CHAPTER 2 SELECTING AND DEFINING A RESEARCH TOPIC

1. Document facts and substantiate opinions. Cite references to support your facts and opinions. Note that facts are usually based on empirical data, while opinions are not. In the hierarchy of persuasiveness, facts are more persuasive than opinions. Differentiate between facts and opinions in the review.

2. Technical writing is precise, so clarity of definitions and consistency in the use of terms is required.

3. The review should be logically organized and aimed at a particular audience. Usually the review is aimed at a relatively naive reader, one who has some basic understanding of the topic but requires additional education to understand the topic or issue being studied. Do not assume your audience knows as much as you do about the topic and literature! They don’t, so you have to write to educate them.


5. Evade affected verbiage and eschew obscuration of the obvious. In other words, limit big words; avoid jargon.

6. Start each major section of the review with an introduction that provides a brief overview of the section. “In this section, three main issues are examined. The first is . . .” This is also useful advice for introducing chapters in the report.

7. End major sections or chapters with a summary that indicates the main ideas, findings, or points.

Figure 2.6 Guidelines for technical writing.

out a home, there are three logical possibilities: (1) there is something wrong with your outline; (2) they do not belong in your review and should be discarded; or (3) they do not belong in your review but do belong somewhere else in your introduction. Opinion articles or reports of descriptive research often will be useful in the introduction, whereas formal research studies will be most useful in the review of related literature section.

3. Take all the references identified for a given subheading and analyze the similarities or differences among them. If three references say essentially the same thing, there is no need to describe each one; it is much better to make one summary statement followed by three references. For example:

Several studies have found white chalk to be more effective than yellow chalk in the teaching of advanced mathematics (Snud, 1995; Trivia, 1994; Ziggy, 1984).

Do not present your references as a series of abstracts or annotations (Jones found A, Smith found B, and Brown found C). Your task is to organize and summarize the references in a meaningful way. Do not ignore studies that are contradictory to most other studies or to your personal bias. Analyze and evaluate contradictory studies and try to determine a possible explanation. For example:

Contrary to these studies is the work of Rottenstudden (1998), who found yellow chalk to be more effective than white chalk in the teaching of trigonometry. However, the size of the treatment groups (two students per group) and the duration of the study (one class period) may have seriously affected the results.

4. The review should follow the references least related to the problem are discussed first, and the most related references are discussed last, just prior to the statement of the hypothesis. Think in terms of a big V. At the bottom of the V is your hypothesis; directly above your hypothesis are the studies most directly related to it, and so forth. The idea is to organize and present your literature in such a way that it leads logically to a tentative, testable conclusion, namely, your hypothesis. Highlight or summarize important aspects of the review to help readers identify them. If your problem has more than one major aspect, you may have two Vs or one V that logically leads to two tentative, testable conclusions.

5. The review should conclude with a brief summary of the literature and its implications. The length of this summary depends on the length of the review. It should be detailed
enough to clearly show the logic chain you have followed in arriving at your implications and tentative conclusions. Having systematically developed and presented your rationale, you will now be ready to state your hypothesis.

It is important to note that literature reviews are constructed in both quantitative and qualitative research, because of the obligation to place a study in the context of similar or related research. However, there often is a difference between the way the two types approach a literature review. A quantitative researcher normally follows the suggestions and steps for constructing a literature review just described.

Most qualitative researchers do not do a literature review until their study is well underway. Qualitative researchers require substantial time in the research setting (e.g., a school or classroom) and rely heavily on their observations and questioning to understand the research context. Qualitative researchers have a genuine concern about biasing their perceptions as a result of too-early immersion in the topic's related literature. In addition, most qualitative researchers enter the research setting with a broad topic or very tentative hunches about what their study will be, and only lock in a specific topic after observing, questioning, and "living" in the setting. Thus, qualitative researchers often conduct literature reviews later than do quantitative researchers, but ultimately both develop a literature review for which the suggestions just noted become pertinent.

FORMULATING AND STATING A HYPOTHESIS

To begin a research study, you have to have some idea or focus to narrow your research scope. This is true of both quantitative and qualitative research studies. Both quantitative and qualitative researchers deal with hypotheses, but the nature of each approach differs.

QUANTITATIVE DEFINITION AND PURPOSE OF HYPOTHESES

A hypothesis is a researcher's tentative prediction of the results of the research findings. It states the researcher's expectations about the relationship between the variables in the research topic. Many studies contain a number of variables, and it is not uncommon to have more than one hypothesis for a research topic. Note, that the researcher does not set out to prove a hypothesis, but rather, collects data that either support or do not support it. Hypotheses are essential to quantitative research studies, with the possible exception of some descriptive studies whose purpose is to answer certain specific questions.

Hypotheses are typically derived from a theory or the review of related literature. The review of the related literature often leads one to expect a certain relationship. For example, studies finding white chalk to be more effective than yellow chalk in teaching mathematics would lead a researcher to expect it to be more effective in teaching physics, if there were not other findings to the contrary. Similarly, a theory that suggested that the ability to think abstractly was quite different for 10-year-olds versus 15-year-olds might suggest a hypothesis stating that there would be a difference in the performance of 10- and 15-year-olds on a test of abstract reasoning.

Particularly with quantitative research, the hypotheses precede the conduct of the study because the nature of the study is determined by the hypothesis. Every aspect of the research is affected by the hypothesis, including participants, measuring instruments, design, procedures, data analysis, and conclusions. Although all hypotheses are based on theory or previous knowledge and are aimed at extending knowledge, they are not all of equal worth. A number of criteria are applied to construct useful hypotheses. This is especially important for quantitative researchers.
CHAPTER 2 SELECTING AND DEFINING A RESEARCH TOPIC

QUALITATIVE DEFINITION AND PURPOSE OF HYPOTHESES

As noted, the aims and strategies of qualitative researchers differ substantially from those of quantitative researchers. As a general rule, qualitative researchers do not state formal hypotheses prior to the study. Rather than testing a priori hypotheses, qualitative researchers are much more likely to generate new hypotheses as a result of their studies. The inductive process widely used in qualitative research is based on observing patterns and associations in the participants' natural setting without prior hunches or hypotheses of what researchers will study and observe. Qualitative researchers seek to understand the nature of their participants and contexts before stating a research focus or hypothesis. Note that qualitative researchers' reluctance to immediately start identifying variables and predictions stems from their view that contexts and participants differ and must be understood on their own terms before hypothesizing or judging. Thus qualitative researchers have more discretion in determining when and where to examine and/or narrow a topic.

Identifying patterns and associations in the setting often generates ideas and questions that lead to new hypotheses. For example, the repeated observation that early in the school year first-grade students can accurately identify who are the "smart" and who are the "not smart" students in class might suggest a hypothesis related to how teachers' actions and words communicate students' status in the classroom.

In simple terms, it is generally appropriate to say that a strength of quantitative research is in testing hypotheses, while that of qualitative research is in generating hypotheses.

CRITERIA FOR HYPOTHESES

A good hypothesis has the following characteristics:

1. It is based on sound reasoning.
2. It provides a reasonable explanation for the predicted outcome.
3. It clearly states the expected relationship between defined variables.
4. It is testable within a reasonable time frame.

By now it should be clear that a hypothesis should be based on a sound rationale. It derives from previous research or theory and its confirmation or disconfirming should contribute to educational theory or practice. Therefore, a major characteristic of a good hypothesis is that it is consistent with theory or previous research. The chances of your being a Christopher Columbus of educational research who is going to show that something believed to be "flat" is really "round" are slim! In areas of research where there are conflicting results, you will not be able to be consistent with all of them, but your hypothesis should follow from the rule, not from the exception.

A good hypothesis provides a reasonable explanation for the predicted outcome. If your telephone is out of order, you might hypothesize that it is because there are butterflies sitting on your telephone wires; such a hypothesis would not be a reasonable explanation. A more reasonable hypothesis might be that you forgot to pay your bill or that a repair crew is working outside. If a hypothesis suggested that schoolchildren with freckles pay attention longer than schoolchildren without freckles, it would not be a reasonable explanation for children's attention behavior. On the other hand, a hypothesis suggesting that children who have a good breakfast pay attention longer than children who have no breakfast is more reasonable.

A good hypothesis states as clearly and concisely as possible the expected relationship (or difference) between two variables and defines those variables in operational, that is, measurable, terms. A simply but clearly stated hypothesis makes it easier for readers to understand, simplifies its testing, and facilitates formulating conclusions. The relationship expressed between two variables may or may not be a causal one. For example, the variables anxiety and math
achievement might be hypothesized to be significantly related (there is a significant correlation between anxiety and math achievement), or it might be hypothesized that on math problems high-anxiety students perform better than low-anxiety students. The hypothesis that on math problems high-anxiety students perform better than low-anxiety students is an example of a causal relationship.

This example also illustrates the need for operational definitions that clearly describe variables. Operational definitions ask questions such as, "What kind of math problems?" "What does it mean to 'perform better'?" "What observable characteristics define a high-anxiety student?" In this example, high-anxiety student might be defined as any student whose score on the Acme Anxiety Inventory is in the upper 30% of student scores. A low-anxiety student might be defined as any student who scores in the lowest 30% of students on the Acme Anxiety Inventory. Higher performance on math problems might be defined in terms of math subtest scores on the California Achievement Test. Operational variables serve to clarify the meaning of important terms in a study so that all readers will understand the precise meaning the researcher intends.

If the hypothesis variables can be operationally defined within the actual hypothesis statement without making it unwieldy, you should do so. If not, state the hypothesis statement and define the appropriate terms immediately following it. Of course, if all necessary terms have already been defined, either within or immediately following the topic statement, there is no need to repeat the definitions in the statement of the hypothesis. The general rule of thumb is to define terms the first time you use them, but it does not hurt to occasionally remind readers of these definitions.

A well-stated and defined hypothesis must be testable (and it will be if it is well formulated and stated). It should be possible to test the hypothesis by collecting and analyzing data. It would not be possible to test a hypothesis that indicated that some students behave better than others because some have an invisible little angel on their right shoulder and some have an invisible little devil on their left shoulder. There would be no way to collect data to support the hypothesis. In addition to being testable, a good hypothesis should normally be testable within some reasonable period of time. For example, the hypothesis that first-grade students who brush their teeth after lunch every day will have fewer false teeth at age 60 would obviously take a very long time to test. The researcher would very likely be long gone before the study was completed, not to mention the negligible educational significance of the hypothesis! A more manageable hypothesis with the same theme might be that first-grade children who brush their teeth after lunch every day will have fewer cavities at the end of the first grade than those who don't brush.

**Types of Hypotheses**

Hypotheses can be classified in terms of how they are derived (inductive versus deductive hypotheses) or how they are stated (declarative versus null hypotheses). As noted in Chapter 1, an **inductive hypothesis** is a generalization based on specific observations. The researcher observes that certain patterns or associations among variables occur in a number of situations and uses these tentative observations to form an inductive hypothesis. For example, a researcher observes that in some eighth-grade classrooms students who are given essay tests appear to show less testing stress than those who are given multiple-choice tests. This observation could become the basis for an inductive hypothesis. **Deductive hypotheses** are generally derived from theory, based on the researcher's developing a specific prediction from general principles.

A **research hypothesis** states an expected relationship or difference between two variables. In other words, it specifies the relationship the quantitative researcher expects to verify in the research study. Research hypotheses can be nondirectional or directional. A
A non-directional hypothesis simply states that a relationship or difference exists between variables. A directional hypothesis states the expected direction of the relationship or difference. For example, a non-directional hypothesis might state the following:

There is a significant difference in the achievement of 10th-grade biology students who are instructed using interactive multimedia and those who receive regular instruction only.

The corresponding directional hypothesis might read as follows:

Tenth-grade biology students who are instructed using interactive multimedia achieve at a higher level than those who receive regular instruction only.

The non-directional hypothesis states that there will be a difference between the 10th-grade groups, while the directional hypothesis states that there will be a difference and that the difference will favor interactive media instruction. A directional hypothesis should only be stated if you have a basis for believing that the results will occur in the stated direction. Non-directional and directional hypotheses involve different types of statistical tests of significance, as will be examined in Chapter 5.

Finally, a null hypothesis states that there is no significant relationship or difference between variables. For example, a null hypothesis might state the following:

There is no significant difference in the achievement level of 10th-grade biology students who are instructed using interactive multimedia and those who receive regular instruction.

The null hypothesis is the hypothesis of choice when there is little research or theoretical support for a hypothesis. Also, statistical tests for the null hypothesis are more conservative than they are for directional hypotheses. The disadvantage of null hypotheses is that they rarely express the researcher's true expectations based on literature, insights, and logic. Given that few studies are really designed to verify the nonexistence of a relationship, it seems logical that most studies should be based on a nonnull hypothesis. Hypotheses are critical aspects of quantitative research approaches; they focus the study on the methods and strategies needed to collect data to test the hypotheses.

**STATING THE HYPOTHESIS**

A good hypothesis is stated clearly and concisely, expresses the relationship between two variables, and defines those variables in measurable terms. A general model for stating hypotheses for experimental studies is as follows:

P who get X do better on Y than
P who do not get X (or get some other X)

If this model appears to be an oversimplification, it is and it may not always be appropriate. However, this model should help you to understand the statement of a hypothesis. Further, this model, sometimes with variations, will be applicable in many situations. In the model,

P = the participants
X = the treatment, the causal or independent variable (IV)
Y = the study outcome, the effect or dependent variable (DV)

Study the following topic statement and see if you can identify the P, X, and Y.

The purpose of this study is to investigate the effectiveness of 12th-grade mentors on the absenteeism of low-achieving 10th graders.
PART 1 INTRODUCTION

In this example,

\[ P = \text{low-achieving 10th graders} \]
\[ X = \text{presence or absence of a 12th-grade mentor (IV)} \]
\[ Y = \text{absenteeism (days absent or, stated positively, days present) (DV)} \]

A review of the literature might indicate that mentors have been found to be effective in influencing younger students. Therefore, the directional hypothesis resulting from this topic might read,

Low-achieving 10th graders (P) who have a 12th-grade mentor (X) have less absenteeism (Y) than low-achieving 10th graders who do not.

As another example, suppose your topic statement was as follows:

The purpose of the proposed research is to investigate the effectiveness of different conflict resolution techniques in reducing the aggressive behaviors of high school students in an alternative educational setting.

For this topic statement,

\[ P = \text{high school students in an alternative educational setting} \]
\[ X = \text{type of conflict resolution (punishment or discussion) (IV)} \]
\[ Y = \text{instances of aggressive behaviors (DV)} \]

The related nondirectional hypothesis might read,

There will be a difference in the number of aggressive behaviors of high school students in an alternative educational setting who receive either punishment or discussion approaches to conflict resolution.

Got the idea? Let's try one more.

Topic Statement:

This study investigates the effectiveness of token reinforcement, in the form of free time given for the completion of practice worksheets, on the math computation skills of ninth-grade general math students.

\[ P = \text{ninth-grade general math students} \]
\[ X = \text{token reinforcement in the form of free time for completion of practice worksheets} \]
\[ Y = \text{math computation skills} \]

Hypothesis:

Ninth-grade general math students who receive token reinforcement in the form of free time when they complete their practice worksheets have higher math computation skills than ninth-grade general math students who do not receive token reinforcement for completed worksheets.

Of course, in all of these examples there are terms that require operational definition (e.g., clearly defining aggressive behaviors).

For the null hypothesis for this topic statement the paradigm is as follows:

There is no difference on Y (the outcome of the study) between \( P_1 \) (treatment A) and \( P_2 \) (treatment B).

\[ P_1 \text{ (treatment A) } = \text{free time} \]
\[ P_2 \text{ (treatment B) } = \text{no free time} \]
CHAPTER 2 SELECTING AND DEFINING A RESEARCH TOPIC

See if you can write the null hypothesis for the following problem statement:

The purpose of this study is to assess the impact of formal versus informal preschool reading instruction on first graders’ reading comprehension at the end of the first grade.

TESTING THE HYPOTHESIS

The researcher selects the sample, measuring instruments, design, and procedures that will enable her to collect the data necessary to test the hypothesis. Collected data are analyzed in a manner that permits the researcher to determine whether the hypothesis is supported. Note that analysis of the data does not lead to a hypothesis being proven or not proven, only supported or not supported for this particular study. The results of analysis indicate whether a hypothesis was supported or not supported for the particular participants, context, and instruments involved. Many beginning researchers have the misconception that if their hypothesis is not supported by their data, then their study is a failure, and conversely, if it is supported, then their study is a success. Neither of these beliefs is true. It is just as important to know what variables are not related as it is to know what variables are related. If a hypothesis is not supported, a valuable contribution may be made in the form of a revision of some aspect of a theory; such revision will generate new or revised hypotheses. Thus, hypothesis testing contributes to education primarily by expanding, refining, or revising its knowledge base.

SUMMARY

Identifying a Topic or Question to Research

1. The first step in selecting a research topic is to identify a general area that is related to your area of expertise and is of particular interest to you.

Sources of Research Topics

2. There are four main sources of research topics: theory, personal experience, replication, and library immersion.

3. Theories are composed of organized bodies of concepts, generalizations, and principles. Research studies often study particular aspects of a theory to determine its applicability or generalizability.

4. A researcher’s personal experiences and concerns often lead to useful and personally rewarding studies. Common questions, such as, “Why does that happen?” and “What would happen if . . . ?” can be rich topic sources if followed up.

5. Replication, repeating an existing study, is a common source of research topics. Replication usually involves some feature differing from the original study.

6. Library immersion in the literature in a problem area is generally not an efficient way to identify a research topic. Handbooks, encyclopedias, and yearbooks that cover many topics briefly are more useful. Of course, library resources will be invaluable once you have identified a topic to study.

Narrowing the Topic

7. Once an initial topic is identified, it often needs to be narrowed and focused into a manageable topic to study.

8. Qualitative and quantitative research often differ in the timing of narrowing their topics. Quantitative research topics are usually narrowed quickly. Qualitative research topics are not usually narrowed until the researcher has more information about the participants and their setting.

Characteristics of Good Topics

9. A basic characteristic of a research problem is that it is researchable using the collection and analysis of data. Topics related to philosophical, ethical, and “should” topics are not researchable.

10. A good problem has theoretical or practical significance; its solution contributes in some way to improving the educational process.
11. A good topic must be a topic that can be adequately investigated given your (1) current level of research skill, (2) available resources, and (3) time and other restrictions.

12. A good topic is one that is ethical, that is, a study that does not harm participants in any way.

Stating the Research Topic

13. A well-written topic statement for a quantitative study generally indicates the variables of interest to the researcher, the specific relationship between those variables that is to be investigated, and, ideally, the type of participants involved.

14. A well-written quantitative topic statement also defines all relevant variables, either directly or operationally; operational definitions define concepts in terms of measurable characteristics.

15. The statement of the problem should indicate the background of the problem, including a justification for the study in terms of its significance.

16. Qualitative research topics usually are stated later than quantitative research topics because qualitative researchers need to become attuned to the research context before narrowing their topic.

17. The topic statement is the first item in the introductory section of a research plan and provides direction for all remaining aspects of the study.

Review of Related Literature

Definition, Purpose, and Scope

18. The review of related literature involves systematically identifying, locating, and analyzing documents pertaining to the research topic.

19. The major purpose of reviewing the literature is to identify information that already exists about your topic. Qualitative researchers usually review the literature later than quantitative researchers.

20. The literature review can point out research strategies, procedures, and instruments that have and have not been found to be productive in investigating your topic.

21. A smaller, well-organized review is preferred to a review containing many studies that are more or less related to the problem.

22. Heavily researched areas usually provide enough references directly related to a topic to eliminate the need for reporting less related or secondary studies. Little-researched topics usually require review of any study related in some meaningful way in order to develop a logical framework and rationale for the study.

23. A common misconception is the idea that the worth of a problem is a function of the amount of literature available on the topic. Unfortunately, there is no formula that indicates how much literature has to be reviewed for a given topic.

Getting Started

24. Find out what references are available and where they are located. Resources such as handbooks, encyclopedias, and yearbooks are useful starting places to obtain an overview of your topic and useful references to examine.

25. You should also be familiar with services offered by your library. Most libraries have tours or written materials describing the resources and their use. Reference librarians will be of most help in planning and executing your literature review.

26. Before the review, make a list of keywords related to your problem to guide your search.

Identifying Your Sources

27. A primary source is a study written by the person who conducted it; a secondary source is generally a much briefer description of a study written by someone other than the original researcher. Primary sources are preferred in the review.

28. There is a difference between the opinion of an author and the results of an empirical study. The latter is more valued in a review.

Searching for Books on Your Topic in the Library

29. A good starting point to obtain a perspective on a topic and identify literature sources is to look in your library at handbooks, encyclopedias, and reviews in your topic area.

30. Most libraries use a computer catalog system that indexes all of the sources in the library by author, title, and subject. Familiarize yourself with your library and its resources.

31. If you are at the beginning of a literature search for primary references, you might not have identified specific titles or authors to search for. A keyword search uses terms or phrases pertinent to your topic to search and identify potentially useful literature sources.

32. Keyword searches can be focused by using the Boolean operators and, or, and not. Using and or not narrows a search and the number of sources identified, while or broadens the search and acquired sources. It is often best to start with a narrow search.
CHAPTER 2 SELECTING AND DEFINING A RESEARCH TOPIC

Consulting Computer Databases
13. Computerized databases can facilitate identifying relevant primary sources. Among the most used are ERIC, Education Index, Psychological Abstracts, and Dissertation Abstracts. Most of these sources provide abstracts of literature.

Searching the Internet and the World Wide Web
34. The Internet links organizations and individuals all over the world. The World Wide Web is on the Internet.
35. To access the Internet you need a computer with a modem hooked to a telephone or cable line and a browser to get you onto the Web. Alternatively, you can access the Internet at most libraries.
36. Since the available resources on the World Wide Web are virtually limitless, the best way to become familiar with its use is to “surf around” in your spare time. Talk to other Internet users when you have a question.
37. The Web contains a variety of sites relevant to an educational researcher. Each site is reached by using its Internet address. Addresses containing .edu or ending in .edu are related to educational institutions and those ending in .com are related to commercial enterprises.
38. Search engines allow the user to search the Internet. Most search engines list a variety of topics that can be used to focus a search. Search engines also allow keyword searches that encompass large portions of the World Wide Web.
39. It cannot be overemphasized that material on the World Wide Web is not screened for quality, honesty, bias, or authenticity. Virtually anyone can put anything on the Web. Thus, users must be careful not to assume that all material obtained from the Web is useful or accurate just because it comes from the Internet.
40. Combining a library search with a Web search will probably produce the most useful material.

Evaluating Your Sources
41. All identified sources must be evaluated for quality and applicability. Are sources up to date? Are they from refereed journals? Do they pertain directly to the research topic?

Abstracting
42. Abstracting involves locating, reviewing, summarizing, and classifying your references.

43. The main advantage of beginning with the latest references on your topic is that the most recent studies are likely to have profited from previous research. Also, references in more recent studies often contain references to other studies you had not identified.
44. For each reference, list the complete bibliographic record, including author’s name, date of publication, title, journal name or book title, volume number, issue number, page numbers, and library call number. Identify main ideas. Put quotation marks around quotes taken from the reference and don’t forget to get page numbers of the quote. Keep all references in the format required for research reports or dissertations.
45. Make a copy of your references and put it in a safe place.

Analyzing, Organizing, and Reporting the Literature
46. Describing and reporting research call for a different style of writing than commonly used. Technical writing requires documenting facts and substantiating opinions, clarifying definitions and using them consistently, using an accepted style manual, and starting sections with an introduction and ending them with a brief summary.
47. The following guidelines should be helpful: make an outline; sort your references into appropriate topic piles; analyze the relationships and differences between references in a given subheading; do not present your references as a series of abstracts or annotations; discuss references least related to the problem first; and conclude with a brief summary of the literature and its implications.
48. Both qualitative and quantitative researchers construct literature reviews. Qualitative researchers are more likely to construct their review after starting their study, while quantitative researchers are more likely to construct the review prior to starting their study.

Formulating and Stating a Hypothesis
49. A hypothesis is the researcher’s tentative predictions of the research findings. Hypotheses are more common in quantitative than qualitative research.
50. Researchers do not set out to “prove” a hypothesis but rather collect data that either support or do not support it.
51. A hypothesis is formulated based on a theory or the review of related literature. The hypothesis logically follows the literature review and is based on the implications of previous research.
Criteria for Hypotheses

52. A critical characteristic of a good hypothesis is that it is based on a sound rationale. A hypothesis is a reasoned prediction, not a wild guess. It is a tentative, but rational, explanation for the predicted outcome.

53. A good hypothesis states as clearly and concisely as possible the expected relationship (or difference) between variables. Variables should be stated in measurable terms.

54. A well-stated and defined hypothesis must be testable.

Types of Hypotheses

55. An inductive hypothesis is a generalization made from a number of observations. A deductive hypothesis is derived from theory and is aimed at providing evidence that supports, expands, or contradicts aspects of a given theory. Deductive, quantitative hypotheses are more common than inductive, qualitative hypotheses.

56. A research hypothesis states the expected relationship (or difference) between two variables. It states the relationship the researcher expects to verify through the collection and analysis of data. Research hypotheses can be nondirectional, directional, or null.

57. A nondirectional hypothesis indicates that a relationship or difference exists but does not indicate the direction of the difference; a directional hypothesis indicates that a relationship or difference exists and indicates the direction of the difference. A null hypothesis states that there will be no significant relationship (or difference) between variables.

Stating the Hypothesis

58. A general paradigm, or model, for stating hypotheses for experimental studies is as follows: P who get X do better on Y than P who do not get X (or get some other X). P refers to participants, X refers to the treatment or independent variable (IV), and Y refers to the outcome or dependent variable (DV).

Testing the Hypothesis

59. Hypotheses are tested using statistical analyses of data gathered in the study.

60. It is just as important to know which variables are not related as it is to know which variables are.
The introduction that you develop for Task 2 will be the first part of the research report required for Task 10. Therefore, it may save you some revision time later if, when appropriate, statements are expressed in the past tense (the topic investigated was or it was hypothesized, for example). Your introduction should include the following subheadings and contain the following types of information:

- **Introduction (Background and significance of the problem)**
- **Statement of the Problem (Problem statement and necessary definitions)**
- **Review of the Literature (Don't forget the big V)**
- **Statement of the Hypothesis(es)**

As a guideline, three typed pages will generally be sufficient length for Task 2. Of course, in a real study you would review not just 10 to 15 references but all relevant references, and your introduction would be correspondingly longer.

Because of feedback from your instructor on Objective 4, and insight gained through developing your review of related literature, the hypothesis you state in Task 2 may very well be somewhat different from the one you stated for Objective 4 on page 39.

One final note: The hypothesis you formulate now will influence all further tasks—that is, the what you will be your participants, what they will do, and so forth. In this connection, the following is an informal observation based on the behavior of thousands of students, not a research-based finding. All beginning research students fall some place on a continuum of realism. At one extreme are the Cecil B. Demise students who want to design a study involving a small sample of hundreds of participants. At the other extreme are the Mr. Magi students who will not even consider a procedure unless they know for sure they could actually conduct it in their work setting, with their students or clients. Since you do not have to actually implement the study you design, feel free to operate in the manner most comfortable for you. Keep in mind, however, that there is a middle ground between Demise and Magi.

On the following pages an example is presented that illustrates the format and content of the introduction that meets the criteria just described (see the following Task 2 example). This example (and succeeding qualitative task examples), with few modifications, represents a task as submitted by a former student in an introductory educational research course—Ms. Jane Caldon, Florida International University. While an example from published research could have been used, the example given more accurately reflects the performance that is expected of you at your current level of expertise. Additional examples for this and subsequent tasks are included in the Student Guide that accompanies this text.
Effect of Interactive Multimedia on the Achievement of 10th-Grade Biology Students

Introduction

One of the major concerns of educators and parents alike is the decline in student achievement (as measured by standardized tests). An area of particular concern is science education where the high-level thinking skills and problem solving techniques so necessary for success in our technological society need to be developed (Smith & Westhoff, 1992).

Research is constantly providing new proven methods for educators to use, and technology has developed all kinds of tools ideally suited to the classroom. One such tool is interactive multimedia (IMM). IMM provides teachers with an extensive amount of data in a number of different formats including text, sound, and video, making it possible to appeal to the different learning styles of the students and to offer a variety of material for students to analyze (Howson & Davis, 1992).

When teachers use IMM, students become highly motivated, which results in improved class attendance and more completed assignments (O'Connor, 1993). Students also become actively involved in their own learning, encouraging comprehension rather than mere memorization of facts (Kneedler, 1993; Reeves, 1992).

Statement of the Problem

The purpose of this study was to investigate the effect of interactive multimedia on the achievement of 10th-grade biology students. Interactive multimedia was defined as “a computerized database that allows users to access information in multiple forms, including text, graphics, video and audio” (Reeves, 1992, p. 47).

Review of Related Literature

Due to modern technology, students receive more information from visual sources than they do from the written word, and yet in school the majority of information is still transmitted through textbooks. While textbooks cover a wide range of topics superficially, IMM provides in-depth information on essential topics in a format that students find interesting (Kneedler, 1993). Smith and Westhoff (1992) note that when student interest is sparked, curiosity levels are increased and students are motivated to ask questions. The interactive nature of multimedia allows the students to seek out their own answers and by so doing they become owners of the concept involved. Ownership translates into comprehension (Howson & Davis, 1992).

Many science concepts are learned through observation of experiments. Using multimedia, students can participate in a variety of experiments that are either too expensive, too lengthy, or too dangerous to carry out in the laboratory (Howson & Davis, 1992; Leonard, 1989; Louie, Sweat, Gresham, & Smith, 1991). While observing the experiments the students can discuss what is happening and ask questions. At the touch of a button teachers are able to replay any part of the proceedings, and they also have random access to related information that can be used to completely illustrate the answer to the question (Howson & Davis, 1992). By answering students’ questions in this detailed way the content will become more relevant to the needs of the student (Smith & Westhoff, 1992). When knowledge is relevant students are able to use it to solve problems and, in so doing, develop higher-level thinking skills (Helms & Helms, 1992; Sherwood, Kinzer, Bransford, & Franks, 1987).
A major challenge of science education is to provide students with large amounts of information that will encourage them to be analytical (Howson & Davis, 1992; Sherwood et al., 1987). IMM offers electronic access to extensive information allowing students to organize, evaluate and use it in the solution of problems (Smith & Wilson, 1993). When information is introduced as an aid to problem solving, it becomes a tool with which to solve other problems, rather than a series of solitary, disconnected facts (Sherwood et al., 1987).

Although critics complain that IMM is entertainment and students do not learn from it (Corcoran, 1989), research has shown that student learning does improve when IMM is used in the classroom (Sherwood et al., 1987; Sherwood & Others, 1990). A 1987 study by Sherwood et al., for example, showed that seventh- and eighth-grade science students receiving instruction enhanced with IMM had better retention of that information, and O'Connor (1993) found that the use of IMM in high school mathematics and science increased the focus on students' problem solving and critical thinking skills.

**Statement of the Hypothesis**

The quality and quantity of software available for science classes has dramatically improved during the past decade. Although some research has been carried out on the effects of IMM on student achievement in science, due to promising updates in the technology involved, further study is warranted. Therefore, it was hypothesized that 10th-grade biology students whose teachers use IMM as part of their instructional technique will exhibit significantly higher achievement than 10th-grade biology students whose teachers do not use IMM.

**References**


