time (and resources) it takes to learn new software programs and the relatively modest amounts of narrative data you are likely to encounter as a novice researcher, it is likely that you will resort to using the other "old-fashioned" techniques described in this chapter. The Digital Research Tools for the 21st Century feature on the next page discusses three common computer software packages available to assist teacher researchers with the analysis of qualitative data.

Qualitative Data Analysis: An Example

The example that follows is intended to provide a sense of qualitative analysis. A true qualitative study would entail more data analysis than shown here, but the basic ideas represent the process that a qualitative researcher would undertake when analyzing data throughout a study.

In this example, the topics under study are the concerns of parents regarding their first child's entrance into kindergarten and the kindergarten teacher's interactions with the students and families. The participants were four parents—three female and one male, representing four families—and the first child in each of the families. The children attend the same school; the kindergarten teacher was also a participant. Data collection procedures included observations and interviews with students, parents, and the kindergarten teacher.

Data analysis would proceed as follows:

1. From the field notes of your classroom observations, you begin to list some common items or topics that you noticed. You recorded in your notes that during classroom instruction, the teacher was using books, videos, and handouts. You also noted that at times, instruction was directed toward individual students, sometimes toward the whole class, and sometimes toward students who were working together in small groups.
2. From your interviews with the teacher, you realize that she gave you information about how she communicated with families about the children. You note that she talked about how she indirectly communicates through grading and report cards and how her lesson plans and tests are related to her overall assessment of the students' work. She also mentioned that she talks about report cards directly with families during conferences. Additionally, she communicates with families about their children through progress reports and phone calls.
3. From your initial analysis, you group the individual items or topics together into categories that show how the items or topics are related. For example, as shown in Figure 7–3, you could group books, videos, and handouts under a category called "Teaching Materials." You could group together the ways in which the instruction was carried out—individual, small group, and whole class—and label this category as "Classroom Interactions." Using information

DIGITAL RESEARCH TOOLS FOR THE 21ST CENTURY

Qualitative Data Analysis Computer Software

Computer software to assist with the analysis of qualitative, narrative data has been available to researchers for many years. The important word in this sentence is *assist*. This software will not do the analysis for you! It is important for novice qualitative researchers to remember that computers do not analyze or even code data. They are designed only to help expedite these operations when researchers are working with large bodies of text and other kinds of data. The process of coding, retrieving, and subsequently mulling over and making sense of data remains a laborious process completely controlled by researchers. Even if a computer is used, researchers still must go through the process of creating codes and labels and keying them into the computer as they read through their interviews, field notes, and audio- and videotapes. Computers are merely handy and extremely fast labeling and retrieval tools. Researchers also must remember that they must program the computer to retrieve and sort data in specific ways; the machines do not do these tasks automatically. Although computers can enhance and broaden qualitative research analysis, if you are not connected in some way with a research university, it is unlikely that you will have access to the software and the expertise of someone to teach you how to use it.

Three common and popular qualitative analysis software packages are NVivo 11, The Ethnograph v6, and HyperRESEARCH 3.7.3.

NVivo 11

NVivo 11 is designed for qualitative researchers who need to work with complex data, especially multimedia data. NVivo is designed to assist researchers with organizing, classifying, and analyzing data and allows the researcher to work with documents, PDFs, spreadsheets, audio, video, and pictures. More information on NVivo can be found on the QSR International website at http://www.qsrinternational.com.

The Ethnograph v6

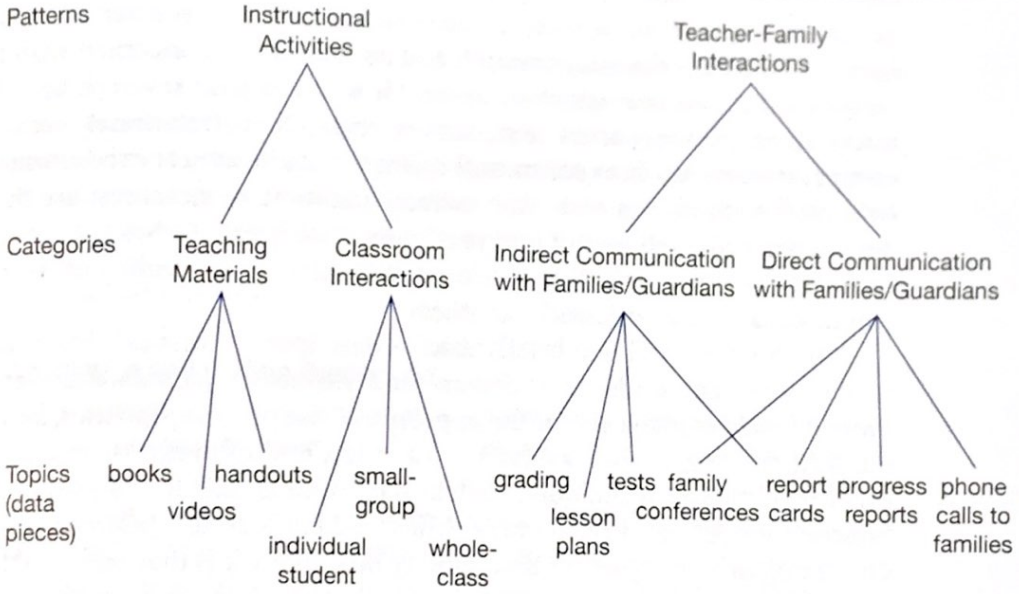
The Ethnograph v6 is a program designed to help qualitative researchers work with text files (in any format) and search for and code segments of interest to the researcher. More information about The Ethnograph can be found on the Qualis Research website at http://www.qualisresearch.com.

HyperRESEARCH 3.7.3

HyperRESEARCH 3.7.3 is an advanced software program that allows the qualitative researcher to work with text, graphics, audio, and video sources and to code and retrieve data. More information about HyperRESEARCH can be found on the ResearchWare website at http://www.researchware.com.

Remember, computer software will not do the data analysis for you, but it will help you to retrieve categories from a large amount of narrative, audio, video, and photo data (Mills & Gay, 2016, p. 477).

figure 7–3 ■ Diagram of Category Levels and Organization



from the interviews, you could construct the category "Indirect Communication with Families/Guardians" to include grading, lesson plans, tests, and report cards. A category of "Direct Communication with Families/Guardians" could include family conferences, report cards, progress reports, and phone calls to families. Notice that report cards appear in both the indirect and the direct communication categories.

4. You organize your four categories into patterns, which are made up of two or more categories. For example, the categories of "Teaching Materials" and "Classroom Interactions" indicate a pattern of "Instructional Activities." The categories of "Indirect Communication" and "Direct Communication" fit together under a pattern of "Teacher-Family Interactions."

You then decide whether you need to collect additional data by interviewing students and parents about their experiences of interacting with the teacher to confirm your categories and patterns.

Analyzing and Interpreting Quantitative Data

Data analysis and interpretation can also involve the use of descriptive statistics to help make sense of your quantitative data. My advice here is simple: Count what counts! If it makes sense to tally and count events, categories, occurrences, test

scores, and the like, use an appropriate descriptive statistic. However, do not feel compelled to include elaborate statistical measures simply to add a perceived sense of rigor or credibility to your inquiry. Action research is a very different kind of inquiry from experimental research and as such is less concerned with the statistically based claims that scientists make. However, if your research has used quantitative research approaches (e.g., survey research, correlational research, causal-comparative research, experimental research, single-subject experimental research, or mixed-methods research) that include quantitative measures, use the appropriate statistics to analyze and interpret your data. Treat statistics as one of an array of many tools that can help teacher researchers gain insight into their data and communicate them efficiently to others.

In this section, I will briefly discuss descriptive statistical measures of central tendency (mean, mode, and median) and variability (standard deviation). For a more detailed explanation of the appropriate use of these statistics, and of inferential statistics (e.g., *t* tests, analysis of variance, multiple regression, chi-square, and other investigative techniques, such as data mining, factor analysis, and structural equation modeling), I recommend Mills and Gay (2016). Inferential statistics are data analysis techniques for determining how likely it is that results obtained from a sample or samples are the same results that would have been obtained from the entire population. As stated previously, few (if any) action researchers concern themselves with making claims about the findings of their studies (based on the results obtained in their classrooms) that would generalize to a larger population (e.g., all fifth-grade students in the state).

Many readily available computer programs, such as SPSS for Windows and Microsoft Office Excel, may be accessible for computing statistics at your school or university. Remember, there are many excellent math specialists in your school or district, so don't hesitate to call on those resources with questions.

Preparing Quantitative Data for Analysis

Scoring Procedures

After data are collected, the first step toward analysis involves converting behavioral responses into some numeric system (i.e., scoring quantitative data) or categorical organization (i.e., coding qualitative data). When a standardized instrument is used for data collection, scoring is greatly facilitated. The test manual usually spells out the steps to follow in scoring each test, and a scoring key is usually provided. It is important that data are scored

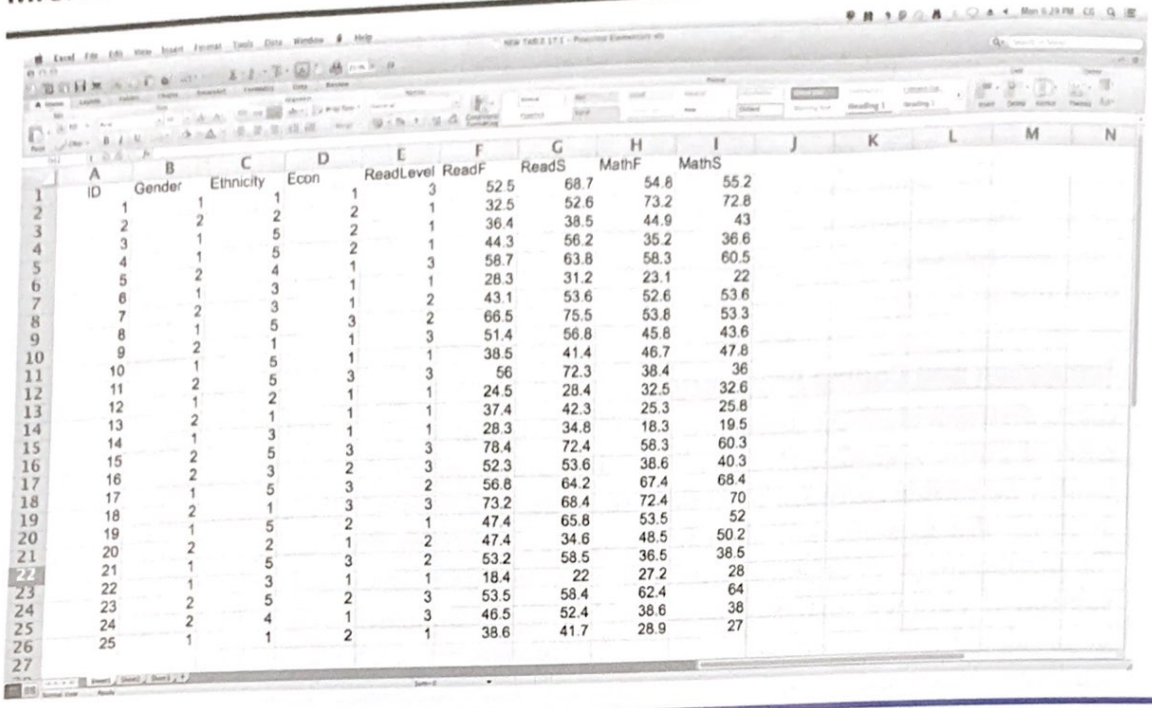
accurately and consistently; each participant's test results should be scored in the same way and with one criterion. If the manual is followed conscientiously and each test is scored carefully, errors are minimized. It is usually a good idea to recheck all or at least some of the tests (say, 25 percent, or every fourth test) for consistency of scoring. Scoring self-developed instruments is more complex, especially if open-ended items are involved, because the researcher must develop and refine a reliable scoring procedure. Steps for scoring each item and for arriving at a total score must be delineated and carefully followed, and the procedure should be described in detail in the final research report.

Tabulation and Coding Procedures

After instruments have been scored, the resulting data are tabulated and entered into a spreadsheet, usually on the computer. To demonstrate how a readily accessible software program can be applied, I have used Excel for the analysis of a hypothetical elementary school: Pinecrest Elementary School. Tabulation involves organizing the data systematically, such as by individual subject. If planned analyses involve subgroup comparisons, scores should be tabulated for each subgroup. Table 7–1 shows the data for the Pinecrest students, organized in an Excel spreadsheet. Each student's record is listed horizontally by student number, and then codes representing the values for each variable are placed in the vertical columns. For example, reading across the table for Student #1, we find Gender = 1 (male), Ethnicity = 1 (African American), Economic level = 1 (low), and so forth. The score or code for each categorical variable (a variable that has two or more named categories, such as sex (male, female) and ethnicity (African American, Native American, etc.)—should be included in a codebook (see Table 7–2), which serves as the key for the numerical values assigned to each variable. The ratio variables (variables with a true zero point, e.g., achievement scores), such as ReadF (reading score for fall), are defined by their range or maximum score (e.g., student scores can range from 0 to 100 for all the tests at Pinecrest).

Following tabulation, the next step in our analysis is to describe what is happening with our students or, in other words, to summarize the data using descriptive statistics. Choice of appropriate statistical techniques is determined to a great extent by your research design, hypothesis, and the kind of data you collect. Thus, different research approaches lead to different statistical analyses. Note, however, that the complexity of the analysis is not an indication of its "goodness" or appropriateness. Regardless of how well the study is conducted, inappropriate analyses can lead to inappropriate research conclusions. Data analysis is as important as any other component of research, and the statistical procedures and techniques of the study should be identified and described in detail in the research plan.

table 7–1 ■ Excel Spreadsheet of Pacific Crest Elementary Data: Mrs. Alvarez's Third-Grade Class



	A	B	C	D	E	F	G	H	I
1	ID	Gender	Ethnicity	Econ	ReadLevel	ReadF	ReadS	MathF	MathS
2	1	1	1	1	3	52.5	68.7	54.8	55.2
3	2	2	2	2	1	32.5	52.6	73.2	72.8
4	3	1	5	2	1	36.4	38.5	44.9	43
5	4	1	5	2	1	44.3	56.2	35.2	36.6
6	5	2	4	1	3	58.7	63.8	58.3	60.5
7	6	1	3	1	1	28.3	31.2	23.1	22
8	7	2	3	1	2	43.1	53.6	52.6	53.6
9	8	1	5	3	2	66.5	75.5	53.8	53.3
10	9	2	1	1	3	51.4	56.8	45.8	43.6
11	10	1	5	1	1	38.5	41.4	46.7	47.8
12	11	2	5	3	3	56	72.3	38.4	36
13	12	1	2	1	1	24.5	28.4	32.5	32.6
14	13	2	1	1	1	37.4	42.3	25.3	25.8
15	14	1	3	1	1	28.3	34.8	18.3	19.5
16	15	2	5	3	3	78.4	72.4	58.3	60.3
17	16	2	3	2	3	52.3	53.6	38.6	40.3
18	17	1	5	3	2	56.8	64.2	67.4	68.4
19	18	2	1	3	3	73.2	68.4	72.4	70
20	19	1	5	2	1	47.4	65.8	53.5	52
21	20	2	2	1	2	47.4	34.6	48.5	50.2
22	21	1	5	3	2	53.2	58.5	36.5	38.5
23	22	1	3	1	1	18.4	22	27.2	28
24	23	2	5	2	3	53.5	58.4	62.4	64
25	24	2	4	1	3	46.5	52.4	38.6	38
26	25	1	1	2	1	38.6	41.7	28.9	27
27									

table 7–2 ■ Pacific Crest Elementary Code Book

Variable	Name	Coding Values
Student ID	ID	1-25
Gender	Gender	1 = male, 2 = female
Ethnicity	Ethnicity	1 = African American, 2 = Asian, Pacific Islander, 3 = Hispanic, 4 = Native American, 5 = White
Economic Level	Econ	1 = low (free/reduced lunch), 2 = medium/working class, 3 = middle/upper class
Reading Level	ReadLevel	1 = low, 2 = middle, 3 = high
Fall Reading Score	ReadF	0-100 scale
Spring Reading Score	ReadS	0-100 scale
Fall Math Score	MathF	0-100 scale
Spring Math Score	MathS	0-100 scale

From Mills, Geoffrey E.; Gay, Lorraine R., *Educational Research: Competencies for Analysis and Applications,* Loose-Leaf Version, 11th Ed., © 2016. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Why Use Descriptive Statistics?

Descriptive statistics provide a shorthand way of giving lots of information about a range of numbers using only one or two numbers, such as by using attitude scales (Likert scales and semantic differentials) to measure students' attitudes and other sources of quantitative data available to action researchers (e.g., teacher-made tests, standardized tests, and school-generated report cards). One way to provide a great deal of information about our students' attitudes (as measured by these instruments) is to use descriptive statistics to describe the students' attitudes. For example, we might describe students' attitudes to a new mathematics curriculum (see Chapter 5) by reporting the average response to the following item on a questionnaire:

1. I believe that the problem-solving skills I learn in class help me make good problem-solving decisions outside of school.

   SA A U D SD

   By assigning point values—SA = 5, A = 4, U = 3, D = 2, SD = 1—and calculating the average response, we would be able to describe, on average, what children believed about the transfer of problem-solving skills to decisions made outside of school. In other words, the use of a number, in this case an average, conveys a great deal of information about students' attitudes and helps us make sense of our questionnaire data. Without the use of numbers, we would be limited to talking about an individual student's response to each question and not in more general terms about the attitudes of all of our students.

Measures of Central Tendency

Simply put, a measure of central tendency is a single number that gives us information about the entire group of numbers we are examining. Three common measures of central tendency are the *mean* (the average), the *mode* (the most frequently occurring score/s), and the *median* (the middle score). In education, perhaps the most common descriptive statistic used by teachers is the mean. It allows us to talk in generalities and to compare how the students in our class have performed "on average" in comparison to other students or over a given time period. As a teacher, you have no doubt calculated many averages, but remember: The **mean** (M) is calculated by adding together all of the scores (observations) and dividing by the number of scores.

Mean = The sum of all the scores divided by the number of scores.

For example, you administer a mathematics test with 100 questions to the 30 students in your class. After grading the tests, you award the following scores: 95, 95, 92, 92, 90, 90, 90, 88, 88, 85, 85, 85, 82, 82, 82, 82, 79, 79, 75, 75, 75, 75, 75, 72, 72, 72, 69, 69, 69, 65.

$$\text{Mean } (\bar{x}) = \frac{\sum x (\text{the sum of scores})}{n (\text{the number of scores})}$$

$$= \frac{2{,}424}{30}$$

$$= 80.8$$

The mean is greatly affected by extreme scores because it is "pulled" in the direction of the atypical values. For that reason, the median is sometimes a better descriptor of the full range of scores. For the most part, though, the mean (or the average) is the easiest, most familiar measure to use.

The **median** (Mdn) is the middle score in a distribution when the scores are ordered from the highest to the lowest. If there is an odd number of scores (say, 31), then the middle score (the 16th one) is the median. But in the distribution of the math scores above, there is an even number of scores. To find the midpoint in the distribution when there is an even number of scores, we must add the two middle scores in the rank-ordered distribution and divide by two. In this case, we would add together the two scores that are at positions 15 and 16, and divide by two. In this case, it would be scores 82 and 82. Therefore, 82 is the median score.

The **mode** is the most frequently occurring score in a distribution. In the case of these math scores, the mode would be 75 because that score was received by five students in the class. A distribution of scores can have more than one mode (making it bimodal or multimodal) or have no mode at all. The mode is the least useful measure of central tendency in most educational research: It tells us only about the score received most often and doesn't give us any information about the other scores.

Measure of Variability: Standard Deviation

As a teacher, you may have been exposed to standard deviation (SD) but perhaps did not fully understand its meaning. For example, you may have received test scores for your students following administration of a standardized test with individual scores, a class average, and a standard deviation. For our purposes, it is not important to see and memorize the formula for the standard deviation or even to know its origins. It is more important to understand the concepts of variability and standard deviation, to know what they mean, and to recognize when they would be appropriate to use.

A measure of variability tells us "how spread out a group of scores are." The standard deviation is the most important measure of variability for our action research purposes. Whereas the mean is a measure of a position in a distribution of scores (in this case, 80.8 on a scale of 1 to 100), the **standard deviation** indicates the spread of a set of scores around the mean (Mills & Gay, 2016, p. 247). In essence, the standard deviation helps us to understand approximately how much a particular score deviates from the average score.

As a teacher researcher, I might also be puzzled about whether a relatively large or small standard deviation is "good" or "bad." Perhaps a better way to think of a standard deviation as it relates to our mathematics test scores is in terms of equity. For example, the mean is 80.8, and the standard deviation is 8.59. (I calculated the standard deviation using SPSS 18.0 for Windows. If you have a larger data set, this is not the kind of calculation you want to do by hand, but for a small data set, you can calculate the standard deviation by hand.) If the data set is too large to calculate by hand and you don't have access to SPSS, you can use computer programs, such as Excel or a calculator with a statistics function, to calculate the standard deviation.

In our example, where the mean is 80.8 and the SD is 8.59, the majority (68 percent to be precise) of the children scored (roughly) between 72 and 89 (±1 SD from the mean). In short, most of them probably succeeded on the test if, in fact, scoring within this range of scores suggests some kind of mastery of the content. Now, let's compare the standard deviation of 8.59 to a standard deviation of, say, 16. If this were the case, we might conclude that the majority of children scored between 64 and 97. Again the question is one of mastery and whether a score of 64 suggests mastery of the content. The larger standard deviation suggests that the children's scores on the math test are more spread out and, hence, leaves us to question the degree to which the children have achieved mastery on the test. For the classroom teacher seeking to confirm mastery of subject matter on a criterion-referenced test (teacher-made test), a higher mean and smaller standard deviation would be a desirable outcome.

All of this leads us to the question, "So how does this help me understand my students' mathematics test scores?" Armed with the knowledge that the average score for the 30 students in your class is 80.8 and the standard deviation of this distribution of scores is 8.59, you can make the following statements:

- On average, the children in the class scored 80 on the test.
- Approximately two-thirds of the children in the class scored between 72 and 89 on the test.
- The relatively small standard deviation and mean of 80 suggest that approximately two-thirds of the children achieved mastery of the content that the test covered.

Used in conjunction, the mean and standard deviation can provide you and your colleagues with a great deal of information about the data you have collected if you have determined that it is data that can be counted. See Key Concepts Box 7–1 for some of the uses of descriptive statistics.

KEY CONCEPTS BOX 7–1

Descriptive Statistics

Definition of Measure	Type Used in Action Research
A measure of **central tendency** is a single number that gives us information about an entire group of numbers.	• Mean (the average) • Mode (the most frequently occurring score/s) • Median (the middle score)
A measure of **variability** tells us how spread out a group of scores is.	• Standard deviation (a measure of distance from the mean that helps us understand approximately how much a *particular* score deviates from the *average* score)

An Illustration

In my study of change in the McKenzie School District (Mills, 1988), I administered a survey to classroom teachers. One of the items on the survey focused on the teachers' perceptions of how the district's at-risk program had changed classroom practices. Specifically, teachers were asked to respond to the following statement: To what degree has the at-risk program changed your classroom practice? The survey included an item that required teachers to circle a number between 1 and 5 (1 = no change, 5 = large change). A total of 52 teachers responded to the survey item with the following frequency:

Impact of At-Risk Program on Classroom Practices

	No Change				Large Change
	1	2	3	4	5
Number of Respondents	7(13%)	18(37%)	17(35%)	10(15%)	0(0%)

I used the following descriptive statistics to describe the distribution of teachers' responses:

4,4,4,4,4,4,4,4,4,4,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,1,1,1,1,1,1, 1,1

$$\text{Mean } (\bar{x}) = \frac{\sum x}{n} = \frac{134}{52} = 2.58$$

Mode = 2.0 (most frequently occurring score—it occurred 18 times)
Median = 3.0 (the middle score in this distribution of 52 responses)
Standard Deviation = 1.02

However, numbers alone do not tell a complete story. They inform the reader about how a sample responded to a particular item. For example, the analysis of the earlier illustration related to classroom teachers' perceptions of how the district's at-risk program had changed classroom practices is incomplete using only descriptive statistics. To complete my reporting on this item, I included the following representative responses to the question, "To what extent do you think that the at-risk program changed your classroom practices?" The responses were grouped under the categories of "Positive Impact" and "No Impact."

Positive Impact

Reminded me and reinforced the concepts of learning styles and how to provide for them in my classroom.

Having insight to these kids has allowed me to be more sensitive and caring toward them and to act more compassionately.
I am more aware of needs of the "total child" as well as the student.

No Impact

No time to plan and implement all of those ideas!
I feel that the services needed for at-risk students are not available.
I was already using many of the skills.
I have been dealing with at-risk students since becoming a resource teacher, so I was already aware of the problem.
I believe that I have always been aware of the problem. It's only new at the district level.

The statistical analysis combined with the quotes from the teachers who responded provided me with a good understanding of the teachers' perceptions of the impact the at-risk program had on their classroom practices.

Be Careful About Your Claims

A final caveat: Be careful about how you "interpret" the descriptive statistics that you use to analyze your data and be careful about the claims you make based on a descriptive statistical analysis. Be clear about the limited significance that can be attached to averages and standard deviations. Remember that these statistics are used for description, not for identifying statistically significant relationships that can be generalized to the larger population.

Clearly, this discussion about descriptive statistics is quite brief. My experiences with teacher researchers is that, like me, they are somewhat math phobic and reluctant to incorporate statistics into their studies. But as Pelto and Pelto (1978) remind us,

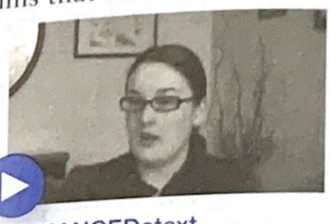
> In fact, not only humans but also other animals are constantly counting things in the process of adapting to their environments. Basic processes of learning, as described by experimental psychologists, most often imply some kind of counting or measurement that permits an animal (human or other) to distinguish between one condition and another as a relevant stimulus for appropriate action. (p. 123)

If counting things positively contributes to understanding your research or suggests a relationship that warrants further investigation, then use whatever statistic is most appropriate to analyze and interpret your data. Moreover, if you are math phobic but still want to examine whether statistics can give you insight into your data, do not hesitate to call on the skills of your critical friends, colleagues, and university professors.

Voices from the Field

Analyzing and Interpreting Quantitative Data

In this vignette, the teacher researcher shares her analysis and interpretation of her quantitative data collection focused on better understanding how formative assessments (quizzes) changed student attitudes toward the class, learning language, and taking tests. Rachelle ultimately claims that there were some "very, very positive" results from her action research. These results rested with her interpretation of percentages and frequency counts. For example, after the use of formative assessments, the percentage of students who reported "no test anxiety" had gone from 13 to 26 percent. Rachelle's interpretation of this result was "very, very positive." This example is a good reminder for action researchers to be modest in their claims and interpretations of numerical data. Further, the example includes times of moving between percentages and numbers of students: quite different measures. Rachelle's analysis would have benefited from the use of other descriptive statistical analyses, including mean, mode, median, and standard deviation, in order to provide a more detailed analysis on which to base interpretations of the survey data.



ENHANCEDetext

video example 7–3

In this video, Rachelle summarizes some of her findings in her action research project, which focused on whether weekly quizzes changed students' attitudes toward the class, learning language, and taking tests. How does her presentation of the quantitative data help you to understand and draw conclusions about her students' test anxiety? Are there other descriptive statistics that you'd like to hear about?

Data Analysis in Mixed-Methods Designs

As I have discussed throughout this chapter, one of the most difficult aspects of any research endeavor is the analysis of data. This problem is showcased when we attempt to analyze quantitative and qualitative data sources concurrently or in sequence and then attempt to find points of intersection as well as discrepancies, as is the case in mixed-methods designs. To refresh your memory, mixed-methods research designs combine quantitative and qualitative approaches by including both quantitative and qualitative data in a single study. Many teacher researchers find themselves including both data sources in their studies, especially when capturing student achievement data. Table 7–3 summarizes the type of mixed-methods research designs and examples of data analysis and data interpretation techniques that teacher researchers can use (Creswell, 2015). Many of the suggestions in this table build on the information in the quantitative and qualitative analysis and interpretation sections in this chapter and therefore should be familiar to you. (For a comprehensive discussion of mixed-methods research designs, see Mills & Gay, 2016, Chapter 15.)

table 7–3 ■ Types of Mixed-Methods Designs and Data Analysis/Interpretation Procedures

Types of Mixed-Methods Designs	Examples of Data Analysis and Data Interpretation Techniques
Convergent parallel (quantitative and qualitative data are collected simultaneously)	Quantify qualitative data coding by assigning a number to a code and counting the number of times it occurs. Quantitative data are descriptively analyzed for frequency of occurrence. The two data sets are compared.
Explanatory sequential (quantitative data are collected first, followed by qualitative data)	Follow up on outliers (extreme cases). Quantitative data are collected and outliers identified. Qualitative data are then collected on the outliers to increase understanding of these cases.
Exploratory sequential (qualitative data are collected first, followed by quantitative data)	Qualitative data are collected and analyzed and themes identified. The themes are used as the basis for identifying, or developing, an instrument that can be administered to collect quantitative data to measure the identified themes.

Source: Adapted from J. W. Creswell (2012, 2015). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research.*

Qualitative Data Interpretation Techniques

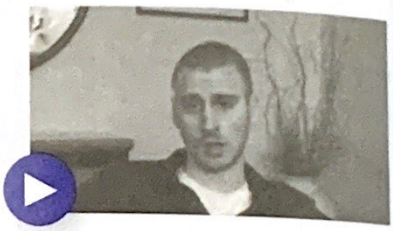
You may wonder, why bother with interpretation, especially since interpretation involves taking risks and making educated guesses that might be off base? According to Wolcott (1994), qualitative (action) researchers must accept "the risks and challenges of the interpretive mode" because in doing so we can "demonstrate to others (and reassure ourselves) that, in spite of their undistinguished origins, our works and the implications to be drawn from them are socially significant" (p. 258). In other words, Wolcott argues for the importance of interpretation because as teacher researchers, our interpretations matter to the lives of our students. In addition, the process of interpretation is important because it can challenge teacher researchers' taken-for-granted assumptions and beliefs about the educational processes they have investigated.

The list of techniques for data interpretation that follow are adapted from Wolcott (1994, pp. 39–46) and Stringer (1996, pp. 87–96) but have been reframed to apply specifically to teacher researchers.

Voices from the Field

Data Analysis in Mixed-Methods Designs

In this vignette, the teacher researcher describes the mixed-methods design he used to study high school student interest and engagement. Doug's study can be classified as a convergent parallel mixed-methods design where he collected simultaneously qualitative and quantitative data and compared the data sets to better understand the impact of his intervention on student interest and engagement. Specifically, Doug used pre- and postsurveys that were analyzed using descriptive statistics (quantitative data) and student essays that were analyzed by coding and identifying themes (qualitative data). Doug characterizes his two data sets as "hard data" (data that can be reduced to numbers) and "affective data" (data that can be reduced to themes). However, Doug's assertion that "numbers reflect the significance of your intervention" should be viewed cautiously. The use of a mixed-methods design is specifically intended to provide the teacher researcher with multiple data sets to compare regardless of whether the data are numerical or narrative, and "significance" is a term best reserved for "statistical significance" and inferential statistical analyses.



ENHANCEDetext video example 7–4

Doug, the action researcher in this video, describes the measures in his mixed-methods study. Which type of mixed-methods design did he use, and what recommendations might you give to him as he begins analysis of his data?

Extend the Analysis

One technique that is low on the data interpretation risk scale is to simply extend the analysis of your data by raising questions about the study, noting implications that might be drawn without actually drawing them. As Wolcott (1994) suggested, "This is a strategy for *pointing* the way rather than *leading* the way" (p. 40, emphasis added). For example, "While it appears as though the teen theater improvisation model positively impacts audience participation, a number of questions are raised by this strategy." In this example from Cathy Mitchell's Teen Theater group's use of improvisation (see Chapter 3), the analysis of data can be extended by raising questions about the intervention that were not asked as part of the original investigation but that may signal the beginning of the next action research cycle.

Similarly, in the Highland Park High School vignette, the research raised questions such as the following: Is the total elimination of letter and number grades the best way to deemphasize grades? Is there a way to deemphasize grades that requires less paperwork on the teacher's part? What is an appropriate role for students to play in determining their own grades? How can grades be deemphasized while teachers maintain specific criteria/outcomes for students?

Connect Findings with Personal Experience

Action research is personal business, so it makes sense to personalize our interpretations. For example, you may present your findings with the following prelude: "Based on my experiences in conducting this study, this is what I make of it all." Remember, you know your study better than anyone else; after all, it's been conducted in your classroom or school and focused on your students. You have been there for every twist and turn along the way, trying to make sense of discrepant events just when you thought you "had it right." Share your interpretations based on your intimate knowledge and understanding of schools and classrooms and teaching and learning. For example, recall that Deborah South (Chapter 1) had experienced the frustration of working with unmotivated children and the apparent futility of a study skills intervention. When faced with the "So what?" question, she based her interpretation not only on the analysis of data (test scores, surveys, interviews, and observations) but also on the memories and emotions of adolescent off-task behavior—a powerful interpretive lens.

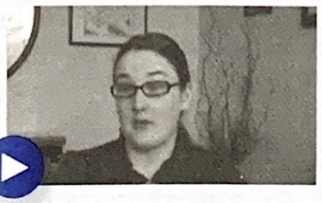
Seek the Advice of "Critical" Friends

If you have difficulty focusing an interpretive lens on your work, rely on your trusted colleagues to offer insights that you may have missed because of your closeness to the work. Offer your accounts to colleagues with the request that they share with you their possible interpretations. For example, the group of teachers at Highland Park High School found that their interpretations were enriched by the multiple viewpoints that came as a result of their collaboration. Remember, these colleagues may be people you have never met face-to-face but with whom you

Voices from the Field

Seek the Advice of Critical Friends

The teacher researcher in this vignette provides a simple illustration of the role of critical friends in action research. A "car pool" of other MAT students provided a perfect venue for Rachelle to share her struggles and outcomes and to seek confidential feedback about how to move forward with her action research efforts specifically and her student teaching in general.



ENHANCEDetext video example 7–5
Rachelle briefly describes her experience with a group of "critical" friends in this video.

have talked in action research chat rooms on the Internet. Similarly, you may ask your informants (students, parents, teachers, and administrators) for their insights.

But beware! The more opinions you seek, the more you will receive, and often these suggestions come with the expectation that you will accept the advice! Over time, you will develop reciprocity with a cadre of trusted, like-minded colleagues who will selflessly fulfill the role of critical friends. Take the time to build these relationships and reap the rewards they offer. For example, when Deborah South concluded from her data analysis and interpretation that her study skills class was the "cause" of her students' lack of motivation, her critical friends in her action research class protested that interpretation and provided her with ideas for alternate explanations. What Deborah gained from the feedback of her critical friends was a commitment to change the "intervention" that was being touted as "the solution" to the "unmotivated students" problem in the school.

Contextualize Findings in the Literature

Uncovering external sources as part of the review of related literature is a powerful way for teacher researchers to provide support for the study's findings. Wolcott (1994) suggested that qualitative (action) researchers "draw connections with external authority. Most often this is accomplished through informed references to some recognized body of theory in one's special field, or to the recognized classics, in the tradition of the literature review" (p. 34). Making these connections also provides teacher researchers with a way to share with colleagues the existing knowledge base in a specific area of focus and to acknowledge the unique contribution the teacher researcher has made to our understanding of the topic studied.

Turn to Theory

Let me first offer a modest definition of theory as "an analytical and interpretive framework that helps the researcher make sense of 'what is going on' in the social setting being studied" (Mills, 1993, p. 103). Theory serves a number of important roles for action researchers. First, theory provides a way for teacher researchers to link their work to broader issues of the day. As Wolcott (1994) suggested, "One interpretive tack is to examine a case in terms of competing theories and then proclaim a winner or, more often, attempt some eclectic resolution" (p. 43). Second, "theory allows the researcher to search for increasing levels of abstraction, to move beyond a purely descriptive account" (Mills, 1993, p. 115). That level of abstraction "allow(s) us to communicate the essence of descriptive work to our colleagues at research meetings" (Mills, 1993, p. 115). Finally, theory can provide a rationale or sense of meaning to the work we do. As educators, we have all been influenced by learning theories that provide a safe haven for our own work. Share the theories that appear to help make sense of your data. For example, Mills's story of the use of technology to enhance mathematics learning for the students at Billabong Elementary School (Chapter 2) is influenced by theories about how

RESEARCH IN ACTION CHECKLIST 7–2

Data Interpretation Techniques

_____ Extend the analysis by raising questions.

_____ Connect the findings with personal experience.

_____ Seek the advice of critical friends.

_____ Contextualize findings in the literature.

_____ Turn to theory.

students best learn math. Some of these theories are evident in the references to how students were using technology for "drill-and-kill" activities and how access to calculators was limited because calculator functions had been removed from the computers. The vignette suggests that other theories explain how students best learn math by challenging the "rote learning" theory that appeared well established at Billabong Elementary.

Know When to Say "When"!

Finally, if you don't feel comfortable with offering an interpretation, don't do it. Be satisfied with suggesting what needs to be done next and use that as a starting point for the next action research cycle. Restate the problem as you now see it and explain how you think you will fine-tune your efforts as you strive to increase your understanding of the phenomenon you have investigated. Wolcott (1994) cautioned, "Don't detract from what you have accomplished by tacking on a wimpy interpretation" (p. 41). (See Research in Action Checklist 7–2 for a list of data interpretation techniques.)

Sharing Your Interpretations Wisely

As educators, we have all, at some time, been exposed to what are variously called "fads," "the pendulum swing," the "bandwagon," and so on. Thus, many of us may hesitate to embrace anything new or different that comes our way in schools, calming ourselves with the mantra "This, too, shall pass!" If we, as professional educators, attempt to use our action research findings only to confirm our beliefs and values, then we risk being alienated by our colleagues. Avoid being evangelical about your interpretations, connect them closely to your data and analysis, and share your newfound understandings with colleagues in an appropriate manner.

SUMMARY

Ongoing Analysis and Reflection

1. Action research studies provide teacher researchers with data that can be used formatively and summatively; that is, much of the data collected during the study can be used to positively affect teaching throughout the study.
2. Use the following two questions to guide reflection:
   a. Is your research question still answerable and worth answering?
   b. Are your data collection techniques catching the kind of data you want and filtering out the data that you don't? (Anderson et al., 1994, p. 155)
3. Although ongoing analysis and reflection is a natural part of the action research process, you should avoid premature actions based on early analysis and interpretation of the data. Action researchers—especially those who are inexperienced—often make rash or impulsive decisions based on limited or no data.
4. The action research process takes time. Teacher researchers must be wary of the lure of quick-fix strategies and patient enough to avoid the pitfalls of basing actions on premature analysis.

The Role of Analysis and Interpretation

5. Data analysis is an attempt by the teacher researcher to summarize collected data in a dependable and accurate manner.
6. Data interpretation is an attempt by the researcher to find meaning in the data, to answer the "So what?" question in terms of the implications of the study's findings.
7. Put simply, analysis involves summarizing what's in the data, whereas interpretation involves making sense of—finding meaning in—those data.
8. Data analysis and interpretation are critical stages in the action research process that require the teacher researcher to both know and understand the data.
9. One way to proceed with analysis is to follow three iterative, or repeating, steps: reading/memoing, describing what is going on in the setting, and classifying research data.
10. Reading/Memoing. The first step in analysis is to read and write memos about all field notes, transcripts, and observer comments to get an initial sense of the data. To begin, find a quiet place and plan to spend a few hours at a time reading through the data.
11. Describing. The second step, describing, involves developing thorough and comprehensive descriptions of the participants, the setting, and the phenomenon studied in order to convey the rich complexity of the research. The descriptions are based on your collected observations, interview data, field notes, and artifacts.
12. Classifying. Qualitative data are typically broken down through the process of classifying or *coding*; the pieces of data are then categorized. A *category* is a classification of ideas or concepts; categorization, then, is grouping the

data into themes. When concepts in the data are examined and compared to one another and connections are made, categories are formed.

Qualitative Data Analysis Techniques

13. Identifying Themes. One place to start your analysis is to work inductively as you begin to analyze the data: Consider the big picture and start to list "themes" that you have seen emerge in your literature review and in the data collection. Are there patterns that emerge, such as events that keep repeating themselves, key phrases that participants use to describe their feelings, or survey responses that seem to "match" one another?
14. Coding Surveys, Interviews, and Questionnaires. One of the most frequent data analysis activities undertaken by action researchers is coding, the process of trying to find patterns and meaning in data collected through the use of surveys, interviews, and questionnaires.
15. Analyzing an Interview. Another common form of qualitative data that action researchers analyze is interview data, most commonly in the form of a transcript from the audio recording of the interview.
16. Asking Key Questions. Another approach to data analysis involves the use of key questions, such as those with which the teacher researcher started the study; they may take form of who, what, where, when, why, and how questions about the educational process.
17. Doing an Organizational Review. This approach to data analysis involves focusing on the following features of the organization (e.g., school): vision and mission, goals and objectives, structure of the organization, operation, and problems, issues, and concerns (Stringer, 1996, p. 90).
18. Developing a Concept Map. Concept maps are a useful strategy that helps action researcher participants to visualize the major influences that have affected the study (Stringer, 1996). The steps for developing a concept map include the following:
    a. List the major influences that have affected the study of your area of focus.
    b. Develop a visual representation of the major influences (factors) connecting the influences with relationships you know exist (using solid lines) and influences you have a "hunch" about (using dotted lines).
    c. Review the concept map to determine any consistencies or inconsistencies that exist among the influences. This forces you back to your data to see "what's missing."
19. Analyzing Antecedents and Consequences. A process of mapping antecedents (causes) and consequences (effects) helps action researchers identify the major elements of their analysis (Stringer, 1996). The steps for analyzing antecedents and consequences are as follows:
    a. List the influences that emerged from the analysis for which there appear to be a causal relationship.
    b. Revisit the review of literature to determine whether the analysis of the study supports or is challenged by the findings of previous studies.

c. Revisit your data to determine whether anything is missing and suggest how your findings may influence the next action research cycle.

20. Displaying Findings. The information you have collected should be summarized in an appropriate and meaningful format that you can share with interested colleagues. "Think display" as one way to convey your findings.
21. State What's Missing. Flag for the consumers of your research what pieces of the puzzle are still missing and identify any remaining questions for which you have not been able to provide answers.
22. Use Computer Software to Assist with Data Analysis. Computer software is available to assist with the analysis of qualitative data. This software will not do the analysis for you. It is designed to help researchers who are working with large bodies of text and other kinds of data.
23. Three common and popular qualitative analysis software packages are NVivo 11, The Ethnograph v6, and HyperRESEARCH 3.7.3.

Analyzing and Interpreting Quantitative Data

24. Data analysis and interpretation can also involve the use of descriptive statistics to help make sense of your findings. My advice here is simple: Count what counts! If it makes sense to tally and count events, categories, occurrences, test scores, and the like, use an appropriate descriptive statistic.
25. Descriptive statistics give us a shorthand way of giving lots of information about a range of numbers using only one or two numbers.
26. A measure of central tendency is a single number that gives us information about the entire group of numbers we are examining. Three common measures of central tendency are the *mean* (the average), the *mode* (the most frequently occurring score/s), and the *median* (the middle score).
27. The mean (average) is calculated by adding together all of the scores (observations) and dividing by the number of scores. The mean is greatly affected by extreme scores because it is "pulled" in the direction of the atypical values.
28. The median is the middle score in a distribution when the scores are ordered from the highest to the lowest.
29. The mode is the most frequently occurring score in a distribution. The mode is the least useful measure of central tendency in most educational research.
30. Standard deviation is a measure of variability that tells us how spread out a group of scores are (Mills & Gay, 2016, p. 326). The standard deviation is the most important measure of variability for our action research purposes. The standard deviation helps us to understand approximately how much a particular score deviates from the average score.
31. Be careful about how you "interpret" the descriptive statistics that you use to analyze your data and be careful about the claims you make based on a descriptive statistical analysis. Be clear about the limited significance that can be attached to averages and standard deviations.
32. The challenges of data analysis are showcased when we attempt to analyze quantitative and qualitative data sources concurrently or in sequence and

then attempt to find points of intersection as well as discrepancies, as is the case in mixed-methods designs.

33. Mixed-methods research designs combine quantitative and qualitative approaches by including both quantitative and qualitative data in a single study.

Qualitative Data Interpretation Techniques

34. Extend the Analysis. One technique low on the data interpretation risk scale is to simply extend the analysis of your data by raising questions about the study, noting implications that might be drawn without actually drawing them.
35. Connect Findings with Personal Experience. Action research is personal business, so it makes sense to personalize our interpretations. Share your interpretations based on your intimate knowledge and understanding of schools and classrooms and teaching and learning.
36. Seek the Advice of "Critical" Friends. If you have difficulty focusing an interpretive lens on your work, rely on your trusted colleagues to offer insights that you may have missed because of your closeness to the work. But beware! The more opinions you seek, the more you will receive, and often these suggestions come with the expectation that you will accept the advice.
37. Contextualize Findings in the Literature. Uncovering external sources as part of the review of related literature is a powerful way for teacher researchers to provide support for the study's findings.
38. Turn to Theory. Share theories about teaching and learning that appear to help make sense of your data.
39. Know When to Say "When"! If you do not feel comfortable with offering an interpretation, don't do it. Be satisfied with suggesting what needs to be done next and use that as a starting point for the next action research cycle.

Sharing Your Interpretations Wisely

40. Avoid being evangelical about your interpretations, connect them closely to your data and analysis, and share your newfound understandings with colleagues in an appropriate manner.

TASKS

1. How will you analyze each data source that you have indicated in your data collection plan? Remember: Don't collect data when you don't know what you are going to do with it. For each data source identified in your data collection matrix, identify appropriate data analysis and data interpretation approaches.