Professional Development From Your Easy Chair

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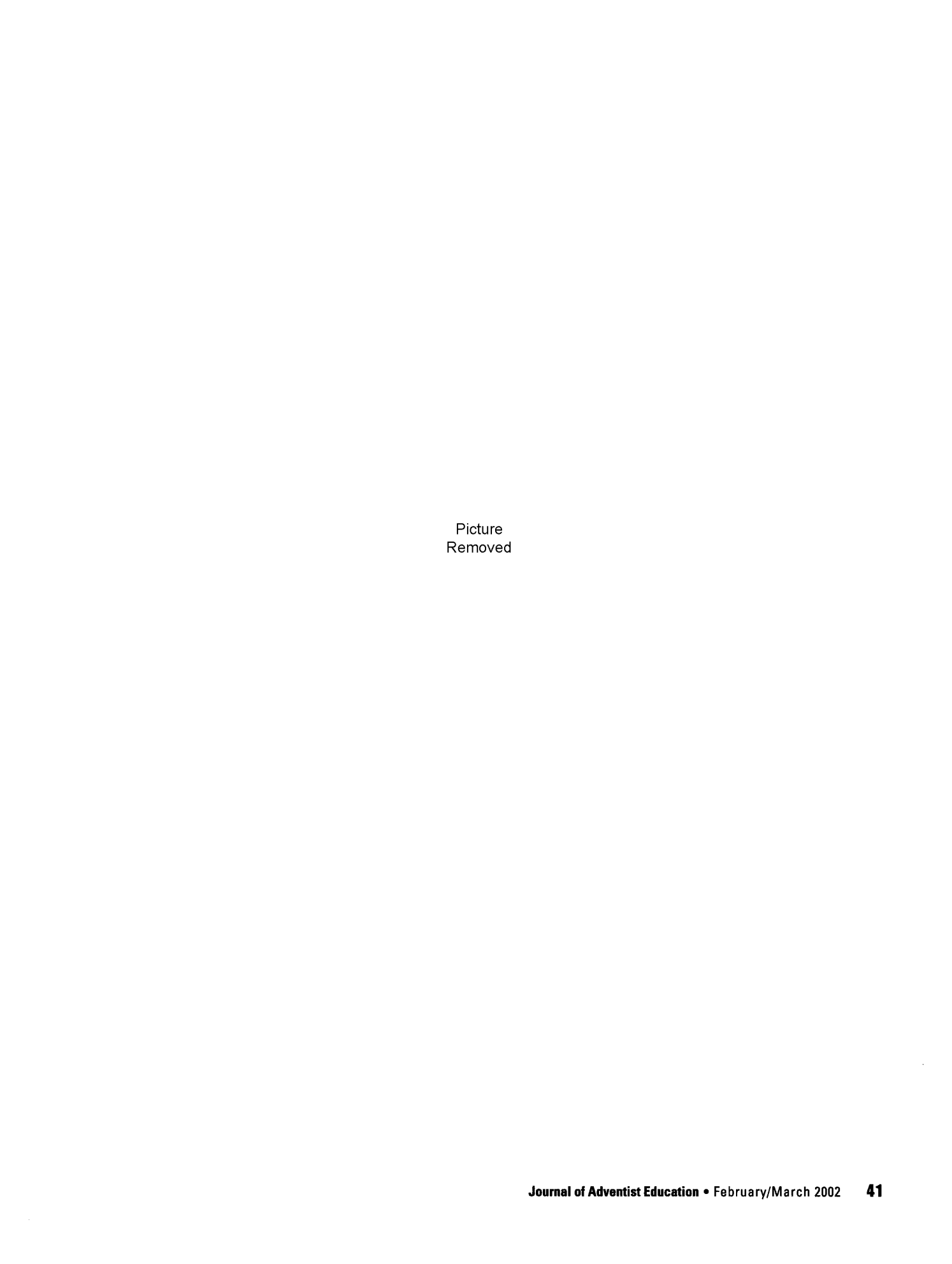
Do you remember your career goals as a college student? If you're like many teachers, your dream was to be "Teacher of the Year" for at least three consecutive years. You would be feted for your creativity, innovation, and effective teaching interventions. Your highest honor would come when years later, your students returned to your well-organized, immaculate classroom to say, "Thank you for being such a wonderful teacher. Because of you, I am what I am today—a neurosurgeon." Or better yet, "Because of you, I am a teacher." I think most teachers have had visions of those moments. On the other hand, some of you may be feeling burned out, and your vision for "Teacher of the Year" may seem a near impossibility as the years pass.

This article will enable you to get the most out of your professional reading by helping familiarize you with the structure and language of research reports.

But even if things seem grim, you probably have some "Teacher of the Year" fire burning in you somewhere. The challenge is to revisit your initial dreams and goals and determine how you can refocus your thinking and energies to regain a sense of excitement about teaching. Here is one resource for rekindling that fire. It won't transform your students into angels or solve your school's financial problems. It can, however, help change your perspective, sharpen your classroom management and teaching skills, expand your knowledge base, and help you learn new techniques from your peers.

What is this marvelous aid to professional development? It's research reports. Those pages and pages of small font, single-spaced research articles in peer-reviewed professional journals can help you reclaim your dream of being "Teacher of the Year," or at least spur you on to teach like one. This article will enable you to get the most out of your professional reading by helping familiarize you with the structure and language of research reports. You will thus be able to approach them feeling confident that you understand and can apply what you're reading.

Because of the challenges the authors of this article faced when we began reading research reports, we take nothing for granted when talking about research. We'll explain terms that are commonly used but sometimes misunderstood. If you are already knowledgeable about the design and implementation of research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studies, this article may not be for you. If you're still struggling with how to understand the jargon of research reports, keep reading.

Research Reports as an Aid to Professional Development

Professional development, which includes continuing education, workshops, seminars, and in-service meetings, is important for teachers because it keeps them on the cutting edge of research and informs them about new techniques.[1] However, teachers often have difficulty participating in traditional types of professional development due to time and distance constraints, family responsibilities, and costs. Consequently, they can benefit from alternative ways of obtaining this type of enrichment. We'd like to suggest the reading of professional journals and research reports as an effective option for professional growth. A great deal of research is being conducted that can help you deal with the challenges you face in the classroom.

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However, many people feel intimidated by technical reports. They are unfamiliar with the language and techniques used by researchers. One editor said this about the authors of journal articles: "We think we would not be able to impress others if they understood what we were talking about. . . . The interesting thing is that when we are among other people who do the same thing, we are embarrassed to say, 'I have no idea what you are talking about.' We nod to each other . . . but nobody communicates."[2] Demystifying the jargon can help facilitate understanding. That is the primary purpose of this article.

Some Definitions

What is research? It is a systematic approach to problem-solving and decision-making. The operative word here is *systematic*. Scientific inquiry must be performed and reported in a systematic way for the results to be trustworthy and transferable to classroom techniques and practices.[3] Most research reports contain the following: a title, an abstract, methods, results, a discussion section, and a reference list. We'll look at each section briefly and identify its important parts.

Title and Abstract

As you prepare to read a research article, look first at the title and abstract. They should provide enough information to help you decide whether the article contains information you need or want.

The title should be precise and indicate what variables the researchers studied.[4] The abstract is a summary of the research report. It includes the purpose of the study, who was studied and how, and with what results. It also lists the researchers' conclusions. If the title and abstract address your interests, read on.

Introduction

The introduction should identify the problem the researchers set out to study, describe the significance of the research, and give the rationale for studying it. Research, however, can involve more than merely identifying and solving problems. Sometimes it describes or examines a phenomenon or seeks to answer a question.

A good research report includes a thoughtful and comprehensive review of the relevant literature and tells how personal experiences and interaction with peers contributed to the context and rationale for the study. To provide a broad perspective and put the research in context, the literature review should include studies by researchers with conflicting opinions.

Your literature review can be expanded by using key words or the researchers' names to help you locate information about their backgrounds and other relevant materials. Knowing the researchers' background can help you determine whether they are a credible source.

The Research Question

A clear and well-focused research question is critical to successful completion of a research study. As you read the research question, ask yourself, "Is the question being studied important to the profession? Is it feasible to study this topic? Can the question be answered by analyzing the data collected?"

The research question should focus on a specific concern. Let's consider this example: "Is there a difference in math test scores between 8th graders who receive computer-based math instruction versus 8th graders who receive conventional math instruction?" This is not the same as asking whether there is a *relationship* between math test scores and computer-based instruction. Read carefully to see whether the authors have clearly stated the research question so that it can be answered by the research. Without a well-thought-out and carefully focused research question, the study may lack credibility.

Hypothesis

Once you've established that the research question is a good one, look at the alternative hypothesis. Before discussing the alternative hypothesis, we need to say a word about the research hypothesis, which is commonly called the "null hypothesis." This is the status quo or prevailing viewpoint. Considering the example of types of math instruction above, the null hypothesis would be *that the type of math instruction **does not** make a difference in the math scores of 8th graders*. Hold that thought. We'll revisit null hypotheses in the Interpretation of Results and Discussion sections of this article.

Back to the alternative hypothesis. Ask yourself, Is it clear? Is it

a one-tailed (directional) or two-tailed (non-directional) hypothesis? You can determine if a hypothesis is one-tailed or two-tailed by its wording. If the hypothesis describes a difference between groups that will be studied but does not specify the direction, it is a two-tailed test. Example: *The mean math scores of 8th graders who receive computer-based math instruction are different from the mean math scores of 8th graders who receive conventional math instruction.* In this example, the researchers think the mean (commonly referred to as the "average") math scores of the two groups will be different but have not specified whether they think they will be higher or lower. On the other hand, if the researchers state in the hypothesis that they think the scores of one group will exceed those of the other group, this is called a *one-tailed test*. Example: *The mean math scores of 8th graders who receive computer-based math instruction are higher than the mean math scores of 8th graders who receive conventional math instruction.* This is a subtle but important difference, since it suggests that the researchers have specific expectations about the outcome of the study.

If the researchers' problem, rationale, research question, and hypothesis are clearly stated, you should be able to determine the purpose of the study. Based on the research question and hypothesis noted above, it is logical to assume that the researchers wanted to determine whether there is a difference in math scores between 8th graders who receive different types of math instruction. The purpose is logical because of the consistency between the research question and hypothesis. If the purpose of the study were to provide normative values for math scores, we would expect a different research question. For instance, "What are the normative values for math scores of 8th graders?"

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Now that you know what to look for in the abstract and introduction, you're ready to move to the next question: How did the researchers answer the research question? The research design and methods describe the mechanics of how the study was conducted.

Research Design

There are two broad categories of research design, *experimental* and *non-experimental*. Experimental designs "offer the greatest control over the various factors that may influence the results," whereas quasi-experimental designs "usually cannot control for all factors that affect the validity of the results."[5] In experimental designs, the researcher controls or changes one or more variables in some way to determine the effects on other variables. An **independent variable** affects, or is assumed to affect, the **dependent variable** (referred to as the resultant or outcome variable).[6] Here is how it would work in our math instruction study: The researchers would ask whether differences in math instruction (independent variable) have an effect on math test scores (the dependent variable). Studies using experimental designs typically fall under the category of quantitative research.

The other broad category of research design is known as **non-experimental**. The researchers don't change or alter variables in the study; instead, they examine and observe the data and report on what they found. Surveys, case studies, and interviews are examples of non-experimental designs. These tools are often used to study the thoughts, perceptions, and ideas of individuals regarding different phenomena. In our example above, a researcher using a non-experimental approach to study types of math instruction might survey teachers and students about their perceptions and preferences.

After the researchers choose an appropriate design, they must select an appropriate method of carrying out the research.

Research Methods

The research design gives the procedural details of the study, while the methods tell how the design was implemented. The methods should be specific and clear enough to allow other researchers to replicate the study. The methods section describes the subjects, the instruments and procedures used to collect and measure data, and how the data were analyzed.

Subjects

In most cases, it would be too expensive, time consuming, and difficult to study an entire population. How could researchers possibly survey all 8th graders in the United States? Even if they had a list of all of the schools in the country, how would they contact the children who were home schooled? What about the ones who are absent on the day the survey is administered? Therefore, researchers use a technique called **sampling** to choose a subset or small group from whom to collect data to answer the research question. There are so many sampling techniques that describing them is beyond the scope of this article. However, researchers must keep the following things in mind when choosing subjects:

- A random sample is more likely to represent the overall population than a small sample chosen on the basis of convenience or the accessibility of the subjects.
- The subjects should possess as many characteristics as possible of the population the researchers are studying. (For example, if the researchers want to know how well children from different income groups and cultures perform on math tests, they need to include students from a variety of socio-economic and ethnic groups.)
- Subjects must be treated ethically. This includes protecting them from harm, guarding their privacy, not pressuring them to participate, allowing them to withdraw from the study without penalty, and honestly informing them about the goals of the study, as well as any potential risks or benefits.[7] Despite having a flawless

design and meticulous implementation, any research study that fails to follow ethical principles cannot be considered credible.

A study of computer-based math instruction seems innocuous. There is, however, potential for emotional harm and distress in any testing situation. Students must not be penalized or humiliated if they choose not to participate in the study or do not perform well.

Another red flag for research credibility is whether the subjects are representative of the target population. Is there a similar proportion of males and females in the study as in the general population of 8th graders? Are different socio-economic groups, cultures, and ethnic backgrounds represented? This will determine whether the findings can be generalized to the target population.

Research Instruments

Researchers collect data using various types of instruments such as pen-and-paper tests, telephone surveys, interviews, and mechanical instruments. Whatever the instrument, it needs to provide measurements with moderate to strong **reliability** and **validity**.[8] If the measurements produced by the instrument are consistent, dependable, and reproducible, they are said to be reliable. To assess validity, we can ask, Does the survey measure what it was intended to measure? Do the math test scores reflect the students' understanding of the subject or are they influenced by some other phenomena?[9]

Procedures

The procedures are the "how to's" of the study. The steps should be so clearly explained that if you wanted to repeat the study, you could do so. Using our example of math instruction, some of the questions we would want to know are: How, where, and for how long was the math instruction given? Were students allowed to use the same computer during each class, or did they use different computers? Who gave the instruction? Did students take trial tests? When was the study terminated? The procedures tell you how the data were collected.

Data Analysis

After the data are collected, they must be analyzed. We must admit that this used to be the scariest part of research reports for us. All those unfamiliar statistical terms! We could hear an inner voice saying, "Danger, danger! Unfamiliar territory. Beware!" That little voice is still present, but not as audible as in the past. Hopefully, by the time you finish this article, you too will feel more comfortable with data analysis and statistics.

There are two broad categories of statistics—descriptive and inferential. **Descriptive statistics** analyze the data in terms of the distribution of the scores.[10] What is the mean (arithmetic average) score for the math test? The median (middle score)? The mode (score that occurs most frequently)? How much, on average, do subjects' scores vary from the mean (this is called standard deviation)? Are the scores normally distributed? A descriptive statistics statement might read, "The math test scores were normally distributed, with a mean score of 85. The median was 87, and the mode was 86. The standard deviation was 3.4." This description gives the characteristics of the distribution of the scores.

The branch of statistics used to analyze data and test hypotheses is known as **inferential statistics**. They are used to analyze differences between two or more groups and to examine relationships between two or more variables from one group. An analysis and interpretation of the data suggests whether the hypothesis may be supported or rejected.[11]

A full discussion of the types of statistical tests and the methods for choosing the appropriate one is beyond the scope of this article. However, we have listed some of the more common statistical tests you will see in research reports and tell what the tests analyze. (See Table 1.)

In order to choose the correct type of statistical analysis, the researchers must consider the question being asked. To answer our research question ("Is there a *difference* between math test scores for 8th graders who receive computer-based math instruction versus 8th graders who receive conventional math instruction?"), the researchers should have chosen statistical tests that analyze differences. If the research question had been, "Is there an *association or relationship* between math test scores and the type of math instruction?" then data would be analyzed using correlation coefficients. The appropriate approach depends on what the researchers want to know about their data.

Interpretation of Results and Discussion

The results and the discussion sections of a research report help you determine whether the findings can be generalized to issues you face in your classroom. Examine the results carefully. First, look at the level of significance, commonly called alpha, that the researchers have set. The conventional level of significance is .05, but .10 or .01 can also be used. Next, identify the *p*-value, which is determined by the statistical tests performed. In our example, the *p*-value is less than .05. (It may be written as $p < .05$ or $p = .02$.) The $p < .05$ would indicate there is a significant difference between the math scores of 8th graders who receive different types of math instruction. Since there is a significant difference, we would reject H_o (the null hypothesis).

Other statistical tests can be used to analyze which type of math instruction, conventional or computer-based, is most effective. A discussion of those tests is, however, beyond the scope of this article.

Discussion Section

We've finally come to the discussion section of the research report. Here the researchers synthesize all of the information and comment on the findings of the study. This is where they answer the research question posed at the beginning of the study. Using our math scores illustration, based on the *p* value of .03 (which is less than our alpha of .05), we could justifiably conclude that different types of math instruction will impact math scores of 8th graders.

In this section, researchers may also discuss external variables that could have affected the study's outcome, suggest questions for further study, and make recommendations for future research.

Credibility

Now that you know more about research process, design, and

ethics, you may be tempted to view a study as credible if the researchers have followed a systematic, scientific approach. Beware! Some research studies, though technically and procedurally sound, may not be based on a Christian philosophy or worldview. When reading any research study, you must analyze and filter the researchers' findings by using your moral and ethical compass, as well as your Christian value system.

Conclusion

What now? You can sharpen your teaching skills and even learn new ones by reading about research done by your peers. Now that you know the structure and language of research reports, you're off to a good start. We invite you to pick up a journal, grab a pencil and a highlighter, have a seat in your easy chair, and work on your professional development.

If the researchers' problem, rationale, research question, and hypothesis are clearly stated, you should be able to determine the purpose of the study.

You'll get even more out of your reading if you encourage your colleagues to read the same materials you are perusing, then come together in small groups to discuss the research and suggest ideas for applying it in the classroom. Teachers in isolated areas can discuss the concepts in chat rooms on the Internet or by getting together on a Sunday once a month for a teacher study group. Even teachers without a support network can apply innovations from their professional reading, though this will be more of a challenge—but using your newfound skills, you may even want to do some research yourself!

Review With Critical Eyes

To determine the reliability of the research, you need to ask some specific questions:[12]

1. Who is the researcher? What's his or her background (i.e., educational level, occupation, and experience in the area under study)?
2. How large is the sample (the number of people participating)? Usually, the larger the sample, the more reliable the findings.
3. Is the researcher reporting his or her study, or is someone else, such as an editor, writing about it?
4. Is the report in a professional publication that carefully checks its sources for accuracy and accountability?
5. Who or what organization conducted the research? Was it a research group under the auspices of a university or a private organization?
6. Who paid for the study? Does the group have a "stake" in the findings? "The funding process has an incredible influence on research today. No papers published, no money for research. . . . The rigorous testing proposed by the scientific method is not cost-effective; so ideas and concepts are rushed into print and cited in subsequent publications."[13]
7. How did the researchers test the results? Did they conduct a laboratory study using test tubes and other laboratory techniques? Or did they use animal or human subjects? Human subject studies are best if the research is to be applied to people, such as in education or drug therapy.
8. If the researchers used human subjects, did the sample include a wide variety of groups? If the study surveyed only one or two groups, can the findings legitimately be generalized to other groups?
9. Did the researchers use a control group? Control groups typically do not participate in the new program (as in education) or receive the drug or treatment, in contrast to the experimental group. At the end of the study, the control group is compared to the experimental group. If there are significant differences, it can be inferred that this resulted from the intervention/medication.
10. How were the participants selected? The best sampling techniques use a random selection process that gives every relevant individual an equal chance to be selected—otherwise, the results may be biased.
11. Are the results based on data from the study?
12. Does the study encourage the reader to examine and consider future research questions that need exploring?

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TABLE 1
Frequently Used Statistical Tests for Analyzing Differences and Relationships and Making Predictions

Tests to Analyze Differences		Tests to Analyze Relationships		Tests to Make Predictions
Parametric	Nonparametric	Parametric	Nonparametric	
Independent *t* Test	Mann-Whitney	Pearson Product Moment Correlation	Spearman's rho	Linear Regression
	Wilcoxon rank sum			
	Chi-square			
ANOVA (analysis of variance)	Kruskal-Wallis			
Paired-*t* test	Wilcoxon signed rank			
	McNemar			
Repeated measures ANOVA	Friedman's ANOVA			