

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:

- ➥ **MAXimize true** variance
- ➥ **minimize error** variance
- ➥ **CONtrol 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’m 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