OVERVIEW OF RESEARCH METHODS IN EDUCATION

STRENGTHS AND WEAKNESSES OF RESEARCH DESIGNS

There are many different methodologies that can be used to conduct educational research. The type of methodology selected by a researcher emanates directly from the research question that is being asked. In addition, some of the differing techniques for conducting educational research reflect different paradigms in scientific thought. In this entry, a review of the most commonly used methodologies is presented; in addition, the strengths and weaknesses of various methods are compared and contrasted.

OVERVIEW OF RESEARCH METHODS IN EDUCATION

Research methodologies can be classified in many different ways. For example, some researchers distinguish between quantitative and qualitative studies; others distinguish between experimental and non-experimental research; still others distinguish between research that is conducted in laboratories versus in the field (i.e., in classrooms). Obviously, there are many ways to categorize research methods. However, there also is much overlap in such categorizations. For example, a “non-experimental” study can be either quantitative or qualitative; an experimental study can include some qualitative components. This entry does not attempt to classify these methodologies; rather, the various methods are first briefly described and then compared and contrasted.

### Correlational Research

Correlational research involves quantitatively studying the relations between and among variables. One of the hallmarks of correlational research is that cause and effect relations cannot be determined.

Researchers who engage in correlational research do not manipulate variables; rather, they collect data on existing variables and examine relations between those variables. A number of different statistical techniques can be used to analyze correlational data. An example of a correlational research would be an examination of the statistical relations between middle school students' standardized examination scores in mathematics, and the students' demographic characteristics (e.g., gender, ethnicity, socioeconomic status, etc.).

### Experimental Research

In an experiment, participants are randomly assigned to one of several treatments. One of the most basic experimental designs involves random assignment to either an experimental group (which receives some kind of treatment), or a control group (which does not receive the treatment). If the differences in...
treatment between the experimental and the control group are tightly controlled, and if subsequent to the experiment there are measurable differences between the two groups that were not present before the experiment, then researchers often conclude that the experimental manipulation “caused” the differences to occur.

Many researchers and government agencies consider true experiments to represent the gold standard in research; however, it is extraordinarily difficult to conduct true experiments in actual educational settings (i.e., schools). The primary reason for this difficulty is the fact that students can rarely be randomly assigned to conditions or classrooms in school settings. It is also important to distinguish between small-scale experiments and larger-scale clinical trials. Small-scale experiments can occur in settings such as laboratories or classrooms, whereas larger-scale clinical trials often occur across many classrooms or schools.

An example of an experiment would be a study examining the effects of a video presentation on learning multiplication skills. Students in a classroom where all students are learning about multiplication could be randomly assigned to either watch a video that demonstrates multiplication skills, or to watch another video (i.e., a video about how to make ice cream sundaes); the students would probably be asked to view the videos in a highly controlled environment, where the experimental and control conditions could be as similar as possible (except for the video presentation). If on a post-test the students who watched the multiplication video outperformed the other students, then a researcher could conclude that the video “caused” the improved performance.

Quasi-Experimental Research. In quasi-experimental studies, researchers do not randomly assign participants to groups (Cook & Campbell, 1979). Quasi-experimentation is used often in educational research, because it is often impossible and sometimes unethical to randomly assign students to settings.

In quasi-experimental studies, researchers attempt to control for differences between non-randomly assigned groups in a number of ways. Two of the most common methods include (a) matching, and (b) statistical control. The following example explains the concept. A researcher is interested in comparing the effects of a traditional third-grade reading curriculum with the effects of an enhanced version of the curriculum that includes extra homework assignments. If the two versions of the curricula are being administered in different classrooms, the researcher can try to “match” similar classrooms on certain variables. For example, the researcher might decide to match classrooms on years of experience of the teacher, wherein teachers with much experience (e.g., 20 or more years of teaching experience) might be paired, so that for each pair of highly experienced teachers, one is assigned to each condition.

In addition, the researcher can statistically control for variables that are related to the outcome. If the researcher knows that variables such as socioeconomic status and prior reading ability are related to reading achievement, then the researcher can statistically control for these variables, in order to better assess the unique effects of the new curriculum.

Qualitative Research. Qualitative research represents a broad framework for conducting educational studies. Whereas quantitative research focuses on measurable variations between and among variables, qualitative studies focus on holistic descriptions of learners and teachers in naturalistic settings.

Fraenkel and Wallen (1996) describe five general characteristics of qualitative research studies. These include:

1. Researchers collect their data in naturalistic settings (e.g., classrooms), by observing and participating in regular activities.
2. Data are collected via words or pictures (not via numerical or quantifiable indicators).
3. Processes (i.e., how individuals communicate with each other about a lesson) are as important as products (i.e., whether or not students obtain the correct answers to a problem).
4. Most qualitative researchers do not start out with specific hypotheses; rather, they use inductive methods to generate conclusions regarding their observations.
5. Qualitative researchers care about participants' perceptions; investigators are likely to question participants in depth about their beliefs, attitudes, and thought processes.
A variety of methods can be used to conduct qualitative studies. For example, qualitative researchers can collect their data from direct observations, from analyses of video or audio recordings, from interviews, or from long-term ethnographic studies.

There are a variety of different ways of analyzing qualitative data. Generally, researchers carefully examine their data and discover themes that emerge from the data. Sometimes several researchers will analyze the same sources of data and then compare their conclusions and examine the extent to which they agree or disagree (inter-rater reliability); in other studies, one researcher will conduct all of the analyses, and will also critically examine how his or her own biases may affect interpretations. Software packages have been developed to assist qualitative researchers with data analysis. Two of the most commonly used packages are Envivo and NUDIST.

**Longitudinal and Cross-sectional Research.** Many research studies in education focus on developmental issues (i.e., how individuals change over time). For example, it is known that the reading strategies that young children use are different from the reading strategies adopted by older children (Pressley & Harris, 2006). There are several different methods that can be used to examine such developmental phenomena.

In a **longitudinal** study, researchers collect data on the same individuals over a number of different time periods or “waves.” Thus the same group of students might complete study assessments at the end of first grade, second grade, third grade, and fourth grade. Researchers can then examine changes in student data across those four years.

In a **cross-sectional** study, researchers collect data on individuals of differing ages or developmental levels, at the same time. Thus data are collected for many students, at one time interval only. For example, a researcher might give assessments to 200 first graders, 200 second graders, 200 third graders, and 200 fourth graders all at the same time. Then the researcher can compare the results of students in these four different grades and try to draw some conclusions about developmental differences.

Most researchers agree that when possible, longitudinal studies provide better developmental data than cross-sectional studies. The primary advantage of longitudinal studies is that the same individuals are assessed at different time points; therefore, it is easier to make inferences about true development over time, since the distinct data points represent the same individuals across different time periods. However, longitudinal research is often difficult to conduct, because it is very expensive, and it is often difficult to track individuals over time; many of the students who participate in the first wave of data collection may have moved or may not want to participate in later waves of the study.

**Design Experiments.** When researchers conduct design experiments, they examine the effects of educational interventions in actual classrooms while the interventions are being implemented. As results are obtained and analyzed, the intervention is changed and continuously re-evaluated (Brown, 1992).

Cobb, Confrey, diSessa, Lehrer, and Schauble (2003) identified five overarching features of design experiments:

1. **The purpose of design experiments is to develop theories about learning (including how learning is supported).**
2. Design experiments involve an intervention, or the introduction of a new instructional technique.
3. In design experiments, researchers attempt to develop new theoretical perspectives, but also must test and refine their theories along the way.
4. Design experiments have iterative designs; as theories change during the study, the design of the study must be revised and altered accordingly.
5. The theories that are developed in design experiments should affect future instruction.

An example of a design experiment might be a study of a new curriculum designed to teach adolescents about HIV and pregnancy prevention. The curriculum might be introduced into the classroom setting; then, after initial presentation of the first few units, the researchers might collect data and then make some alterations to the next units, based on those data. This process can continue until the curriculum is substantially improved.
It is important to note that in design experiments, the changes in instruction that occur across iterations are often confounded with greater teacher familiarity with the approach as a whole. This can be problematic, because it hinders researchers’ abilities to make causal inferences.

**Microgenetic Research.** In microgenetic research studies, the same individual is observed intensively over a long period of time; this could be for many weeks or even months. Data are collected in order to examine both large-scale and small-scale changes in learners’ use of strategies over time (Kuhn, 1995). Data can be analyzed via either quantitative or qualitative methods, depending on the types of data that are collected.

As noted by Chinn (2006), most educational research using a microgenetic approach has examined learners' usage of cognitive strategies (e.g., problem solving). Micro-genetic studies are time consuming and be expensive, but they also can provide researchers with rich and detailed information concerning cognitive processes in learners. An example of a microgenetic study would be an examination of a kindergartener’s strategy usage in solving simple addition problems over a three-month period.

**Single-Subject Research.** In a single-subject study, there is only one participant. Researchers generally examine a variable at a baseline stage (prior to the start of an intervention), and then later examine how this variable changes at different time intervals, as an intervention is introduced. In single-subject research, control or comparison groups are not used. Researchers are particularly interested in whether or not patterns replicate over time within the same subject; in addition, researchers also examine whether or not similar patterns can be generated in new subjects.

Single-subject studies are particularly common in the special education literature, although this methodology can be used in other areas of educational research as well. An example of a single-subject study would be an examination of the effect of classical music on the ability of a learning-disabled child to solve single-digit addition problems. First, the child's baseline addition skills would be assessed; then, the student's skills in the presence of music would be measured. The music might then be alternately started and stopped several times, while the student's problem-solving skills are continuously assessed.

**Action Research.** Action research is research that is conducted by classroom teachers, examining their own practices. The goal of action research is to examine one’s practices critically and then to make changes to those practices based on the results of the research. Action research can be conducted by a single teacher, or by a group of educators working together.

Ferrance (2000) summarizes five steps in action research. These include:

1. Identify the problem or question that is going to be investigated.
2. Gather data to help answer the driving question. Data can be collected in many forms (e.g., interviews with students, surveys, journals, video or audio tapes, samples of student work, etc.).
3. Interpret the data by critically examining all data sources, and identifying major themes.
4. Evaluate results; in particular, examine whether or not the research question has been answered.
5. Take next steps—develop additional research questions, or make changes to instructional methods.

Action research can improve instruction for students; in addition, it can empower teachers, since it is a tool that allows them to judge their own efforts and evaluate the outcomes of their practices.

**STRENGTHS AND WEAKENESSES OF RESEARCH DESIGNS**

Each of the aforementioned research designs has both strengths and weaknesses. Some of these differences are obvious but others are not. Table 1 presents some examples of the key strengths and weaknesses of the various research methodologies discussed in this entry. This is not an exhaustive list; rather, it is provided to demonstrate that each methodology is complex and has both pros and cons.

When researchers and consumers of research evaluate the strengths and weaknesses of various designs, there are many issues to consider. Specifically, there are several key questions that can serve as a framework for
evaluating research designs. The main questions are discussed below.

**The Research Question.** The research question is by far the most important question to consider when selecting and evaluating a research design. In all educational studies, the major research question should be articulated before the methodology is selected; the appropriate methodology should then be chosen based on that question. Most social scientists agree that a preferred methodology should not be used as a framework to guide research.

For example, a large school district might want to know if high school students' foreign language pronunciation is better after two years of studying Spanish or two years of studying French. The research question might be: What is the relation between studying French versus studying Spanish, and foreign language pronunciation after two years of study?

The researcher then must decide which research design is the most appropriate to answer the specific research question. In this example, the researcher can easily eliminate several options. For example, an experiment would be impossible, since students cannot be randomly assigned to Spanish or French classes. In addition, the researcher might decide that qualitative and microgenetic studies are inappropriate, since the researcher is not interested in the processes or developmental trends that occur over time. There are several other questions that the researcher must also address that will help to finalize the decision.

**The Sample Being Studied.** Researchers must consider the nature of their samples when selecting a methodology. This is an important question because some methodologies are challenging to implement with certain populations.

For example, most studies that use survey-based methodologies require the participants to be able to read the survey items. If the sample included young children, or individuals with impaired visual abilities, then this might preclude the use of a self-administered survey. In addition, if the researcher is studying a large sample, with more than 1000 participants, in many cases this would prohibit the investigator from implementing single-subject designs, since the sample is so large.

**Resources Available to Do the Research.** Many resources are needed to complete research studies. Novice researchers often do not realize the cost involved with educational studies. A college student doing a small study for a research methods course will certainly not have the same resources available as an experienced investigator with a multimillion dollar grant.

Resources involve more than money. Another important consideration is personnel. Some research methodologies require more personnel than others. For example, a microgenetic study might be carried out by one investigator who can focus on the progress of a few subjects. In contrast, a large experimental study that requires collection of large amounts of data from many participants will require many more personnel. Thus if fewer resources are available, a researcher might not be able to use the ideal methodology to conduct a study.

Time is another important resource that often affects the type of methodology that is chosen for a particular study. A design experiment that involves continuous evaluation of progress and setting of goals might be ideal if a researcher has enough time to devote to a long-term study. Some studies (e.g., longitudinal studies) take a long time to complete. Thus a researcher who is interested in examining developmental issues, but who does not have a lot of time and funding, might select a cross-sectional methodology instead.

**The Intended Audience for the Research.** Different audiences will benefit from different kinds of research studies. If the audience is practitioners, then action research might be highly appropriate. First, teachers can be directly involved in action research studies; second, other educators might be more willing to accept the results obtained from one of their peers via action research than from unknown researchers.

Certain funding agencies might be interested in only funding some types of studies. For example, there is much debate among educational researchers about the advantages and disadvantages of using experimental designs in educational research; whereas many funding agencies encourage experimental studies, many educational
researchers argue that sometimes, true experiments are difficult to implement in actual classroom settings.

**Using Mixed Methods.** Many educational issues are multifaceted and complex; consequently, often one single methodology will not yield all of the essential information that researchers desire. Given the strengths and weaknesses of the various designs, and the many decisions that researchers must make before choosing a methodology, a number of scholars in recent years have begun to use mixed methods in educational research. When researchers use mixed methods, they use a variety of different methodologies within the same study.

A mixed methods study is usually challenging; the researchers must be able to utilize multiple designs appropriately. Some mixed methods studies involve two or more methodologies being carried out simultaneously, whereas others involve a succession of different studies, all designed to answer one general research question.

An example is a study conducted by Turner and her colleagues (Turner et al., 2002). In that study, the researchers were interested in examining the relations between early adolescents’ perceptions of the classroom environment and the students’ use of avoidance strategies (e.g., avoidance of asking for help from the teacher) in math classrooms. The researchers realized that the use of multiple methods would help them to best answer their research question. Therefore, they conducted a study in which longitudinal survey data were collected from a sample of more than 1,000 students. The researchers also randomly selected nine classrooms in which they conducted observations. The final analysis of data included quantitative results from the surveys as well as qualitative results from detailed discourse analyses from the classrooms. Each source of data provided different types of information, which allowed the researchers to examine a variety of indicators of the use of avoidance strategies by students. The quantitative survey data allowed the researchers to examine the relations of both student characteristics (e.g., gender) and students’ perceptions of classroom environments to the use of avoidance strategies; the observational data allowed the researchers to examine the discourse patterns in classrooms with different types of learning environments.

In summary, research methodology is a complex topic. This entry has described some of the most basic issues in the research enterprise, some of the methods that educational researchers use in their work, and some of the complexities involved in deciding upon an appropriate methodology. Ultimately, the methodology that is chosen will be determined by the specific research question and by the resources that are available.

Most research studies have limitations, which often are related to the design of the study. Research can always be improved, and it is important for scholars engaged in educational research critically to evaluate their designs and to acknowledge the limitations of their studies. As new researchers replicate previous studies, they often will attempt to eliminate the design problems encountered by previous researchers. This is one of the most important ways in which educational researchers can continue to improve and enhance knowledge about teaching and learning.

**BIBLIOGRAPHY**


Copyright 2003-2009 The Gale Group, Inc. All rights reserved.