While some of this material might be challenging to you, we suspect that other parts will be quite familiar and straightforward. We have chosen to err on the side of caution, to try to ensure that we are as clear as possible and that all of us are able to move forward together. We know that you are very intelligent and that you know a great deal about education and even educational research, but all of us are prone at times to gaps in our knowledge and understanding.

We invite you to move forward in the exciting process of developing your skills toward becoming a research critic.

**Educational Research is built upon an ongoing and evolving foundation of research articles.** While there are books and monographs in our field, the majority of research is reported in article form. In fact, JSTOR lists some 477 journals devoted to the publishing of original research studies in education. Therefore, it makes perfectly good sense to master the basics of research articles in our attempt to become research literate in this field.

Before we look at articles themselves, however, we need to step back and take a look at the basic foundations of educational research itself.

**Basics of Educational Research**

Education is one of the most fundamental things that human beings do. In order for us to survive, from the most personal level to the most global level, we need to be able to teach
Schooling consists of formal systems of teaching and learning, usually occurring within some specialized setting and employing specialized methods. The default model of schooling is a classroom, staffed by a teacher using a curriculum to guide instruction, with some form of ongoing assessment of student learning. From these default conditions we can lay out some of the key questions that drive educational research:

- What are the most important things for students to learn?
- What are students like, and how can we use this knowledge to improve the ways we teach them?
- How can we improve the learning process?
- How can we help teachers teach better?

In order to get at these and other important questions, we need to improve our understanding of the nature and application of research. That is, we need to become more research literate. To this end, we will take a brief look at the basics of quantitative literacy, statistical literacy, and qualitative literacy in turn.

**The Quantitative Approach**

When we talk about quantitative research, we are talking about research that follows the principles of the scientific method. There are many different formulations of the scientific method, but most of them share the following common principles:

- We make careful observations
- We make predictions from those observations
- We test those predictions
- We use our findings to support or modify our predictions

quantitative approach. These other aspects allow us to see how the scientific method is crafted into a process that strives to examine the basic nature of the educational process. Toward this task, there are three directions, or guidelines, that are particularly important when putting together quantitative research in the field of education.

First of all, there is an emphasis on the typical. That is, when we do quantitative research, we are most often interested in how the typical student, for example, learns a typical lesson in a typical situation from a typical teacher. This is important because, if we understand the typical, we can then understand how most educational situations unfold. Once we have the basic framework, then all we need to do is fill in the particular details. Even if we find ourselves with an unusual situation, we can still compare that situation to what is typical.

Here are some examples of the sorts of typical things that we might look at in educational research:

- How many hours of homework the average high school student does each evening
- The number of hours of sleep these students get every evening and how it affects their grades
- The amount of grade point average improvement we tend to find when we do some kind of intervention with students

Secondly, we are looking for things that are regular and repeatable. We cannot make any predictions or create rules or laws from one-of-a-kind events. Ideally, not only are these sorts of things predictable but they are also controllable to some degree.

Here are some of the regular things we might look at within a program of educational research:
Furthermore, here are some things that are both regular and controllable:

- Amount of time available to do homework
- Amount of nutrition both before and during school hours
- Specific instructions for doing learning tasks

Finally, our research must be public. We make our research public by reporting not only our findings but also the procedures we used to get them. These procedures include the exact research questions we asked, as well as a detailed account of the methods we used to answer those questions. These procedures should be reported in a clear and complete fashion, so that if someone wanted to repeat our exact study, they have enough information to do so.

Before we leave our discussion of the quantitative approach, we need to say a few words about variables. Anything that we can assign a value to is a measurement. For instance, we can measure height, weight, intelligence, and so on. Furthermore, there are two basic types of measurements—constants and variables. Constants are just what they sound like—measurements that do not change. It is rare in educational research to measure constants, usually because most of the important constants have already been identified and accounted for.

Variables are another matter. Variables are measurements that can change, either within people or across people. For instance, we can get older or taller or heavier or smarter. Measurements across people give us pictures of how a given group of people might vary on this kind of measurement. Both are important in educational research.

There is another important distinction to make when talking about the use of variables in educational research. That is the distinction between an independent variable and a dependent variable.

The logic is most often like this: if I do this, then what?

kinds of food for breakfast (this is our independent variable) and then we look at how each group of kids performs on a math quiz (dependent variable).

Measuring variables is necessary for nearly all forms of quantitative research. Comparing variables is also extremely common. Manipulating independent variables and then seeing the impact on dependent variables is at the very heart of doing experiments.

The Nature of Statistics

Just about every quantitative article in education makes use of statistics, to one degree or another. We will not talk about actual statistical tests and techniques just yet, but we will save that discussion for how they are used to answer research questions (in the Results and Findings chapters). For now, we will look at a few of the basic concepts of statistics that are useful to keep in mind when we see statistical results.

Why are statistics so important for quantitative research? There are a number of key reasons:

- Statistics is a useful tool to use to describe our data
- Statistics is a useful tool to use to test our data
- Statistics is a powerful tool to use to model the nature and operation of the empirical world

Let us consider each of these key insights in turn.

Descriptive Statistics

The simplest use of statistics is to gather data and organize them in a meaningful way. When we do this, we are creating distributions.

A distribution is an assembly of related measurements
measurable characteristics (like shoe size, arm length, and so on) and abilities (like a hundred-meter dash speed, IQ, recall ability from memory, and so on).

By themselves, our individual measures may or may not be that interesting. But if we combine our measures with other people who are similar to us in some clear and objective way (for instance, same age, same income level, same profession, and so on) we can begin to form a group picture that sheds more light on what we might expect from the average or typical person in our group.

In addition, these descriptive pictures tend to be more balanced and stable than any individual measure. Some of the more typical descriptive statistical concepts, such as the mean, median, mode, range, and standard deviation will be discussed in some detail when we look at quantitative results and findings.

We need to make one last point about distributions. There are any number of different distributions that have been identified and studied, such as the Poisson distribution or the F distribution or the t distribution, among others. But unless the researchers say otherwise, their variables will fall into a normal distribution (or, as is commonly stated, they will be normally distributed). This is because almost all naturally occurring variables, including the ones discussed above, are normally distributed. There are deep and important theoretical and methodological reasons for this fact, but they are beyond our scope of discussion here.

**Inferential Statistics**

The second primary function of statistics is to help us make decisions. To do this, we often make use of inferential statistics. This makes sense, since the term “inferential” is based on the notion of inference, or using reasoning skills to put together a decision based on available information. In inferential statistics, we are trying to decide whether two or more things are different from each other, or whether they are just different-looking cases of the same thing. This is most clearly illustrated when we look at some of the areas where we are seeking these kinds of “yes/no” decisions.

**Inferences and Frequencies** The first area deals with frequencies. When we compare frequencies of occurrence across two or more conditions, we try to decide if these frequencies are essentially the same for each condition. Because of the natural vagaries and whims of everyday life, we would not expect these frequencies to be identical. But, at some point, we decide that the differences are too great to be incidental. For instance, we might expect roughly the same number of men and women in the US Senate (there are one hundred senators, so this makes the math easier). In this case, our expected frequencies are 50 percent of each. If the actual frequencies were, say, 55 percent men and 45 percent women we would not think that is too far from our expectations. As we get to 60 percent men and 40 percent women we are less sure, but we are still willing to concede to chance. Currently, the frequency is about 80 percent men and 20 percent women. While this is far better than the not-so-distant past, where the figures were 98 percent men and 2 percent women, nonetheless we would not expect these numbers by chance alone (measured by a technique we call Chi-square analysis).

**Inferences and Relationships** The second kind of “yes/no” inference deals with deciding whether a given relationship is greater than we might expect by chance. When we are typically looking at variables that we can only measure but cannot control, we often correlate them (note that the term correlation has the concept of co-relation built into it). For instance, we can measure outside temperature in our hometown (which we call “X”) and measure the daily temperature...
If there were actually no relation between these two variables, then we would expect them to go their merry ways, so to speak. But suppose we find that, in general, as the outside temperature rises the number of pints of ice cream sold increases. We would not expect a perfect correlation here, since folks often buy ice cream in the winter and abstain at times in the summer for reasons having nothing to do with the temperature outside. But we can use inferential statistical tools (in this case, a correlation coefficient) to determine that the joint rise and fall of these two variables is most likely not just a matter of chance.

Inferences and Hypotheses Our final inferential situation deals with deciding if common variables between two or more conditions act like one another, or whether at least one of those conditions seems to be acting differently. The simplest case of this involves a treatment and a control group. We do something different to the treatment group, and look to see if it has any impact on the target variable. That is, does the treatment group look different from the control group? For instance, suppose we divide a bunch of kids into two groups. We teach the first group how to make and read a simple code. The second group reads comic books just to keep them occupied. Then we give each kid a coded message and measure how long it takes each kid to solve the code. Of course we would expect some variability. Some kids like solving codes, or may be naturally better at it. But if we looked at each group and compared their times (using, in this case, a technique called the independent t-test) and found the code training group was overall faster at a level that would be hard to explain just by chance, then we have validated to some degree our code training methods.

Inferences and Probabilities In all of our inferential work we will be looking for

Remember that we said that all inferences are “yes/no” inferences. In actuality, they are “probably yes/probably no” inferences. That is, we can never say with complete certainty that, say, a treatment group is different from a control group. That is because, when you are dealing with sampling, you cannot ever rule out the possibility that your results are due to a strange and highly unlikely sample.

A simple example should make this point clear. Suppose you tossed a coin and got twenty heads in a row. The odds of getting twenty heads in a row are 1,049,000 to 1. Does this mean your coin is unbalanced and will always land heads, or does it mean you have happened onto a really rare, but theoretically possible, sample? You solve this problem by putting some expectations on the probabilities you are willing to live with. In most studies, researchers are willing to live with circumstances where the possibility of a random rare sample occurring is either 20 to 1 or 100 to 1. In either case, the researchers are setting a critical value. At or below that value, you have a rare naturally occurring sample. Above that value, you are looking at two different populations. When you can claim that you are looking at two different populations, then your findings are significant.

In the case of the twenty heads in a row, you can say that this finding is significantly different from chance. This does not tell you why the findings are significantly different from chance, just that they are. Hopefully, you have thought out a reason ahead of time why this difference should exist.

When reporting significance, researchers indicate this by asterisking the computed value, and linking it to the pre-selected probability level. For a finding that is significant at the 20 to 1 level, it might look like this:

13.67∗ *(p<.05), which means probability less than 5 percent
There is one final probability concept that we need to address concerning inferences. This deals with the fact that the likelihood of an inference is sensitive to the number of measurements we have amassed. Here is a simplified example. Suppose we measure the IQ of two people and get an average IQ of one hundred. How confident are we that this average is correct? Now suppose we measure the IQ of a million people and get an average of one hundred. We are much more confident that our sample of a million people is more representative of the population as a whole than our sample of two people (even though, coincidentally, we got the same estimate of the population from each sample). All of this goes to prove that at least in some settings, the size of our samples matters.

The most common method for incorporating sample sizes into our inferences is by the use of **degree of freedom**. A degree of freedom is a measure of the impact of the sample size on the likelihood of our inference. If our sample size consists of N cases, then most of the time the degree of freedom is (N-1). Researchers report degrees of freedom to let the readers know the size of the samples used to make inferences, and these sample sizes are used to adjust critical values. As a rule of thumb, the smaller the sample the larger the critical value has to be in order for the results to be significant at the selected probability level.

**Statistical Modeling**

The final, and in some ways most interesting, property of statistics is its ability to model many of the key aspects of the world of experience itself. There is both an immediate and a far-reaching side to statistical modeling.

At the immediate level, we see that improved theoretical and especially improved computational capabilities (fostered almost entirely by the growth and advancement of computers) have enhanced our ability to look inside science at just one or two variables at a time. These modeling tools include such processes as multiple regressions, path analyses, cohort analyses, structural equation modeling, and many more. They all share the ability to work with a large number of variables at the same time in order to improve either our theoretical understanding, our predictive abilities, or most often both of these.

At the far end of statistical modeling, where we take a broader philosophical view of statistics and its role in describing the nature of the world, we come face-to-face with three profound insights about the interaction of research and reality.

First of all, there is the realization that human dynamics are so rich and complex that mere causal claims cannot do justice to (or completely capture) the crucial interactions we deal with in everyday life. For instance, there was once a belief that poverty caused crime. While it seems to be true that there are more reported and obvious crimes in poor neighborhoods, the picture is actually far more complicated. Many people in poverty lead honest and virtuous lives, and any number of middle-class and upper-class individuals commit crimes. Merely testing hypotheses is not enough, researchers realized. They needed to bring together many variables and look at their differential impacts on a number of different types of people dealing with different life situations. When we do this kind of research, we move beyond testing claims into modeling life impacts.

At an even deeper level, there is the further realization that no research project can completely and accurately capture every facet of what it is trying to study. Even the very act of measuring can change what we are measuring. Therefore, all data sets are actually approximations of what they purport to measure, and all claims made from these research efforts are probable rather than certain. The idea of refining research to the point where we have perfect studies is not just a practical impossibility. It is, in fact, a statistical impossibility as well. Therefore,
actually ever exist. So at this level, statistics is not just the best game in town—it is actually the only game in town.

This leads us to our last, and deepest, point. The reason that statistical pictures work so well as models of the world is that freedom is built into the very fabric of reality. That is, no matter how precise or mechanical a process is, it is never completely and totally determined. It exists merely along a continuum of freedom. When we are dealing with carefully configured phenomena, such as timepieces and airplane engines and the like, these variations from perfect determination are called errors. As we move toward more complex and organic phenomena, it begins to look more and more like choice and free will. But in reality it is the necessary presence of freedom, no matter how small or how rich and complex, that is woven into the fabric of reality. And to date, statistics is our best available language to talk about such panoramas of phenomena.

In summary, statistics takes us from being able to organize simple information to being able to describe and model complex and free-ranging phenomena, and all points in between. No wonder it is so important on the empirical research landscape.

The Qualitative Approach

As educational research continues to grow and develop, we would not be surprised to see that research in general becomes less and less restricted to only quantitative studies, but that qualitative research comes to grow and flourish and to establish its own important identity within this domain. But before we consider these possibilities, we need to take a closer look at the qualitative approach in general.

The qualitative perspective takes its own approach to the process of defining meaning. It is the process of digging deeper, and understanding what things mean. So for our purposes here, rather than thinking of these two approaches as being end points of a continuum, it is much more useful to think of them as being mostly independent of each other. In that way, you can look at each of them on their own terms.

Defining Characteristics of Qualitative Research

Qualitative research, because it is a much younger discipline, has less of a history of theoretical development. As a consequence, more often than not it is defined by its methods and perspectives. There are, however, at least a few defining characteristics. Some of the most important are described here.

Targeting Meaning over Facts Qualitative research has been defined as a systematic empirical inquiry into meaning (Shank, 2005). By this, we see that qualitative research assumes that the world is always meaning-rich. Too often in our research culture we assume the opposite—that there is not enough meaning in the world and therefore that the world is meaning-poor. From a quantitative perspective, we try to fix this situation by adding more information, with the assumption that increasing information increases meaningfulness.

To move away from this “poverty” model into a richer picture of meaning is one of the key aims of qualitative research. We can see this particularly clearly when we look at the ways that human beings tend to operate together to address common goals.

For instance, we might know very little about how people form quilting societies in order to address their common interests and desires to do quilting. But as we come to look at quilting societies, and observe and talk to the quilters who are there on a regular basis over the years, we come to find out how they form “eld” a world that we might once
practice is one of the most exciting aspects of qualitative research in education.

**Focusing on Understanding over Knowing** If you are looking at the world of experience first and foremost as a source of meaning, then the process of understanding becomes your primary goal. That is, if meaning is the coin of the realm, then understanding is its payoff. More often than not, such understandings take the form of insights, where our picture of things has been illuminated, and we receive deeper and richer insights into what might have seemed to be more mundane to us at one time.

Going back to our example of quilting societies, it is important for us to understand what quilting means to these participants. Quite often, we are surprised and even delighted to discover insights that cause us to look at quilting, and maybe even learning, in different ways.

**Looking at Differences in Kind Instead of Differences in Degree** In many quantitative studies, there are circumstances that are either known or hypothesized to be important. For instance, we all assume that proper sleep is important for school children. Therefore, we tend to ask such questions as: How much sleep do kids need? What happens when they get too little, or too much sleep? These are examples of what we mean by differences in degree. We all agree that sleep is important, but we don’t know yet to what degree we need it.

Qualitative researchers tend to look at different types of change—what happens when things change and a person’s world is no longer the same? These are differences in kind. That is, we become different kinds of people from one situation to the next. Differences in kind are also important when we look at other cultures and their traditions. That is, different kinds of things and actions, and ignore others that we or others might deem important.

**Key Qualitative Methods**

As we said earlier, qualitative methods tend to play a crucial role in defining the conduct of given qualitative studies in education. The seven key methodological tools are as follows:

**Observations** This is the simple but powerful process of paying careful attention and documenting what you find when you do so. It is hard to imagine any sort of qualitative research that does not have some form of observational component.

**Interviews** How do you know what people think and believe? Often, the best way to find out is to ask them. There is a range of interview protocols, from the structured interview at one end, the semi-structured interview in the middle, and the unstructured interview at the other end. All three forms have their appropriate uses and places.

**Focus Groups** Focus groups had their beginnings in group therapy, where therapists realized that when people collectively address a topic or problem, this process often brings out insights and ideas that might have eluded us individually. Focus groups play important roles in areas as diverse as research and marketing, and have evolved into a process that uses clear and sophisticated rules.

**Material Analysis** Human beings tend to make and use things. The collective total of these things for a group is called its material record or culture. This material culture can tell us much about those who build and prize it, and includes both important formal things (like church buildings and historically important novels and movies) to things that
Archive and Historical Records Analysis  Most societies and cultures keep records and retain information of historical significance. These archives and records can be rich sources of information, insight, and meaning.

Interpretive Analysis  Often called hermeneutics, this method involves the careful “reading” of not only texts, but also customs, patterns of behavior, habits, celebrations, rituals, and the like. These “reading” processes are used to dig under the surface, and to look for connections to areas that on the surface might appear to be unrelated.

Participant Observation  Participant observation occurs when researchers join into the lives and activities of those people they are studying, often with the intent of improving the lives of those they are working with.

Qualitative Methodological Perspectives  

Finally, we need to take a look at how these various qualitative characteristics and tools are brought together to form important methodological perspectives. Each of these perspectives has a rich and nuanced history of practice. The seven basic methodological perspectives are as follows:

Ethnography  Ethnography is the oldest method practiced by qualitative researchers. Ethnographers immerse themselves in a given culture, to try to understand the customs, beliefs, and day-to-day activities of that culture. In the early days, ethnographers went to remote and unstudied locales to work with little-known peoples. Nowadays, ethnographers often work in familiar areas like schools and suburban neighborhoods. A special type of ethnography is called autoethnography, where ethnographers study their own backgrounds and reactions.

were medical sociologists. In grounded theory, researchers set aside their preconceptions and use directed observation to find important themes that can be used to create theoretical perspectives. Grounded theory bills itself as a bottom-up process and is still quite influential today.

Case Studies  When researchers do case studies, they concentrate on just a few persons, and most often just one person. Often, people who are extraordinary in their fields are targeted for the close-up look that case study research allows for.

Narrative Analysis  Human beings are narrative creatures, and we routinely constitute our vision of the world via story. Qualitative researchers often use tools for parsing and understanding narratives that have been developed by sociolinguistic researchers and comparative literary critics. Chief among these tools is discourse analysis, which allows us to look carefully at multiple dimensions of the spoken word.

Oral Histories  In many ways, oral historians are special types of ethnographers. Most often, researchers go into remote areas or talk with marginalized people in order to secure an oral record of accounts and beliefs and understandings that might otherwise get lost.

Critical Theory  Critical theorists believe that certain ideological perspectives can be powerfully applied to the study of settings where there are social, economic, or cultural power imbalances. In particular, critical theorists most often look to use their theoretical tools to expose hidden areas of oppression and intimidation. Some of the main critical theories are based on a sophisticated application of an analysis of the roles of gender, race, or economics.
research is based on the notion that it is not enough to just study some situation; you need to make things better by the time you leave. Action researchers often work with marginalized persons in marginal settings.

The Mixed Methods Approach

So far, we have been talking (at least from a teaching perspective) as if qualitative and quantitative approaches are essentially independent of each other. We should hasten to note that this is far from a settled matter. In fact, there are two camps in the educational research community regarding the relationship of these two modes to each other.

The approach that we call the independent perspective says that the power in the assumption that qualitative and quantitative approaches are independent of each other is in the ability to ask completely different types of research questions, depending on which approach you use. Therefore, there is always the very real possibility that a research question asked from one perspective will not make sense from the other perspective (Shank, 2005). It also follows that if these approaches are independent, and often at cross-purposes with each other, then it makes no sense to talk of mixed methods research.

There are a great many other educational researchers who hold a completely different position. They are adherents of what we can call the global approach to research. This global perspective says that research is research—and that the type of research is far less important than the questions asked. This perspective tends to hold that the most important thing about research is the research questions that are asked, and that the choice of method should only be made once the research question itself is clear. Furthermore, it tends to assume that while most research questions are best served by using one approach

From the global perspective, mixed methods articles make sense in those situations where the research question requires both a qualitative and a quantitative approach to the problem. The reason that these approaches can be mixed is that, at heart, they are both scientific and use, in their own fashions, the scientific method. Remember, these claims, while they seem plausible on the surface, are far from settled.

It follows, then, that mixed methods articles fall within the framework of the global perspective. Even so, it is highly unlikely that both approaches are evenly represented in a given study. For our purposes, there are two broad types of mixed methods articles:

- **Quantitative-leading.** In a quantitative-leading article, the basic design is quantitative. Often, there are relationships or hypotheses tested. The qualitative component is used to elaborate on the findings and to help create a richer description and interpretation of the data. This is the most common form of mixed methods article.
- **Qualitative-leading.** This is the less common form of mixed methods article. Quantitative data, mostly descriptive, are brought in to clarify the parameters of the study. That is, we are given basic demographic information about the people and settings that are being examined. In some cases, relationships are explored. Finally, in some participative action research studies, quantitative measures are used to test the effectiveness of the studies.

The question of whether quantitative and qualitative approaches are independent will take many years to settle. In the meantime, we are ready to look at how quantitative and qualitative approaches are used to create basic types of quantitative and qualitative articles. This is the focus of the next chapter.
Chapter 2 -

Again

In case you can’t read the other
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Chapter Two

Basic Approaches in Educational Research

Educational research is built upon an ongoing and evolving foundation of research articles. While there are books and monographs in our field, the majority of research is reported in article form. In fact, JSTOR lists some 4,777 journals devoted to the publishing of original research studies in education. Therefore, it makes perfectly good sense to master the basics of research articles in our attempt to become research literate in this field.

Before we look at articles themselves, however, we need to step back and take a look at the basic foundations of educational research itself.

Basics of Educational Research

Education is one of the most fundamental things that human beings do. In order for us to survive, from the most personal to the broadest cultural level, we need to be able to teach and learn from each other. When we talk about education, though, we are usually referring to some form of schooling.
classroom, staffed by a teacher using a curriculum to guide instruction, with some form of ongoing assessment of student learning. From these default conditions we can lay out some of the key questions that drive educational research:

- What are the most important things for students to learn?
- What are students like, and how can we use this knowledge to improve the ways we teach them?
- How can we improve the learning process?
- How can we help teachers teach better?

In order to get at these and other important questions, we need to improve our understanding of the nature and application of research. That is, we need to become more research literate. To this end, we will take a brief look at the basics of quantitative literacy, statistical literacy, and qualitative literacy in turn.

**The Quantitative Approach**

When we talk about quantitative research, we are talking about research that follows the principles of the *scientific method*. There are many different formulations of the scientific method, but most of them share the following common principles:

- We make careful observations
- We make predictions from those observations
- We test those predictions
- We use our findings to support or modify our predictions

Beyond this bare bones understanding of the scientific method, there are a number of other major aspects of the task, there are three areas, particularly important when putting together quantitative research in the field of education.

First of all, there is an emphasis on the typical. That is, when we do quantitative research, we are most often interested in how the typical student, for example, learns a typical lesson in a typical situation from a typical teacher. This is important because, if we understand the typical, we can then understand how most educational situations unfold. Once we have the basic framework, then all we need to do is fill in the particular details. Even if we find ourselves with an unusual situation, we can still compare that situation to what is typical.

Here are some examples of the sorts of typical things that we might look at in educational research:

- How many hours of homework the average high school student does each evening
- The number of hours of sleep these students get every evening and how it affects their grades
- The amount of grade point average improvement we tend to find when we do some kind of intervention with students

Secondly, we are looking for things that are regular and repeatable. We cannot make any predictions or create rules or laws from one-of-a-kind events. Ideally, not only are these sorts of things predictable but they are also controllable to some degree.

Here are some of the regular things we might look at within a program of educational research:

- Attitudes toward learning
- Degree of motivation for doing specific learning tasks
- Favorable or unfavorable opinions about teachers
• Amount of time available to do homework
• Amount of nutrition both before and during school hours
• Specific instructions for doing learning tasks

Finally, our research must be public. We make our research public by reporting not only our findings but also the procedures we used to get them. These procedures include the exact research questions we asked, as well as a detailed account of the methods we used to answer those questions. These procedures should be reported in a clear and complete fashion, so that if someone wanted to repeat our exact study, they have enough information to do so.

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There is another important distinction to make when talking about the use of variables in educational research. That is the distinction between an independent variable and a dependent variable.

The logic is most often like this—we do something to the independent variable, and then we measure its impact on the dependent variable. For instance, we give children different measures for learning tasks.

Measuring variables in research. Comparing variables is also extremely common. Manipulating independent variables and then seeing the impact on dependent variables is at the very heart of doing experiments.

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The simplest use of statistics is to gather data and organize them in a meaningful way. When we do this, we are creating distributions.

A distribution is an assembly of related measurements that we combine to get a group picture. For instance, each and every one of us has a height, a weight, and various other
By themselves, our individual measures may or may not be that interesting. But if we combine our measures with other people who are similar to us in some clear and objective way (for instance, same age, same income level, same profession, and so on) we can begin to form a group picture that sheds more light on what we might expect from the average or typical person in our group.

In addition, these descriptive pictures tend to be more balanced and stable than any individual measure. Some of the more typical descriptive statistical concepts, such as the mean, median, mode, range, and standard deviation will be discussed in some detail when we look at quantitative results and findings.

We need to make one last point about distributions. There are any number of different distributions that have been identified and studied, such as the Poisson distribution or the F distribution or the t distribution, among others. But unless the researchers say otherwise, their variables will fall into a normal distribution (or, as is commonly stated, they will be normally distributed). This is because almost all naturally occurring variables, including the ones discussed above, are normally distributed. There are deep and important theoretical and methodological reasons for this fact, but they are beyond our scope of discussion here.

Inferential Statistics

The second primary function of statistics is to help us make decisions. To do this, we often make use of inferential statistics. This makes sense, since the term “inferential” is based on the notion of inference, or using reasoning skills to put together a decision based on available information.

The first thing to realize about inferential statistics is that all decisions are “yes/no” decisions. That is, when we are using clearly illustrated when we look at some we are seeking these kinds of “yes/no” decisions.

Inferences and Frequencies The first area deals with frequencies. When we compare frequencies of occurrence across two or more conditions, we try to decide if these frequencies are essentially the same for each condition. Because of the natural vagaries and whims of everyday life, we would not expect these frequencies to be identical. But, at some point, we decide that the differences are too great to be incidental. For instance, we might expect roughly the same number of men and women in the US Senate (there are one hundred senators, so this makes the math easier). In this case, our expected frequencies are 50 percent of each. If the actual frequencies were, say, 55 percent men and 45 percent women we would not think that is too far from our expectations. As we get to 60 percent men and 40 percent women we are less sure, but we are still willing to concede to chance. Currently, the frequency is about 80 percent men and 20 percent women. While this is far better than the not-so-distant past, where the figures were 98 percent men and 2 percent women, nonetheless we would not expect these numbers by chance alone (measured by a technique we call Chi-square analysis).

Inferences and Relationships The second kind of “yes/no” inference deals with deciding whether a given relationship is greater than we might expect by chance. When we are typically looking at variables that we can only measure but cannot control, we often correlate them (note that the term correlation has the concept of co-relation built into it). For instance, we can measure outside temperature in our hometown (which we cannot control, obviously) and compare the daily temperature to the number of pints of ice cream sold in the local grocery store (also not easy to control).
temperature rises the number of pints of ice cream sold increases. We would not expect a perfect correlation here, since folks often buy ice cream in the winter and abstain at times in the summer for reasons having nothing to do with the temperature outside. But we can use inferential statistical tools (in this case, a correlation coefficient) to determine that the joint rise and fall of these two variables is most likely not just a matter of chance.

**Inferences and Hypotheses** Our final inferential situation deals with deciding if common variables between two or more conditions act like one another, or whether at least one of those conditions seems to be acting differently. The simplest case of this involves a treatment and a control group. We do something different to the treatment group, and look to see if it has any impact on the target variable. That is, does the treatment group look different from the control group? For instance, suppose we divide a bunch of kids into two groups. We teach the first group how to make and read a simple code. The second group reads comic books just to keep them occupied. Then we give each kid a coded message and measure how long it takes each kid to solve the code. Of course we would expect some variability. Some kids like solving codes, or may be naturally better at it. But if we looked at each group and compared their times (using, in this case, a technique called the independent t-test) and found the code training group was overall faster at a level that would be hard to explain just by chance, then we have validated to some degree our code training methods.

**Inferences and Probabilities** In all of our inferential examples, we talked about whether a finding was significant or not. We need to clarify what that concept means methodologically.

That is because, when you are dealing with sampling, you cannot ever rule out the possibility that your results are due to a strange and highly unlikely sample.

A simple example should make this point clear. Suppose you tossed a coin and got twenty heads in a row. The odds of getting twenty heads in a row are 1,049,000 to 1. Does this mean your coin is unbalanced and will always land heads, or does it mean you have happened onto a really rare, but theoretically possible, sample? You solve this problem by putting some expectations on the probabilities you are willing to live with. In most studies, researchers are willing to live with circumstances where the possibility of a random rare sample occurring is either 20 to 1 or 100 to 1. In either case, the researchers are setting a critical value. At or below that value, you have a rare naturally occurring sample. Above that value, you are looking at two different populations. When you can claim that you are looking at two different populations, then your findings are significant.

In the case of the twenty heads in a row, you can say that this finding is significantly different from chance. This does not tell you why the findings are significantly different from chance, just that they are. Hopefully, you have thought out a reason ahead of time why this difference should exist.

When reporting significance, researchers indicate this by asterisking the computed value, and linking it to the pre-selected probability level. For a finding that is significant at the 20 to 1 level, it might look like this:

\[ 13.67^* \ (p<.05), \text{ which means probability less than 5 percent} \]

At the 100 to 1 level it might look like this:

\[ 13.67^* \ (p<.01), \text{ which means probability less than 1 percent} \]
measurements we have amassed. Here is a simplified example. Suppose we measure the IQ of two people and get an average IQ of one hundred. How confident are we that this average is correct? Now suppose we measure the IQ of a million people and get an average of one hundred. We are much more confident that our sample of a million people is more representative of the population as a whole than our sample of two people (even though, coincidentally, we got the same estimate of the population from each sample). All of this goes to prove that at least in some settings, the size of our samples matters.

The most common method for incorporating sample sizes into our inferences is by the use of degree of freedom. A degree of freedom is a measure of the impact of the sample size on the likelihood of our inference. If our sample size consists of N cases, then most of the time the degree of freedom is (N-1). Researchers report degrees of freedom to let the readers know the size of the samples used to make inferences, and these sample sizes are used to adjust critical values. As a rule of thumb, the smaller the sample the larger the critical value has to be in order for the results to be significant at the selected probability level.

Statistical Modeling

The final, and in some ways most interesting, property of statistics is its ability to model many of the key aspects of the world of experience itself. There is both an immediate and a far-reaching side to statistical modeling.

At the immediate level, we see that improved theoretical and especially improved computational capabilities (fostered almost entirely by the growth and advancement of computers) have enhanced our ability to look at quite a few relevant variables at the same time. This allows us to tackle larger and more complex questions—no longer are we limited to looking more. They all share the ability to work with a large number of variables at the same time in order to improve either our theoretical understanding, our predictive abilities, or most often both of these.

At the far end of statistical modeling, where we take a broader philosophical view of statistics and its role in describing the nature of the world, we come face-to-face with three profound insights about the interaction of research and reality.

First of all, there is the realization that human dynamics are so rich and complex that mere causal claims cannot do justice to (or completely capture) the crucial interactions we deal with in everyday life. For instance, there was once a belief that poverty caused crime. While it seems to be true that there are more reported and obvious crimes in poor neighborhoods, the picture is actually far more complicated. Many people in poverty lead honest and virtuous lives, and any number of middle-class and upper-class individuals commit crimes. Merely testing hypotheses is not enough, researchers realized. They needed to bring together many variables and look at their differential impacts on a number of different types of people dealing with different life situations. When we do this kind of research, we move beyond testing claims into modeling life impacts.

At an even deeper level, there is the further realization that no research project can completely and accurately capture every facet of what it is trying to study. Even the very act of measuring can change what we are measuring. Therefore, all data sets are actually approximations of what they purport to measure, and all claims made from these research efforts are probable rather than certain. The idea of refining research to the point where we have perfect studies is not just a practical impossibility, but a theoretical impossibility as well. Therefore, we will not be able to replace statistical findings with more perfect findings, since those more perfect findings cannot
that statistical pictures work so well as models of the world is that freedom is built into the very fabric of reality. That is, no matter how precise or mechanical a process is, it is never completely and totally determined. It exists merely along a continuum of freedom. When we are dealing with carefully configured phenomena, such as timepieces and airplane engines and the like, these variations from perfect determination are called errors. As we move toward more complex and organic phenomena, it begins to look more and more like choice and free will. But in reality it is the necessary presence of freedom, no matter how small or how rich and complex, that is woven into the fabric of reality. And to date, statistics is our best available language to talk about such panoramas of phenomena.

In summary, statistics takes us from being able to organize simple information to being able to describe and model complex and free-ranging phenomena, and all points in between. No wonder it is so important on the empirical research landscape.

The Qualitative Approach

As educational research continues to grow and develop, we would not be surprised to see that research in general becomes less and less restricted to only quantitative studies, but that qualitative research comes to grow and flourish and to establish its own important identity within this domain. But before we consider these possibilities, we need to take a closer look at the qualitative approach in general.

The qualitative perspective takes its own approach to the process of doing educational research. Where quantitative research is concerned with measuring, predicting, and controlling, qualitative research is concerned with exploring, more useful to think of each other. In that way, you can look at each of them on their own terms.

Defining Characteristics of Qualitative Research

Qualitative research, because it is a much younger discipline, has less of a history of theoretical development. As a consequence, more often than not it is defined by its methods and perspectives. There are, however, at least a few defining characteristics. Some of the most important are described here.

Targeting Meaning over Facts Qualitative research has been defined as a systematic empirical inquiry into meaning (Shank, 2005). By this, we see that qualitative research assumes that the world is always meaning-rich. Too often in our research culture we assume the opposite—that there is not enough meaning in the world and therefore that the world is meaning-poor. From a quantitative perspective, we try to fix this situation by adding more information, with the assumption that increasing information increases meaningfulness.

To move away from this “poverty” model into a richer picture of meaning is one of the key aims of qualitative research. We can see this particularly clearly when we look at the ways that human beings tend to operate together to address common goals.

For instance, we might know very little about how people form quilting societies in order to address their common interests and desires to do quilting. But as we come to look at quilting societies, and observe and talk to the quilters who are there on a regular basis over the years, we come to find a richer picture of this “world,” a world that we might once have assumed to be fairly simple and straightforward. Finding areas of depth like this within the boundaries of educational
Focusing on Understanding over Knowing  If you are looking at the world of experience first and foremost as a source of meaning, then the process of understanding becomes your primary goal. That is, if meaning is the coin of the realm, then understanding is its payoff. More often than not, such understandings take the form of insights, where our picture of things has been illuminated, and we receive deeper and richer insights into what might have seemed to be more mundane to us at one time.

Going back to our example of quilting societies, it is important for us to understand what quilting means to these participants. Quite often, we are surprised and even delighted to discover insights that cause us to look at quilting, and maybe even learning, in different ways.

Looking at Differences in Kind Instead of Differences in Degree  In many quantitative studies, there are circumstances that are either known or hypothesized to be important. For instance, we all assume that proper sleep is important for school children. Therefore, we tend to ask such questions as: How much sleep do kids need? What happens when they get too little, or too much sleep? These are examples of what we mean by differences in degree. We all agree that sleep is important, but we don’t know yet to what degree we need it.

Qualitative researchers tend to look at different types of change—what happens when things change and a person’s world is no longer the same? These are differences in kind. That is, we become different kinds of people from one situation to the next. Differences in kind are also important when we look at other cultures and their traditions. That is, qualitative research acknowledges that cultural differences are not just in terms of the degree to which certain things are present or absent, but in how different cultures valorize

**Key Qualitative Methods**

As we said earlier, qualitative methods tend to play a crucial role in defining the conduct of given qualitative studies in education. The seven key methodological tools are as follows:

**Observations**  This is the simple but powerful process of paying careful attention and documenting what you find when you do so. It is hard to imagine any sort of qualitative research that does not have some form of observational component.

**Interviews**  How do you know what people think and believe? Often, the best way to find out is to ask them. There is a range of interview protocols, from the structured interview at one end, the semi-structured interview in the middle, and the unstructured interview at the other end. All three forms have their appropriate uses and places.

**Focus Groups**  Focus groups had their beginnings in group therapy, where therapists realized that when people collectively address a topic or problem, this process often brings out insights and ideas that might have eluded us individually. Focus groups play important roles in areas as diverse as research and marketing, and have evolved into a process that uses clear and sophisticated rules.

**Material Analysis**  Human beings tend to make and use things. The collective total of these things for a group is called its material record or culture. This material culture can tell us much about those who build and prize it, and includes both important formal things (like church buildings and historical monuments and great novels and movies) to things that are more informal and ephemeral (like comic books and baseball cards).
of information, insight, and meaning.

**Interpretive Analysis** Often called hermeneutics, this method involves the careful “reading” of not only texts, but also customs, patterns of behavior, habits, celebrations, rituals, and the like. These “reading” processes are used to dig under the surface, and to look for connections to areas that on the surface might appear to be unrelated.

**Participant Observation** Participant observation occurs when researchers join into the lives and activities of those people they are studying, often with the intent of improving the lives of those they are working with.

**Qualitative Methodological Perspectives**

Finally, we need to take a look at how these various qualitative characteristics and tools are brought together to form important methodological perspectives. Each of these perspectives has a rich and nuanced history of practice. The seven basic methodological perspectives are as follows:

**Ethnography** Ethnography is the oldest method practiced by qualitative researchers. Ethnographers immerse themselves in a given culture, to try to understand the customs, beliefs, and day-to-day activities of that culture. In the early days, ethnographers went to remote and unstudied locales to work with little-known peoples. Nowadays, ethnographers often work in familiar areas like schools and suburban neighborhoods. A special type of ethnography is called autoethnography, where ethnographers study their own backgrounds and reactions.

**Grounded Theory** Grounded theory is a form of qualitative research pioneered in the 1960s by Glaser and Strauss, who

critical perspectives. It is a unique process and is still quite influential today.

**Case Studies** When researchers do case studies, they concentrate on just a few persons, and most often just one person. Often, people who are extraordinary in their fields are targeted for the close-up look that case study research allows for.

**Narrative Analysis** Human beings are narrative creatures, and we routinely constitute our vision of the world via story. Qualitative researchers often use tools for parsing and understanding narratives that have been developed by sociolinguistic researchers and comparative literary critics. Chief among these tools is discourse analysis, which allows us to look carefully at multiple dimensions of the spoken word.

**Oral Histories** In many ways, oral historians are special types of ethnographers. Most often, researchers go into remote areas or talk with marginalized people in order to secure an oral record of accounts and beliefs and understandings that might otherwise get lost.

**Critical Theory** Critical theorists believe that certain ideological perspectives can be powerfully applied to the study of settings where there are social, economic, or cultural power imbalances. In particular, critical theorists most often look to use their theoretical tools to expose hidden areas of oppression and intimidation. Some of the main critical theories are based on a sophisticated application of an analysis of the roles of gender, race, or economics.

**Action Research** Action research was born in the work of Marxist researchers during the 1930s, and the pioneering work of Paulo Freire in the 1950s and 1960s in Brazil. Action
ized persons in marginal settings.

The Mixed Methods Approach

So far, we have been talking (at least from a teaching perspective) as if qualitative and quantitative approaches are essentially independent of each other. We should hasten to note that this is far from a settled matter. In fact, there are two camps in the educational research community regarding the relationship of these two modes to each other.

The approach that we call the independent perspective says that the power in the assumption that qualitative and quantitative approaches are independent of each other is in the ability to ask completely different types of research questions, depending on which approach you use. Therefore, there is always the very real possibility that a research question asked from one perspective will literally not make sense from the other perspective (Shank, 2005). It also follows that if these approaches are independent, and often at cross-purposes with each other, then it makes no sense to talk of mixed methods research.

There are a great many other educational researchers who hold a completely different position. They are adherents of what we can call the global approach to research. This global perspective says that research is research—and that the type of research is far less important than the questions asked. This perspective tends to hold that the most important thing about research is the research questions that are asked, and that the choice of method should only be made once the research question itself is clear. Furthermore, it tends to assume that while most research questions are best served by using one approach over another, in principle it makes sense to assume that the question could be answered to some degree or another by either of the approaches.

The reason that these approaches can be taken at heart, they are both scientific and use, in their own fashions, the scientific method. Remember, these claims, while they seem plausible on the surface, are far from settled.

It follows, then, that mixed methods articles fall within the framework of the global perspective. Even so, it is highly unlikely that both approaches are evenly represented in a given study. For our purposes, there are two broad types of mixed methods articles:

- **Quantitative-leading.** In a quantitative-leading article, the basic design is quantitative. Often, there are relationships or hypotheses tested. The qualitative component is used to elaborate on the findings and to help create a richer description and interpretation of the data. This is the most common form of mixed methods article.

- **Qualitative-leading.** This is the less common form of mixed methods article. Quantitative data, mostly descriptive, are brought in to clarify the parameters of the study. That is, we are given basic demographic information about the people and settings that are being examined. In some cases, relationships are explored. Finally, in some participative action research studies, quantitative measures are used to test the effectiveness of the studies.

The question of whether quantitative and qualitative approaches are independent will take many years to settle. In the meantime, we are ready to look at how quantitative and qualitative approaches are used to create basic types of quantitative and qualitative articles. This is the focus of the next chapter.