

Levels of knowledge (*decreasing reliability*):

- ↪ intuition
- ↪ introspection
- ↪ shared public experience
- ↪ single case study
- ↪ systematic observation
- ↪ scientific method (heuristic paradigm)

Fundamental types of research:

- A. **Analytical** research
- B. **Descriptive** research
- C. **Experimental** research
- D. **Qualitative** research

A. ANALYTICAL RESEARCH:

- ✦ **Historical** research: focus on events, organizations, institutions and people
- ✦ **Philosophical** research: critical inquiry of objectives, curricula, course content, requirements and methodology
- ✦ **Reviews**: critical analysis, evaluation and integration of published literature on particular topic
- ✦ **Research synthesis: META-ANALYSIS** (1977)

B. **DESCRIPTIVE RESEARCH:**

- ◆ **Questionnaire:** responses from persons from wide geographical area on present practices, conditions, demographic data, opinions or knowledge
- ◆ **Interview:** advantages over questionnaire (rephrase, clarify, validate); telephone interviews popular
- ◆ **Normative survey:** gather performance or knowledge data on large sample and present results in form of comparative standards (or norms), e.g. percentiles of motor fitness
- ◆ **Case study:** detailed (anecdotal) consideration of individual, company, community, process etc. over period of time, in order to illustrate thesis/principle or determine unique characteristics (used in medicine, psychology, counseling and sociology)
- ◆ **Job analysis:** describe in detail duties, procedures, responsibilities, preparations, advantages and disadvantages of particular job (used in vocational training and counseling)

B. DESCRIPTIVE RESEARCH (*continued*):

- ✦ **Documentary (content) analysis:** establish status of certain practices, areas of interest, prevalence of certain errors, usage of terms, space counts (used in literature reviews, historical studies etc.); e.g. examine coverage of certain sports or recreational activities in newspapers or magazines; examine use of statistical procedures in research journals
- ✦ **Developmental studies:** interaction of learning or performance with maturation
- ✦ **Correlational studies:** relationship of smoking and lung cancer, heart rate and exertion, anxiety and pain tolerance, attitude and behavior; correlation is described BUT cause-and-effect cannot be prescribed!

C. EXPERIMENTAL RESEARCH:

“Real” scientific research, manipulating treatments in an attempt to establish cause-and-effect relationships

D. QUALITATIVE RESEARCH:

- »»»»→ systematic method of inquiry yet rarely established initial hypotheses
- »»»»→ intensive, long-time observation and extensive interviewing in natural setting
- »»»»→ precise detailed recording of happenings in setting employing field notes, audiotapes, videotapes etc.
- »»»»→ researcher primary instrument in data collection and analysis through intensive first-hand presence
- »»»»→ interpretation and analysis of data using rich description, narratives, quotes, charts, tables and descriptive statistics

RESEARCH PROPOSAL = formal preparation including:

- ◆ introduction
- ◆ review of literature
- ◆ proposed method for conducting study

RESEARCH THESIS/DISSERTATION:

◆ **introduction**

- »»»➤ define and delimit problem
- »»»➤ state research hypothesis
- »»»➤ define terms critical to the study
- »»»➤ acknowledge basic assumptions

◆ **literature review:** role in formulating hypotheses and deductive reasoning to problem statement

◆ **scientific method:**

- »»»➤ gather data
- »»»➤ identify subjects, describe measuring instruments
- »»»➤ present measurement and treatment procedures, explain experimental design
- »»»➤ summarize methods of data analysis

◆ **results:**

- »»»➤ scrutinize as to meaningfulness and reliability
- »»»➤ present findings from data analysis
- »»»➤ represent contribution to new knowledge

RESEARCH THESIS/DISSERTATION (*continued*):

✦ discussion:

- »»»➤ inductive reasoning to analyze findings
- »»»➤ compare findings with previous studies
- »»»➤ integrate findings into theoretical model

✦ conclusions:

- »»»➤ make conclusions on the basis of analysis and discussion (conclusions address purpose and subpurpose of study)

Advantages of formally learning RESEARCH METHODS:

- ✓ approach and solve problems in scientific way
- ✓ search literature efficiently
- ✓ write in clear, scientific fashion
- ✓ understand basic measurement and statistical issues
- ✓ use appropriate writing style
- ✓ be intelligent consumer of research
- ✓ appreciate wide variety of research strategies and techniques

Guidelines for finding research topics:

- ☞ research spawns other research ideas: *be aware of research done at your institution or other professional affiliation*
- ☞ be alert for lively, controversial issues in area(s) of interest: *talk to professors and advanced graduate students*
- ☞ read review journal or conference paper or at least recent textbook; from there, read several research studies referenced and locate other current research papers on the topic; make list of unanswered research questions; pick problems that are neither too hard nor too easy (*hard ones take forever; no one cares about easy ones*)
- ☞ find out how experts develop research problems (*read, hear, ask*)

Criteria on selecting appropriate research problem

- **workability:** manageable within limits/range of resource and time constraints
- **critical mass:** sufficient magnitude, scope and potential results (*“enough to write about”*)
- **interest:** related to background, career interests; useful skills to be learned; interesting (*“turns you on”*)
- **theoretical value:** fills gap in literature, contributes advancement in the field, improves *“state of the art”*, others will recognize its importance
 - ✗ avoid saturated (*“fished out”*) topics with help by advisor
- **practical value:** will improve practice in the field

INDUCTIVE REASONING

- individual observations
- formulation of various hypotheses
- tie into specific hypotheses
- group into more general explanation
- unite into theory

[**CLOSED-LOOP THEORY** of Motor Skill Learning]

[**SCHEMA Theory**]

[**VARIABILITY OF PRACTICE**]

Inappropriate induction:

- train cockroach to jump on command
- remove bug's (six) legs one at a time
- when all legs removed, observe that bug does not jump
- conclude that when all the legs are removed from a cockroach, the bug becomes deaf!

Purposes of **LITERATURE REVIEW**

- **identify problem:** read key studies to produce several ideas and unresolved questions; advisor will help you eliminate unproductive approaches and dead ends
- once problem identified, commence **intensive library search**
- develop **research hypothesis**
- develop appropriate **method** to test hypothesis: planning and pilot work essential!

Steps in literature search:

- » write **problem statement** completely but concisely
- » consult **secondary sources**: encyclopedias, research reviews (invaluable - contain suggestions for areas of needed research)
- » determine major and minor descriptors (**keywords**)
- » search **preliminary sources**: abstracts, poster sessions, indexes to magazine and journal articles re specific topics (e.g. **CURRENT CONTENTS**), (annotated) bibliographies (watch for incorrect entries!), computerized Library Information System (or card catalog), microfiche/microform/microfilm, computer databases
- » read, understand and meticulously **record** the literature (including exact citation information):
 - ◆ problem statement and hypotheses
 - ◆ characteristics of subjects
 - ◆ instruments and tests used (including reliability and validity info)
 - ◆ testing procedures
 - ◆ independent (explanatory) and dependent (response) variables
 - ◆ experimental treatments applied to subjects
 - ◆ design and statistical analyses

- ◆ findings
- ◆ questions raised for further study
- ◆ citations to other relevant studies (*include them in photocopying!*)
- »»» write all parts of **literature review**:
 - ◆ **INTRODUCTION**: explain review purpose and detail its organization
 - ◆ **MAIN BODY**: organized around important topics; synthesized and written in clear, concise and interesting prose (*scientific writing does not have to be complex and circuitous - write as you like to read!*)
 - ◆ **SUMMARY AND CONCLUSIONS**: address important implications and suggest directions for further research

Document literature search as combination of:

- »»» **photocopying**
- »»» **note taking**

Search literature backwards in time!

Read sources yourself rather than relying on other author's critical review!

First part of **THESIS** or **DISSERTATION**:

◆ **TITLE:**

- determine after study is written!
- concise but inclusive
 - ◆ *Have you read the paper?*
 - ◆ *Yes, but I haven't finished the title yet!*
- include keywords
- avoid “waste” words and phrases:
 - ✗ ...an analysis of...
 - ✗ ...a study of...

◆ **INTRODUCTION:**

- do not get too technical
- forceful, simple and direct vocabulary makes effective communication
 - ↳ *The efficacy of hydrochloric acid is indisputable, but the corrosive residue is incompatible with metallic permanence.*
 - ↳ *We cannot assume responsibility for the production of toxic and noxious residues with hydrochloric acid and suggest that you use an alternative procedure.*
 - ↳ *Don't use hydrochloric acid. It eats the hell out of pipes.*
- introductory paragraphs should create interest in the study: introduce necessary background information quickly and explain the rationale behind the study

◆ **PROBLEM STATEMENT**

➤ introduce variables:

☞ **control** variables: kept out of the study

☞ **categorical** or moderator variables:
independent qualitative variables

☞ **extraneous** variables: factors that could affect relationship between independent and dependent variables but that is not included or controlled

➤ structure problem statement

◆ Present **hypotheses**:

➤ **research (working) hypothesis**: deduced from theory or induced from empirical studies; based upon logical reasoning and predictive of outcome of study (expected results)

➤ **null hypothesis**: no difference between the treatments or no relationship among variables

◆ **Operational definitions**: observable phenomena that enable researcher to empirically test whether predicted outcomes can be supported

✦ **Assumptions** and **limitations**:

- **limitation**: possible shortcoming or influence that either cannot be controlled or is the result of the delimitations imposed by investigator
 - **delimitation**: limitation imposed by researcher in scope of study (choice the researcher makes to effect workable research problem)
- ✦ **Significance** of the study: need for the study
- ✓ special section in first chapter

Formulation of **RESEARCH METHOD**

- ✦ subjects
- ✦ instruments or apparatus
- ✦ procedures
- ✦ design and analysis

MAXICON principle:

- **MAX**imize **true** variance
- **min**imize **error** variance
- **CON**trol **extraneous** variance

Good sense when planning experiments:

- ✓ **LESS IS MORE**: do not plan complex studies with too many independent and dependent variables
- ✓ **SIMPLE IS BETTER**: keep text straightforward, plot data graphically and evaluate it carefully

Describing SUBJECTS:

- Characteristics to consider while selecting subjects:
 - age (children, elderly) & gender
 - level of training (untrained, trained)
 - level of performance (novices or experts)
 - size (weight, fat)
 - special types (athletes, cyclists, runners)
- Can you obtain necessary **permission** and **cooperation** from subjects?
- Can you find enough subjects?
- Protect subjects (*use consent forms*): **ethical** issues, e.g. obtain informed consent of humans, ensure protection and care of animals

Describing INSTRUMENTS:

- validity and reliability of measurements?
- difficulty of obtaining measurements? access to instruments, tests or apparatus?
- do you know how to administer tests or use equipment?
- do you know how to evaluate subject's test performance?
- will tests, instruments or apparatus yield reasonable range of scores for selected subjects?
- will subjects be willing to spend time required to administer tests?

Describing PROCEDURES:

◆ Collecting data:

- »»»» When? Where? How much time required?
- »»»» Have pilot data to demonstrate skill and knowledge in using tests and equipment as well as how subjects will respond?
- »»»» Developed scheme for data acquisition, recording and (computer controlled) scoring?

◆ Planning treatments

- »»»» How long? How intense? How often?
- »»»» How will adherence of subjects to treatments be determined?
- »»»» Have pilot data to show how subjects respond to treatments and that you can administer these treatments?
- »»»» Have selected appropriate treatments for type of subjects used?
- »»»» Use pilot work to correct methodological flaws and save thesis or dissertation!

- ✓ *Minimize, standardize and randomize contact between people testers and people subjects in people experiments!*
- ✓ *Importance of pilot work*

ETHICAL ISSUES:

- **plagiarism:** using ideas, concepts, writings and drawings of others as own (“cheating”)
- **fabrication and falsification:** making up or altering (“cooking”) research data (“*I only need a few more subjects but I’ running out of time*”)
- **nonpublication** (exclusion) of data unsupportive of desired outcome (“eliminating *bad* data”)
- **faulty DATA-GATHERING techniques:**
 - continue with data collections on subjects who do not meet requirements of research, e.g. failure to adhere to dietary or exercise regime
 - utilize malfunctioning equipment
 - inappropriate treatment of subjects, e.g. failure to follow guidelines
 - systematically record data incorrectly
- poor data storage and proper retention in unaltered form: original data should always be available for examination!
- **misleading authorship:** order of authorship for presentations and publications should reflect actual contributions to the project
 - technicians do not necessarily become joint authors
 - only those directly contributing to the specific research project are included

- ➡ avoid **sneaky publication practices**:
 - ✗ only second authorship for thesis or dissertation supervisor
 - ✗ extra care with dual publications: must not be “same paper”
- ➡ fair use of **copyrighted** material:
 - ✓ commercial or educational purpose?
 - ✓ copying reasonably expected? (*copying entire book definite no-no*)
 - ✓ is a “significant” part to be copied?
 - ✓ does copying affect the document market?

Pressures on **GRADUATE STUDENTS**:

- ✗ need to obtain external funding for research
- ✗ pressure to publish scholarly findings
- ✗ need to complete graduate degree work
- ✗ desire to obtain rewards in higher education, e.g. promotion, merit

Rights of **HUMAN SUBJECTS**:

- ✓ **privacy** or **nonparticipation**: do not ask unnecessary information, obtain consent
- ✓ **anonymity**: ID to characterize subjects
- ✓ **confidentiality**: inform subjects who will have access to original data by which subjects may be identified
- ✓ **experimenter responsibility**: sensitive to human dignity