reads biographies of General Custer and Sitting Bull. After he has collected all this information, he makes some conclusions about what happened there. His conclusions must follow the rules, not of the scientific method, but of good argumentation. His opinion about the Battle of Little Big Horn must be supported by credible evidence and follow the standards for good reasoning. The Showing Evidence Tool can help students form good arguments.

Both kinds of inquiry are important in the classroom, but some are more appropriate for different subject areas and different topics. For example, students do not have access to the kinds of equipment necessary for many types of scientific experiments, but they can devise experiments using the natural materials they find around them. On the other hand, many historical, social, and political topics can be understood best through investigation, bearing in mind that there are also rules about drawing conclusions in these areas, too.

References

Marzano, R. J. (2000). *Designing a new taxonomy of educational objectives.* Thousand Oaks, CA: Corwin Press.

Shafersman, B. (1997). *An introduction to science: Scientific thinking and the scientific method.* www.carleton.ca/~tpatters/teaching/climatechange/sciencemethod.html*

Programs of the Intel® Education Initiative are funded by the Intel Foundation and Intel Corporation.