

## Session 3

### Approaches to education

#### The Scientific Approach

- a process in which investigators move inductively from their observations to hypotheses and then

Deductively from the hypotheses to the logical implications of the hypotheses

- Investigators deduce the consequences that would follow if a hypothesized relationship is true
- if these deduced implications are compatible with the organized body of accepted knowledge; they are further tested by the gathering of empirical data
- on the basis of the evidence, the hypotheses are accepted or rejected
- the use of the hypothesis is a principal difference between the scientific approach and inductive reasoning
- one reasons what one would find if a hypothesis is true and then makes systematic observations in order to confirm or fail to confirm the hypothesis. (McComas, W. (Ed.). (1998).

The purpose of science education is no longer simply to train that tiny fraction of the population who will become the next generation of scientists. We need a more scientifically literate populace to address the global challenges that humanity now faces and that only science can explain and possibly mitigate, such as global warming, as well as to make wise decisions, informed by scientific understanding, about issues such as genetic modification. Moreover, the modern economy is largely based on science and technology, and for that economy to thrive and for individuals within it to be successful; we need technically literate citizens with complex problem-solving skills. In short, we now need to make science education effective and relevant for a large and necessarily more diverse fraction of the population. What do I mean by an effective education in science? I believe a successful science education transforms how students think, so that they can understand and use science like scientists do. But is this kind of transformation really possible for a large fraction of the total population? The hypothesis that I and others have advanced is that it is possible, but only if we approach the teaching of science like a science. That means applying to science teaching the practices that are essential components of scientific research and that explain why science has progressed at such a remarkable pace in the modern world. (Duschl, R. (2000).

The most important of these components are:

- Practices and conclusions based on objective data rather than—as is frequently the case in education—anecdote or tradition. This includes using the results of prior research, such as work on how people learn.
- Disseminating results in a scholarly manner and copying and building upon what works. Too often in education, particularly at the postsecondary level, everything is reinvented, often in a highly flawed form, every time a different instructor teaches a course. (I call this problem “reinventing the square wheel.”)
- Fully utilizing modern technology. Just as we are always looking for ways to use technology to advance scientific research, we need to do the same in education.

These three essential components of all experimental scientific research (and, not incidentally, of the scholarship of teaching and learning) can be equally valuable in science education. Applied to the teaching of science, they have the capability to dramatically improve both the effectiveness and the efficiency of our educational system. (Krajcik, J., & Merritt, J. (2012)

Educational research refers to a variety of methods,[1][2][3] in which individuals evaluate different aspects of education including: “student learning, teaching methods, teacher training, and classroom dynamics”. [4]

Educational researchers have come to the consensus that, educational research must be conducted in a rigorous and systematic way although what this implies is often debated. There are a variety of disciplines which are each present to some degree in educational research. These include psychology, sociology, anthropology, and philosophy. The overlap in disciplines creates a broad range from which methodology can be drawn. The findings of educational research also need to be interpreted within the context in which they were discovered as they may not be applicable in every time or place.

Educational research attempts to solve a problem.

Research involves gathering new data from primary or first-hand sources or using existing data for a new purpose.

Research is based upon observable experience or empirical evidence.

Research demands accurate observation and description.

Research generally employs carefully designed procedures and rigorous analysis.

Research emphasizes the development of generalizations, principles or theories that will help in understanding, prediction and/or control.

Research requires expertise—familiarity with the field; competence in methodology; technical skill in collecting and analyzing the data.

Research attempts to find an objective, unbiased solution to the problem and takes great pains to validate the procedures employed.

Research is a deliberate and unhurried activity which is directional but often refines the problem or questions as the research progresses.

Research is carefully recorded and reported to other persons interested in the problem.

#### Approaches[edit]

There are two main approaches in educational research. The first is a basic approach.[1] This approach is also referred to as an academic research approach.[2] The second approach is applied research [1] or a contract research approach.[2] Both of these approaches have different purposes which influence the nature of the respective research.

#### Basic approach[edit]

Basic, or academic research focuses on the search for truth [2] or the development of educational theory.[1] Researchers with this background “design studies that can test, refine, modify, or develop theories”. [1] Generally, these researchers are affiliated with an academic institution and are performing this research as part of their graduate or doctoral work.

#### Applied approach[edit]

The pursuit of information that can be directly applied to practice is aptly known as applied or contractual research.[1] Researchers in this field are trying to find solutions to existing educational problems. The approach is much more utilitarian as it strives to find information that will directly influence practice.[2] Applied researchers are commissioned by a sponsor and are responsible for addressing the needs presented by this employer.[2] The goal of this research is “to determine the applicability of educational theory and principles by testing hypotheses within specific settings”. [1]

#### Comparison of basic and applied research[edit]

The following are several defining characteristics that were written by Gary Anderson to compare basic (academic) and applied (contract) research.[2]

Basic (Academic) Research	Applied (Contract) Research
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- 1 Is sponsored by an agency committed to the general advancement of knowledge. Is sponsored by an agency with a vested interest in the results.
- 2 Results are the property of society and the research community. Results become the property of the sponsor.
- 3 Studies rely on the established reputations of the researchers and are totally under their control. Studies follow explicit terms of reference developed by the sponsor to serve the sponsor's needs.
- 4 Budget allocations are generally based on global proposals and accounting is left to the researchers. Budget accountability is directly related to the sponsor and relates to agreed terms of reference, time frames and methodologies.
- 5 The conduct of research is based on 'good faith' between funder and researcher. The work is contractual between sponsor and researcher.
- 6 The research produces findings and conclusions, but rarely recommendations except those related to further research needs. The research includes applied recommendations for action.
- 7 Academic research tends to extend an identifiable scholarly discipline. By its nature, contract research tends to be interdisciplinary.
- 8 Academic research is typically focused on a single set of testable hypotheses. Contract research frequently analyzes the consequences of alternative policy options.
- 9 Decision-rules relate to theoretically-based tests of statistical significance. Decision-rules relate to predetermined conventions and agreements between the sponsor and the researcher.
- 10 Research reports are targeted to other specialized researchers in the same field. Research reports are intended to be read and understood by lay persons.

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