**Dimensions of Research  
Characterizing Research, Research Designs, and Research Studies  
A Comprehensive Faceted Classification**

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**Introductory note on scope and limitations**

* The classification is focused on social and behavioral sciences, but the principles are general.
* It is a resource for students in a one-semester course in research methods (for many the only course in research methods they will take), so it is selective rather than encyclopedic.
* It started out as a guide through Wildemuth 2017 *Application of social research methods to questions in Information and Library Science* t. So the selection of topics included in parts 3 - 5 largely follows Wildemuth; the topic sequence is different.
* There are many definitions, explanations, and/or examples, some from me ({DS}), others assembled from many sources given in {} (see list at the end); source tracking is not complete. Annotations represent different perspectives with some disagreement and some repetition.
* While independence of dimensions is desirable, reality is not so simple. Two dimensions may look at the same conceptual distinction from different perspectives or overlap in other ways.
* Distinction are rarely dichotomous but rather the two ends of a continuum.
* *Research, research design,* and (*research) study* are used somewhat interchangeably, with word choice depending on context.

Wildemuth chapters are indicated by ● , e.g., ●Quasi-experimental Studies. W-Ch. 11, p. 91 – 102

**Tip:** To find a concept number, search for the number followed by a space

**1 Why research? Use of results, research purposes, types of results / knowledge discovered. Research topic.**

**1a- 1e Dimensions related to study purpose and use of study result**s

1a The basic research ꟷ applied research continuum

1b General purposes / applications / uses of research results

1c Specific purposes of research

1d Idiographic vs. nomothetic research

1e Exploratory vs. confirmatory research

**1f - 1i What is being studied**

1f Study by topic

1g Unit of analysis in the study

1h Developing a research topic / research problem and research question

1i Study by regulatory requirements (depend on topic, unit of analysis, and research question)

**1j - 1k Dimensions related to the creation and distribution of knowledge**

1j Degree to which the study adds to the general stock of knowledge

1k Scope of distribution and use of study results

**2 General ways of gaining knowledge**

2a Underlying basic assumptions guiding the conduct of research

2b Research design by basic approach to gaining insight / type of knowledge produced

2c Approaches to empirical research

2d How close to original data or thought? Direct vs. indirect research

2e Degree of flexibility of research protocol

2f Stage of research study (just one example)

2g Research by organizational arrangement

**Parts 3 - 5. Specific research methods in the social sciences**

**3 Overall design of research studies.** Scope and sampling, population studied, time scope, context

3a Research Design by scope of study and sampling

3b Studies by population studied

3c Study by how phenomena are followed over time

3d Research by context / environment

3e Research design by role of participant

3f Research design by getting individual opinion vs getting consensus opinion

**4 Sources of data and methods for data collection**

4a Existing documents as data sources

4b Observation (of individual participants, groups, events, . . .)

4c Eliciting free-form, mostly spoken, answers to open-ended questions

4d Eliciting ✓ or scale value answers to closed questions. Structured questionnaires and interviews

4e Specific types of variables

**5 Methods for data analysis**

5a Methods for qualitative analysis

5b Methods for qualitative and structural analysis (qualitative or quantitative)

5c Methods for quantitative analysis. Statistical Analysis

. 5d Machine learning

**1 Why research? Use of results, research purposes, types of results / knowledge discovered.  
Research topic**.

**1a- 1e Dimensions related to study purpose and use of study results**

. **1a The basic research ꟷ applied research continuum**

. . **1a1** Basic research

. . **1a2** Applied research

. . . **1a2.1** Research and Development (R&D). Design

. . . . **1a2.1.1** Participatory design

. . . . **1a2.1.2** Human-centered design

. . . . **1a2.1.3** Usability study

. . . **1a2.2** Action research

. . . **1a2.3** Evaluation and assessment research

. . . . **1a2.3.1** Formative vs summative evaluation

. . . . . **1a2.3.1,1** Formative evaluation

. . . . . **1a2.3.1,2** Summative evaluation

. . . . **1a2.3.2** Impact assessment research

. **1b General purposes / applications / uses of research results**

. . **1b1** Purposes of basic research )

. . . **1b1.1** Understand the world around us and within us

. . . **1b1.2** Pursue interesting questions arising from curiosity, the wish to know, to expand the frontiers of knowledge

. . . **1b1.3** Build theory

. . . **1b1.4** Develop better research methods

. . **1b2** Purposes of applied research

. . . **1b2.1** Inform action. Evidence-based practice. Translation of research results into practice

. . . **1b2.2** Provide tools for practice

. . . . **1b2.2.1** Support Design / produce a product / artefact / mentefact

. . . . **1b2.2.2** Develop methods for assessment, diagnosis, and treatment

(including, but not restricted to, medicine)

. . . **1b2.3** Environmental scanning and prediction

. . . **1b2.4** Testing / assessment / evaluation to support decision making and accountability

. **1c Specific purposes of research**

. **1d Idiographic vs. nomothetic research**

. . **1d1** Idiographic research

. . **1d2** Nomothetic research

. **1e Exploratory vs. confirmatory research**

. . **1e1** Exploratory research

. . **1e2** Confirmatory research

**1f - 1g What is being studied**

. **1f Topic of the study**

. . **1f0** Methodological vs. subject matter contribution of the study

. . . **1f0.1** Emphasis on developing or testing/validating method**s**

. . . **1f0.2** Emphasis on shedding light on phenomena

. . **1f1** Subject matter of the study

. . . **1f1.1** Example: Communication research

. . . . **1f1.1.1** Control analysis (source)

. . . . **1f1.1.2** Content analysis (message)

. . . . **1f1.1.3** Media analysis (channel)

. . . . **1f1.1.4** Audience analysis (receiver).

. . . . **1f1.1.5** Impact analysis (effects)

. . **1f2** Time scope of the study

. . . **1f2.1** Relative time of the study

. . . . **1f2.1.1** Study of the past

. . . . **1f2.1.2** Study of the present

. . . . **1f2.1.3** Study of the future

. . . **1f2.1** Chronological time of the study

. . **1f3** Spatial scope of the study

. **1g Unit of analysis in the study**

. . **1g1** Study deals with mentefacts

. . **1g2** Study deals with natural or designed processes, techniques

. . **1g3** Study deals with non-living natural or man-made material objects

. . **1g4** Study deals with places

. . **1g5** Study deals with living organisms and groups thereof

. . **1g6** Study deals with people or groups of people

. . . **1g6.1** Study deals with individual people

. . . **1g6.2** Study deals with groups of people

. . . **1g6.3** Study deals with organizations

. . . **1g6.4** Study deals with social artifacts

. . . **1g6.5** Comprehensive example

. **1h Developing a research topic / research problem and research questions**

. . **1h1** Motivation for a research questions

. . . **1h1.1** ●Developing a Research Question. **W-Ch. 2**, p. 11 - 20

. . . **1h1.2** ●Research question originating from theory or researcher curiosity. **W-Ch. 6**, p. 41 – 48.

. . . **1h1.3** ●Research question originating from practice. **W-Ch. 3**, p. 21 - 27

. . **1h2** Research question by type of study

. . . **1h2.1** Research questions for descriptive studies.

. . . . **1h2.1.1** ●Descriptions of Phenomena or Settings**.** **W-Ch. 4,** p. 28–33

. . . **1h2.2** Research questions for explanatory / causal / analytical studies

**. . . . 1h2.2.1** ●Research questions answered by testing hypotheses. **W-Ch. 5**, p. 34 – 40

. **1i Study by regulatory requirements (depend on topic, unit of analysis, and research question)**

. . **1i1** Study does not require IRB review

. . **1i2** Study requires IRB review but is exempt

. . **1i3** Study requires IRB review and IRB approval

. . **1i4** Study requires other agency review and approval

**1j - 1k Dimensions related to the creation and distribution of knowledge**

. **1j Degree to which the study adds to the general stock of knowledge**

. . **1j1** Study assembles and organizes what is generally known already

. . **1j2** Study assembles and organizes and reframes existing knowledge

. . **1j3** Study changes belief in existing knowledge

. . **1j4** Study produces new knowledge

. . **1j5** *ab ovo* study vs. replication study

. . . **1j5.1** *ab ovo* study

. . . **1j5.2** Replication study

. **1k Scope of distribution and use of study results**

. . **1k1** Wide distribution and use of study results, public

. . **1k2** Distribution only to one or few persons / organizations / groups

. . . **1k2.1** Proprietary research

**2 General ways of gaining knowledge**

. **2a Underlying basic assumptions guiding the conduct of research**

. . **2a1** Philosophical stance or paradigm

. . . **2a1.1** Positivism

. . . **2a1.2** Postpositivism

. . . . **2a1.2.1** Research focusing on overt behavior

. . . **2a1.3** Post-structuralist

. . . **2a1.4** Phenomenological research

. . . **2a1.5** Interpretivist

. . . **2a1.6** Constructivism

. . . **2a1.7** Transformative

. . . **2a1.8** Pragmatism

. . **2a2 Analytic (as opposed to holistic) vs. holistic approach**

. . . **2a2.1** Analytic (as opposed to holistic) approach

. . . **2a2.2** Holistic approach

. . **2a3 Political stance. Neutral / impartial vs. engaged / partisan**

. . . **2a3.1** Political stance neutral / impartial

. . . **2a3.2** Political stance engaged / partisan

. **2b Research design by basic approach to gaining insight / type of knowledge produced**

**2b1 - 2b3 Focus on empirical research**

. . **2b1** Descriptive studies

. . . **2b1.1** Descriptive study by format

. . . . **2b1.1.1** Case report

. . . . **2b1.1.2** Case series

. . . **2b1.2** Descriptive study by purpose

. . . . **2b1.2.1** Descriptive studies for description

. . . . . **2b1.2.1,1** Comparison, comparative study

. . . . . **2b1.2.1,2** Categorization

. . . . **2b1.2.2** Descriptive studies for monitoring and evaluation

. . . . . **2b1.2.2,1** Surveillance studies

. . **2b2** Relational studies

. . **2b3** Explanatory / causal / analytical studies

. . . **2b3.1** Explanatory / causal / analytical studies by degree of manipulative control

. . . . **2b3.1.1** Explanatory / causal / analytical studies through qualitative analysis

. . . . **2b3.1.2** Explanatory / causal / analytical studies through statistical analysis of data about

people, organizations, cities, etc.

. . . . **2b3.1.3** Quasi-experimental and experimental studies.

. . . . . **2b3.1.3,1** ●Quasi-experimental Studies. W-Ch. 11, p. 91 – 102

. . . . . **2b3.1.3,2** ●Experimental Studies. W-Ch. 12, p. 103 – 113

. . . **2b3.2** Explanatory / causal / analytical studies by function

. . . . **2b3.2.1** Explanatory / causal / analytical studies for explanation

. . . . **2b3.2.2** Explanatory / causal / analytical studies for prediction

. . . . **2b3.2.3** Explanatory / causal / analytical studies for prescription and planning (decision-making)

. . . **2b3.3** Modeling and simulation

**2b4 - 2bx Focus on general methods and thought research**

. . **2b4** Critical reflection

. **2c** Approaches to empirical research

. . **2c1** The qualitative ꟷ quantitative research continuum

. . . **2c1.1** Qualitative research

. . . **2c1.2** Quantitative research

. . . **2c1.3** ●Mixed Methods. W-Ch. 13, p. 114 – 122

. . **2c2** Relationship data collector - data analyst

Primary vs. secondary data analysis

. . . **2c2.1** Primary analysis (analyst = collector)

. . . **2c2.2** Secondary analysis (analyst ≠ collector)

. . . . **2c2.2.1** Meta-analysis

. **2d How close to original data or thought? Direct vs. indirect research**

. . **2d1** Direct research

. . . **2d1.1** Empirical vs non-empirical research

. . . . **2d1.1.1** Empirical research (see 2c)

. . . . **2d1.1.2**Non-empirical research, thought research

. . **2d2** Indirect research

. . . **2d2.1** Literature review. State-of-the-art report

. . . . **2d2.1.1** Systematic literature review

. **2e** **Degree of flexibility of the research protocol**

. . **2e1** Origin of the protocol. Control of the protocol

. . . **2e1.1** Official or widely accepted standard

. . . **2e1.2** Protocol used by another research team

. . . **2e1.3** Protocol used in another study by the same research team

. . . **2e1.4** Protocol developed specifically for the study

. . **2e2** Research protocol by degree of advance specification

. . . **2e2.1** Detailed advance specification

. . . **2e2.2** Develop the protocol as you go

. . **2e3 Research design by strictness of adherence to protocol**

. . . **2e3.1** Research process with strict adherence to protocol

. . . **2e3.2** Protocol adaptation following exact rules specified in the protocol

. . . **2e3.3** Protocol adaptation by researcher judgment

. . . **2e3.4** Local protocol adaptation

. **2f Stage of research stud**y (just one example)

. . **2f1** Stages of Human-Centred Design {6}

. . . **2f1.1** Immerse mode

. . . **2f1.2** Inspire mode

. . . **2f1.3** Imagine mode

. . . **2f1.4** Invent mode

. **2g Research by organizational arrangement**

. . **2g1** Research by number of disciplines involved

. . . **2g1.1** Monodisciplinary research

. . . **2g1.2** Interdisciplinary research

. . **2g2** Research by number of researchers involved

. . . **2g2.1** Small research group, one principal investigator

. . . **2g2.2** Team research. Team science. Collaborative research

. . . **2g2.3** Big science

**Parts 3 - 5. Specific research methods in the social sciences**

**3 Overall design of research studies. Scope and sampling, population studied, time scope, context**

. **3a Research Design by scope of study and sampling**

. . **3a1** Studies of limited scope or extent

. . . **3a1.1** ●Case Studies. W-Ch. 7, p. 51 – 59

. . . **3a1.2** ●Sampling for Intensive Studies. W-Ch. 15, p. 136 – 144

. . **3a2** Studies of larger Scope. Extensive Studies

. . . **3a2.1** ●Sampling for Extensive Studies. W-Ch. 14, p. 123 – 135

. **3b Studies by population studied**

. . **3b1** ●Studying Special Populations. W-Ch. 16, p. 145 – 151

. . **3b2** Cohort studies

. **3c Studies by how phenomena are followed over time**

. . **3c1** Cross-sectional studies

. . **3c2** Before-and-after studies, one-time outcome measurement

. . **3c3** ●Longitudinal Studies. W-Ch. 9, p. 71 – 80

. . . **3c3.1** Longitudinal studies by retrospective vs prospective

. . . . **3c3.1.1** Retrospective longitudinal studies

. . . . . **3c3.1.1,1** Case-control study

. . . . **3c3.1.2** Prospective longitudinal studies

. . . . **3c3.1.3** Ambidirectional longitudinal studies

. . . **3c3.2** Longitudinal studies by changing sample vs. following sample

. . . . **3c3.2.1** Repeated cross-sectional study

. . . . **3c3.2.2** Panel study. Following the same sample over time

. **3d Research by context / environment**

. . **3d1** In silico, in vitro, in vivo research

. . . **3d1.1** In silico research

. . . **3d1.2** In vitro research

. . . **3d1.3** In vivo research

. . **3d2** Laboratory, clinical, field research

. . . **3d2.1** Laboratory research

. . . **3d2.2** Clinical research - in hospitals, prisons, classrooms

. . . **3d2.3** Research in open nature or society

. . . . **3d2.3.1** Field research

. . . . **3d2.3.2** ●Naturalistic Research. W-Ch. 8, p. 60 - 70

. **3e Research design by role of participant**

. . **3e1** Participants as subjects being studied

. . **3e2** Participants as experts / informants

. . . **3e2.1** ●Delphi Studies. W-Ch. 10, p. 81 - 90

. . **3e3** Participants in a dual role: As subjects studied and as informants

. **3f Research design by getting individual opinion vs getting consensus opinion**

. . **3f1** Research design for getting individual opinion

. . **3f2** Research design for getting mutually informed individual opinion

. . **3f3** Research design for getting consensus opinion

. . . **3f3.1** Focus group

. . . **3f3.2** Delphi-like design

**4 Sources of data and methods for data collection**

. **4a Existing documents as data sources**

. . **4a1** Existing texts and databases as data source**s**

. . . **4a1.1** ●Historical Research. **W-Ch. 17**, p. 155 – 164

. . . **4a1.2** ●Existing Documents and Artifacts as Data. **W-Ch. 1**8, p. 165 - 172

. . . **4a1.3** ●Transaction Logs (pre-existing or created for research). **W-Ch. 20**, p. 185 – 197

. . **4a2** Existing audio recordings as sources of data

. . **4a3** Existing images as sources of data

. **4b Observation** (of individual participants, groups, events, . . .)

. . **4b1** ●Direct Observation. **W-Ch. 22**, p. 209 – 218

. . **4b2** ●Participant Observation. **W-Ch. 23**, p. 219 – 227

. **4c** **Eliciting free-form, mostly spoken, answers to open-ended questions**

. . **4c1** ●Think-aloud Protocols. **W-Ch. 21**, p. 198 – 208

. . **4c2** ●Research Diaries**. W-Ch. 24**, p. 228 – 238

. . **4c3** ●Unstructured Interviews. **W-Ch. 25**, p. 239 – 247

. . **4c4** ●Semistructured Interviews**. W-Ch. 2**6, p. 248 – 257

. . **4c5** ●Focus Groups**. W-Ch. 2**7, p. 258 – 271

. . **4c6** ●Visual Data Collection Methods**. W-Ch. 1**9, p. 173 – 184

. **4d Eliciting ✓ or scale value answers to closed questions. Structured questionnaires and interviews**

. . **4d1** ●Survey Research**. W-Ch. 28**, p. 272 – 283

. **4e Specific types of variables**

. . **4e1** ●Measuring Cognitive and Affective Variable**s. W-Ch. 29**, p. 284 – 290

. . **4e2** ●Developing New Measures**. W-Ch. 30**, p. 291 – 304

**5 Methods for data analysis** (rudimentary list)

. **5a Methods for qualitative analysis**

. **5b Methods for qualitative and structural analysis (qualitative or quantitative)**

. . **5b1** ●Content Analysis. **W-Ch. 31**, p. 307 – 317

. . **5b2** ●Qualitative Analysis of Content. **W-Ch. 32**, p. 318 - 329

. . **5b3** ●Discourse Analysi**s**. W-**Ch. 33**, p. 330 - 338 Optional

. . **5b4** ●Social Network Analysis**.** **W-Ch. 34**, p. 339 – 350

. **5c Methods for quantitative analysis. Statistical Analysis**

. . **5c1** ●Descriptive Statistics. **W-Ch. 35**, p. 351 – 360

. . **5c2** ●Frequencies, Cross-tabulation, and the Chi-square Statistic. **W-Ch. 36**, p. 361 – 372

. . **5c3** ●Analyzing Sequences of Events. **W-Ch. 37**, p. 373 - 386

. . **5c4** ●Correlation**.** W-**Ch. 38**, p. 387 – 394

. . **5c5** ●Comparing Means: t Tests and Analysis of Variance**.** **W-Ch. 39**, p. 395 – 404

. **5d Machine learning**

**Annotated Hierarchy**

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| --- | --- |
| **1 Why research? Use of results, research purposes, types of results / knowledge discovered. Research topic**. | Intended uses / applications of research results, motivation for research and  Purposes of research, types of results / type(s) of knowledge researcher is looking for.  Intended use / applications and purpose of research in terms of the type(s) of knowledge sought are closely intertwined. This is a somewhat loose grouping of specific dimensions |
|  |  |
| **1a- 1e Dimensions related to study purpose and use of study results** | In a lecture introducing research, this should be first. This determines the sequence here.  In a template for describing research studies, topic should be first. |
|  |  |
| **. 1a The basic research ꟷ applied research continuum**  **Distance from practice / closeness to practice** | This deals with the relationship of research effort to practice. Is the research effort removed from practice or closely involved with practice? The defining criterion is the remoteness of the research effort from practice, not the distance of the research problem or the research results from practice. A problem addressed in basic research may be motivated by a practical issue, and whether or not it was, the results ꟷ improved basic understanding of how nature or society work ꟷ may be directly applicable to a practical issue. {DS}  Some researchers focus on using research to advance general knowledge, whereas others use it to solve specific problems. Basic researchers seek an understanding of the fundamental nature of social reality. Applied researchers, by contrast, primarily want to apply and tailor knowledge to address a specific practical issue. They want to answer a policy question or solve a pressing social and economic problem. {11}  Think of this is as a continuum rather as two separate categories.  Basic theory often informs applied work, and applied work may bring up some interesting basic theoretical questions .  Most researchers should contribute to theoretical social science literature but also study issues that are helpful in solving social problems.  Findings of basic research may be translated into applied research, not necessarily by the same people.  Although usually basic research leads to applied research, sometimes the reverse can occur.  Sometimes, practitioners (not even scientists per se) systematically figure out some methods that work  (selling- persuasion techniques).  Later theoreticians work to test these applications, following systematic procedures, and try to explain the phenomenon. . .{22}  in most cases research cannot be strictly divided into basic or applied. findings of a study may contribute both to our basic understanding of the problem and an immediate application.  {22}  Basic and Applied Research Compared  The procedures and techniques used by basic and applied researchers do not differ substantially. Both use the scientific method to answer the questions at hand.  The scientific community is the primary consumer of basic research. The consumers of applied research findings are practitioners such as teachers, counselors, and caseworkers, or decision makers such as managers, committees, and officials. Often, someone other than the researcher who conducted the study uses the results of applied research. This means that applied researchers have an obligation to translate findings from scientific technical language into the language of decision makers or practitioners.  The results of applied research are less likely to enter the public domain in publications. Results may be available only to a small number of decision makers or practitioners, who decide whether or not to put the research results into practice and who may or may not use the results.  Applied and basic researchers adopt different orientations toward research methodology. Basic researchers emphasize high standards and try to conduct near-perfect research. Applied researchers make more trade-offs. They may compromise scientific rigor to get quick, usable results. Compromise is no excuse for sloppy research, however. Applied researchers squeeze research into the constraints of an applied setting and balance rigor against practical needs. Such balancing requires an in-depth knowledge of research and an awareness of the consequences of compromising standards. {11}  Two orientations to science:  1 More detached, scientific, academic orientation  2 More activist, practical, reform oriented.  Not a rigid separation.  This difference is on how to use research: Advance general knowledge or solve specific problems. {22}  Also treated under the headings *According to Goal* {9} and *The Use of Research* {15}  {DS definitions below with acknowledgements to  https://relivingmbadays.wordpress.com/2012/10/14/basic-versus-applied-research/} |
|  | |
| **. . 1a1** Basic research | *academic research; pure research; fundamental research* {11}  Driven by a researcher’s curiosity or interest in a question about the functioning of nature, individual people, or groups or organizations or society or nations. The main motivation is to expand knowledge, not to create or invent something. There may or may not be obvious commercial value to the discoveries that result from basic research. {DS}  Is done for the development of theories and principles. It is conducted for intellectual pleasure of learning. {9} {14}  Basic research advances fundamental knowledge about the human world. It focuses on refuting or supporting theories that explain how this world operates, what makes things happen, why social scientific ideas and ways of thinking about the world. It can be exploratory, descriptive, or explanatory; however, explanatory research is the most common.  Basic research generates new ideas, principles and theories, which may not be immediately used; though are the foundations of modern progress and development in different fields. Today’s computers could not exist without the pure research in mathematics conducted over a century ago, for which there was no known practical application at that time.  Police officers trying to prevent delinquency or counselors of youthful offenders may see little relevance to basic research on the question, “Why does deviant behavior occur?” Basic research rarely helps practitioners directly with their everyday concerns. Nevertheless, it stimulates new ways of thinking about deviance that have the potential to revolutionize and dramatically improve how practitioners deal with a problem.  A new idea or fundamental knowledge is not generated only by basic research. Applied research, too, can build new knowledge. Nonetheless, basic research is essential for nourishing the expansion of knowledge. Researchers at the center of the scientific community conduct most of the basic research.  {11}  Basic research advances fundamental knowledge about the social world. It attempts to address the fundamental questions surrounding a discipline. Occasionally, researchers make significant findings that have great impact on the direction or development of existing schools of thought. Basic research is often criticized as wasteful and useless despite the fact that it is the source of most new scientific ideas and ways of thinking about the world. {15}  Basis research is sometimes lab-based, lacking naturalness. {18}  Discussion from {22} Slide 4   * Addresses fundamental questions about the nature of behavior/social worlds.  involves developing and testing theories and hypotheses that are intellectually interesting to the researcher, might have some social applications in the future, but no intention of social application at the present time. * Gaining knowledge for knowledge’s sake.   + - Motivation is *“understanding”*       * How do people perceive individual differences       * Forgetting rates are comparable in conscious and automatic memory:     - Often tests theories of behavior     - Mostly tests hypotheses containing very abstract and specialized concepts.– requires a thorough lit review and knowledge of previous lit – and gap in previous research.  Refute/support theories.     - In most cases--- provide the bases (ideas, tools, methods) for further applied research. Ex: studied AIDS in chickens for years --- later- advances in AIDS virus. |
| **. . 1a2** Applied research | Carried out to solve practical problems, rather than to acquire knowledge for knowledge’s sake. The goal of the applied researcher is to improve products and services, prevention and treatment of disorders, educational practices, organizational processes, social and political practices, etc. {DS}  The application of pure research. Testing the efficiency of theories and principles {9}  Applied research aims to solve a specific policy, social or environmental issues / problems or help practitioners accomplish tasks. Developing theory is less central to them than seeking a solution on a specific problem for a limited setting, but existing theory is often quite useful in solving a practical problem . Applied research is frequently a descriptive research, and its main strength is its immediate practical use.  Applied research is conducted when decision must be made about a specific real-life problem. Applied research encompasses those studies undertaken to answer questions about specific problems or to make decisions about a particular course of action or policy. For example, an organization contemplating a paperless office and a networking system for the company’s personal computers may conduct research to learn the amount of time its employees spend at personal computers in an average week.  {11 with elements of 15}  The application of the results of pure research. This is testing the efficiency of theories and principles. For instance, a principle says that “praise reinforces learning.” To determine if this is true, one conducts an experiment in which there are two classes. In one class, he uses praise but in the other, there is no praise at all. All other things are kept equal. At the end of the experimental period, he gives the same test to the two classes. If the scores of the students in the class with praise are significantly higher that those in the class without praise, then the principle is true.{14}  Applied research is sometimes field-based, lacking control. {18} |
| **. . . 1a2.1** Research and Development (R&D).  Design | Conducts applied research and uses the results to develop specifications for products and services. {DS}  Uses the results of applied research to develop specifications for products and services. Often goes hand-in-hand with research, hence Research and Development (R&D) {DS}  R&D refers to applied research in science, technology, engineering, and agriculture and the development of new products. {DS}  Research and development (R&D) includes activities that companies undertake to innovate and introduce new products and services. It is often the first stage in the development process. The goal is typically to take new products and services to market and add to the company's bottom line.  The term R&D is widely linked to innovation both in the corporate and government world or the public and private sectors. R&D allows a company to stay ahead of its competition. Without an R&D program, a company may not survive on its own and may have to rely on other ways to innovate such as engaging in mergers and acquisitions (M&A) or partnerships. Through R&D, companies can design new products and improve their existing offerings.  Companies in different sectors and industries conduct R&D; pharmaceuticals, semiconductors, and technology companies generally spend the most. {23} |
| **. . . . 1a2.1.1** Participatory design |  |
| **. . . . 1a2.1.2** Human-centered design |  |
| **. . . . 1a2.1.3** Usability study | A usability study provides an assessment of the usability of a system or object, mostly applied to software systems, Web pages, and such. |
| **. . . 1a2.2** Action research | Action research can be seen as taking the idea of research and development and applying it to social issues.  Action research collects data as processes happen in an organization or other environments, possibly change these processes to achieve desired goals, and collect data all along (some automatically), and analyze the data.  Or this pattern: Identify problem, read literature about it, take action, monitor action with suitable metrics, document results, use for improving action. similar/equal to result-based accounting  Action research includes continuous assessment / evaluation. {DS}  Action research: The applied research that treats knowledge as a form of power and abolishes the line between research and social action. Those who are being studied participate in the research process; research incorporates ordinary or popular knowledge; research focuses on power with a goal of empowerment; research seeks to raise consciousness or increase awareness; and research is tied directly to political action.  The researchers try to advance a cause or improve conditions by expanding public awareness.  They are explicitly political, not value-neutral. Because the goal is to improve the conditions of research participants; formal reports, articles, or books become secondary. Action researchers assume that knowledge develops from experience, particularly the experience of social-political action. They also assume that ordinary people can become aware of conditions and learn to take actions that can bring about improvement. {11}  Action research is applied research that treats knowledge as a form of power and attempts to abolish the line between research and social action. In other words, the goals of the researcher are often motivated based upon an unequal distribution of social, political, and financial power. For example, research focuses on power with a goal of empowerment; research seeks to raise consciousness or increase awareness; and research is tied directly to political action. {15} |
| **. . . 1a2.3** Evaluation and assessment research | There are no sharp distinctions in the semantic space indicated by terms *assessment*, *evaluation*, and some types of research. Some authors define *assessment* as a more or less factual description of a unit of analysis or situation and *evaluation* as ascribing a value based on that description. I can see the following types of studies.  A one-time snapshot of the state of some system, such as a classroom or a school, for example, analyzing students' GPA or students performance on standardized tests at one time. This could be used as a measure of a school's effectiveness in educating a given type of student. The term assessment is often used in this meaning. Such a study is a type of a descriptive study. The results of a descriptive study can be interpreted in a completely value-neutral way; whether the system described is good or bad is not an issue. In assessment, on the other hand, results are interpreted from a value or goal perspective; we want schools that help students learn. Assessments can be used for comparisons across systems or of the same system at different times. Such studies may not look at reasons for any differences observed. {DS}  Much evaluation has the purpose of determining the value of some system or activity not based on its intrinsic properties but based on what is does, its effects. This requires an analytic (explanatory) study, which often is more specifically an experimental or quasi-experimental study. The distinguishing feature is again that the results are considered from a values or goals perspective. For example, one student proposed a study of the effect of library access on student learning (as measured by the GPA); this study is an experiment with the aim of determining the value of a school library, presumably for the purpose of making decision about funding and possibly also on ways the library is run. {DS}  Evaluation Research: It addresses the question, “Did it work?” The process of establishing value judgment based on evidence about the achievement of the goals of a program. Evaluation research measures the effectiveness of a program, policy, or way of doing something. “Did the program work?” “Did it achieve its objectives?” Evaluation researchers use several research techniques (survey, field research).  Practitioners involved with a policy or program may conduct evaluation research for their own information or at the request of outside decision makers, who sometime place limits on researchers by setting boundaries on what can be studied and determining the outcome of interest.  {11}  Evaluation Research is a widely used type of applied research that addresses the question, “Did it work?” In other words, evaluation researchers actively engage in assessing the success or failure of a social program, organization, etc. There are two types of evaluation research, formative and summative. Both are usually used in conjunction with each other. {15} |
| **. . . . 1a2.3.1** Formative vs summative evaluation | Continuum or both done in one assessment  Formative assessment is undertaken to improve what is being assessed.  Summative assessment is undertaken to decide on the use of what is being assessed or action regarding what is being assessed.  Examples:  **Assessed: Person.**  **Formative:** Results used to help the person improve (help a student learn better, change patient treatment)  **Summative:** Results used to decide on use of or action regarding the person (decide whether student should be promoted, whether applicant should be hired, whether person should return to work, whether person should be cleared for travel. whether patient should be cleared for surgery)  **Assessed: Software or system, specifically usability**  **Formative:** Results used to help improve the system (change an input process to avoid input errors, change wording to avoid errors or shorten time users take to figure out what to do, make sure *Submit* button can be seen without scrolling)  **Summative:** Results used to decide on whether to use the system  **Assessed: Curriculum or learning unit**  **Formative:** Results used to help the improve the curriculum (find places where necessary prerequisites have not been covered, find content that is not meaningful to students as presented, find places where better examples are needed)  **Summative:** Results used to decide whether to use the curriculum in a school given the characteristics of the student body or whether to use a learning unit for an individual student  **Assessed: Policies and procedures for the circulation of library materials**  **Formative:** Results used to help the improve policies and procedures to achieve the library's purposes, such as making materials available, increasing circulation, making sure children have books at home, minimizing staff time for circulation, generating good will towards the library. Types of improvements include deploying book mobiles, having multiple points for returning materials (such as in supermarkets), charging fines only for expensive items, a reward system for returning materials in time, giving some books away.  **Summative:** Results used to decide whether to adopt another library's policies and procedures.  {DS} |
| **. . . . . 1a2.3.1,1** Formative evaluation | Formative assessment is undertaken to improve what is being assessed. {DS}  Formative Evaluation consists of built-in monitoring or continuous feedback on a program used for program management. {15} |
| **. . . . . 1a2.3.1,2** Summative evaluation | Summative assessment is undertaken to decide on the use of what is being assessed or action regarding what is being assessed. {DS}  Summative Evaluation looks only at the final outcome. {15} |
| **. . . . 1a2.3.2** Impact assessment research | Research estimates the likely consequences of a planned change. Such an assessment is used for planning and making choices among alternative policies – to make an impact assessment of building a dam on the environment; to determine the impact of building a major new highway on surrounding communities (air quality, housing, business). {11}  Evaluation / assessment deals with actions or systems that are going on or have been completed  Impact Assessment deals with actions or systems being considered to provide information for decision making. {DS}  The purpose of Social Impact Assessment is to measure the likely consequences of a planned change. Areas assessed in impact studies include:  1. Community Service  2. Social Conditions  3. Economic Impact  4. Demographic Consequences  5. Environment  6. Health Outcomes  7. Psychological Well Being  {15} |
|  |  |
| **. 1b** **General purposes / applications / uses of research**  **results** | This is a broad view from one perspective. More views from more perspectives and more specific purposes can be assembled in 1c. That could develop into a huge classification of its own. {DS} |
| . . **1b1** Purposes of basic research |  |
| . . . **1b1.1** Understand the world around us  and within us |  |
| . . . **1b1.2** Pursue interesting questions arising from  curiosity, the wish to know, to expand the frontiersof knowledge |  |
| . . . **1b1.3** Build theory |  |
| . . . **1b1.4** Develop better research methods |  |
| . . **1b2** Purposes of applied research |  |
| **. . . 1b2.1** Inform action. Evidence-supported  practice | * Translation of research results into practice. Develop specifications for an action * Support solving a problem or making a decision * “Conceptual” or “enlightenment” use of research. Providing decision makers with an overall understanding of the system they are responsible for, the forces at work and the stakeholders, and a framework for thinking about that system Rather than being consulted in the course of a specific decision, the research evidence in Organizing Schools for Improvement provided policymakers new ideas and frameworks that influenced how they individually and collectively approached their work. It shaped the beliefs and understanding that leaders drew on as they considered issues to address and evaluated potential solutions. http://wtgrantfoundation.org/conceptual-use-research-important * General assessment of how well given programs, methods, materials, devices work in a given set of circumstances to assist in selecting the best option.   Aside: How students benefit of doing research (of any kind) Also: Research done just for the intellectual joy of Both are about the purpose of the researcher rather than the purpose of the user of research results |
| **. . . 1b2.2** Provide tools for practice | Developmental research. {14} Constructive research {Wikipedia}  Focuses on findings or developing a more suitable instrument or process than has been available {14}   * Methods for learning and instruction, tested learning materials, diagnosing students strengths and weaknesses for planning individualized instruction, parenting guidelines * Methods for improving business processes, economic and financial forecasting methods * Diagnostic methods and devices, therapies, drugs, and medical devices * Crop and animal varieties, methods for agriculture * Materials with desirable properties * Machines, including computers. Software systems, such as machine learning {DS}   *Constructive research*, which tests theories and proposes solutions to a problem or question. {Wikipedia} |
| **. . . 1b2.2** Support Design / produce a product /  artefact / mentefact | *Design science* {Wikipedia}  An outcome-based information technology research methodology, which offers specific guidelines for evaluation and iteration within research projects.  *Design science research* focuses on the development and performance of (designed) artifacts with the explicit intention of improving the functional performance of the artifact. Design science research is typically applied to categories of artifacts including algorithms, human/computer interfaces, design methodologies (including process models) and languages. Its application is most notable in the Engineering and Computer Science disciplines,  {Wikipedia} |
| **. . . . 1b2.2.1** Support Design / produce a product  / artefact |  |
| **. . . . 1b2.2.2** Develop methods for assessment,  diagnosis, and treatment (including, but not restricted to, medicine) |  |
| **. . . 1b2.3** Environmental scanning and prediction | * Climate change * Economic assessment and forecasts - regional, national, global * Status and spread of disease |
| **. . . 1b2.4** Testing / assessment / evaluation to  support decision making and accountability | General assessment of how well given programs, methods, materials, devices work in a given set of circumstances to assist in making a decision, such as continuing or ending a program or selecting the best option. {DS}  Make judgements and compare to a norm, scale, typology, etc. {7}  Methods and measures for differentiated outcome assessment.   * Performance of students: individual students, a class, a school building, a school system, a state. Appropriate assessment: Consider progress of a student, not just comparison with standards. Consider all specific circumstances, give a complete picture of the situation rather than a few simple numbers * Business performance (also important information for stockholders and for decisions of external investors) * Patient outcomes: Individual patient, entire hospital. Differentiate by disease and by condition of patients coming in. * Agricultural productivity * Product testing   {DS} |
| **. . 1b5** Uses of research in the information field | Understand the role of information in all spheres of life, for individuals, organizations, and society  Understand human information behavior considering individual differences.  Understand how people acquire, organize, make sense of, and use information. (Use this understanding to build better systems and to design implicit and explicit user education.)  Principles for good design of all systems that assist users in their interactions with information, including document and Web design and human-computer interfaces  User participation in the design of information systems  Measuring user success in finding and using information  Measuring the performance of information retrieval systems and identify the contribution of various system components to performance  {DS} |
|  |  |
| **. 1c Specific purposes of research** | The intent of this section is to provide a detailed classification of research purposes representing many perspectives. When completed this will be a faceted classification of research purposes. But so far, this is just a preliminary collection of purpose lists from a few sources. {DS}  One study may serve multiple purposes  explore a new topic,  describe a social phenomenon,  explain why something occurs.  test a method (purpose of many pilot studies  {DS}  Test y/n  Parameter estimation  Rank order known entities  Find the best, the most connected, etc. where entity type but not specific entity IDs are known  Find the degree of association or correlation between two variables in a population  Find causal relationships  How wide-spread is a phenomenon? {}  a. Predictive or Prognostic – it has the purpose to determine the future operation of the variables under investigation with the aim of controlling or redirecting such for the better.  b. Directive – it determines what should be done based on the findings.  c. Illuminative – it is concerned with the interaction of the components of the system being investigated.  {9} {14}  Purposes of Research  The principal goal of research is the preservation and improvement of the quality of human life. All kinds of research are directed toward this end. The purpose of research is to serve man. The goal of the research is the good life. Because of research, man has attained great progress and comfort in life.  The following are more specific purposes and goals of research:  1) Discover new facts of known phenomena  2) Find solution to problems that are only partially solved  3) Improve or develop new products  4) Discover unrecognized substances or elements  5) Validate generalizations into systematic order - Generalization: sweeping statement: a statement presented as a general truth but based on limited or incomplete evidence  6) Provide basis for decision-making in any undertaking  7) Satisfy the researcher’s curiosity  8) Acquire better and deeper understanding about one phenomenon to another  9) Verify existing knowledge  10) Improve educational practices by raising the quality of school products  11) Promote health and prolong life  12) Enhance man’s basic life{14} |
| **. .** 1c1 Relative emphasis on shedding light on phenomena vs.  developing or testing/validating methods | Some studies do just one or the other, some do some of each. One way of characterizing a study is to express the relative emphasis as a rough percent value. Another, more difficult way is to express the contribution of the study on each of these aspects on a scale, for example 0 - 10; a study may merit a 7 on both if it makes important contribution to both. {DS} |
| **. . . 1c1.1** Emphasis on shedding light on phenomena |  |
| **. . . 1c1.2** Emphasis on developing or  testing/validating method**s** | * Sometimes a legitimate topic for study is methodological. * For example, development or novel investigation of… * a measuring device * a psychometric instrument (questionnaire or inventory) * a protocol for a physical performance test * a diagnostic test * a method of analysis. * You usually include or focus on a reliability and/or validity study of the measure provided by the method. * Validity = the relationship between observed and true values. * Reliability = reproducibility of observed values. {18} |
|  |  |
| **. 1d Idiographic vs. nomothetic research** | *Idiographic and Nomothetic Explanations* {15}  Idiographic and nomothetic and are terms used by Neo-Kantian philosopher Wilhelm Windelband to describe two distinct approaches to knowledge, each one corresponding to a different intellectual tendency, and each one corresponding to a different branch of academe.  *Idiographic* is based on what Kant described as a tendency to specify, and is typical for the humanities. It describes the effort to understand the meaning of contingent, unique, and often cultural or subjective phenomena.  *Nomothetic* is based on what Kant described as a tendency to generalize, and is typical for the natural sciences. It describes the effort to derive laws that explain types or categories of objective phenomena, in general. {WP}   |  |  | | --- | --- | | **Idiographic** | **Nomothetic** | | Uniqueness Individuality Subjective experience Feelings Qualitative methods Case study Introspection Reflection Subjective Dream Analysis Diaries and letters | Laws Generalization Classification General Principles Quantitative Scientific Theory Experiments Statistical analysis Prediction Scales e.g. IQ DSM-IVR |   {16}  Note: This distinction refers to the intent with which the research is conducted.  *Generalizability* of results is a matter of empirical determination. |
| **Nomothetic vs. idiographic versus approaches to psychology {16}**   |  |  |  | | --- | --- | --- | |  | **Nomothetic approach** | **Idiographic approach** | | **Definitions** | The approach of investigating large groups of people in order to find general laws of behaviour that apply to everyone | The approach of investigating individuals in personal, in-depth detail to achieve a unique understanding of them. | | **Assumptions** | Nomos= laws in ancient Greek; this approach assumes that an individual is a complex combination of many universal laws; it is best to study people on a large scale. | Idios= ‘private’ or ‘personal’ in ancient Greek; this approach assumes that humans are unique. | | **Methodology** | Quantitative Experimental methods are best to identify the universal laws governing behaviour.  The individual will be classified with others and measured as a score upon a dimension, or be a statistic supporting a general principle (‘averaging’). | Qualitative methods are best; case study method will provide a more complete and global understanding of the individual who should be studied using flexible, long terms and detailed procedures in order to put them in a ‘class of their own’. | | **Examples from psychology** | The nomothetic approach is the main approach within scientifically oriented psychology.  • Behaviorism: experiments with animals (rats, cats and pigeons) establish laws of learning (B. F. Skinner e.g.).  • Social psychology: Milgram e.g. used the nomothetic approach and made general conclusions on the basis of his research.  • Psychological theories that propose generalized principles of behaviour have nomothetic assumptions (e.g. intelligence theory of IQ)  • Classification manuals like the DSM-IV classify people according to particular types of disorders. | • Freud (1909) the clinical case study method (patients interviewed over a long period of time, notes of his interpretations, unstructured techniques (free association), and he wrote up his notes at the end of the day to allow a more free and natural expression of the patients’ thoughts and feelings.  • Piaget (1953) longitudinal studies of cognitive development of his children, keeping frequent notes and using the flexible clinical interview method and informal experiments to gain detailed and ecologically valid understanding.  • Gardner and Gardner (1969) spent long time interacting with and observing the chimpanzee Washoe as they tried to teach him sign language. | | **Advantages** | In line with the deterministic, law abiding nature of science, useful in predicting and controlling behaviour; nomothetic findings on prejudice and discrimination perhaps helpful ( reduce discrimination) | More complete and global understanding of an individual; sometimes the most efficient; often lead to results that spark off experimental investigation of behaviour. | | **Disadvantages** | Superficial understanding of any one person; even if two persons have same IQ they may have answered different questions in the test; a person may have 1% chance of developing depression (but is he among the 1%?); classification manuals are not accurate and does not help people. | Difficult to generalize findings; Freud and Piaget created universal theories on the basis of a limited and unrepresentative sample;  Idiographic research tends to be more unreliable and unscientific (subjective, long term and non-standardized procedures) | | |
| **. . 1d1** Idiographic research | “Idio-” in this context means unique, separate, peculiar, or distinct, as in the word “idiosyncrasy.” When we have completed an idiographic explanation, we feel that we fully understand the many causes of what happened in a particular instance. At the same time our scope of explanation is limited to the case at hand. While parts of the idiographic explanation might apply to other situations, our intention is to explain fully one case. {15} |
| **. . 1d2** Nomothetic research | Seeks to explain a class of situations or events rather than a single one. Moreover, it seeks to explain “efficiently,” using only one or just a few explanatory factors. Finally, it settles for partial rather than full explanation of a type of situation. {15} |
|  |  |
| **. 1e Exploratory vs. confirmatory research** | This is very good:  <http://www.koestler-parapsychology.psy.ed.ac.uk/Documents/explore_confirm.pdf>  Clicking in this goes directly to downloading pdf. May need to allow download, seems safe to me.  <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4028181/>  **Confirmatory versus exploratory research**  *Confirmatory* research tests *a priori* hypotheses — outcome predictions that are made before the measurement phase begins. Such *a priori* hypotheses are usually derived from a theory or the results of previous studies. The advantage of confirmatory research is that the result is more meaningful, in the sense that it is much harder to claim that a certain result is generalizable beyond the data set. The reason for this is that in confirmatory research, one ideally strives to reduce the probability of falsely reporting a coincidental result as meaningful. This probability is known as [α-level](https://en.wikipedia.org/wiki/Statistical_significance) or the probability of a [type I error](https://en.wikipedia.org/wiki/Type_I_and_type_II_errors).  *Exploratory* research, on the other hand, seeks to generate *a posteriori* hypotheses by examining a data-set and looking for potential relations between variables. It is also possible to have an idea about a relation between variables but to lack knowledge of the direction and strength of the relation. If the researcher does not have any specific hypotheses beforehand, the study is exploratory with respect to the variables in question (although it might be confirmatory for others). The advantage of exploratory research is that it is easier to make new discoveries due to the less stringent methodological restrictions. Here, the researcher does not want to miss a potentially interesting relation and therefore aims to minimize the probability of rejecting a *real* effect or relation; this probability is sometimes referred to as β and the associated error is of [type II](https://en.wikipedia.org/wiki/Type_I_and_type_II_errors). In other words, if the researcher simply wants to see whether some measured variables could be related, he would want to increase the chances of finding a significant result by lowering the threshold of what is deemed to be *significant*.  Sometimes, a researcher may conduct exploratory research but report it as if it had been confirmatory ('Hypothesizing After the Results are Known', HARKing[[7]](https://en.wikipedia.org/wiki/Research_design#cite_note-7)—see [Hypotheses suggested by the data](https://en.wikipedia.org/wiki/Hypotheses_suggested_by_the_data)); this is a [questionable research practice](https://en.wikipedia.org/w/index.php?title=Questionable_research_practice&action=edit&redlink=1) bordering on fraud.  [https://en.wikipedia.org/wiki/Research\_design#Confirmatory\_versus\_exploratory\_research](https://en.wikipedia.org/wiki/Research_design%23Confirmatory_versus_exploratory_research) |
| **. . 1e1** Exploratory research | formulative research {}  The objective of exploratory research is to gather preliminary information that will help define problems and suggest hypotheses.{}  Exploratory study is undertaken when not much is known about the situation at hand, or no information is available on how similar problems or research issues have been solved in the past. Example: A service provider wants to know why his customers are switching to other service providers?  The researcher’s goal is to formulate more precise questions that future research can answer. Exploratory research may be the first stage in a sequence of studies. A researcher may need to know enough to design and execute a second, more systematic and extensive study.  Initial research conducted to clarify the nature of the problem. When a researcher has a limited amount of experience with or knowledge about a research issue, exploratory research is useful preliminary step that helps ensure that a more rigorous, more conclusive future study will not begin with an inadequate understanding of the nature of the management problem. The findings discovered through exploratory research would encourage the researchers to emphasize learning more about the particulars of the findings in subsequent conclusive studies.  Exploratory research rarely yields definitive answers. It addresses the “what” question: “what is this social activity really about?” It is difficult to conduct because there are few guidelines to follow. Specifically there could be a number of goals of exploratory research. Goals of Exploratory Research:  1. Become familiar with the basic facts, setting, and concerns;  2. Develop well-grounded picture of the situation;  3. Develop tentative theories, generate new ideas, conjectures, or hypotheses;  4. Determine the feasibility of conducting the study;  5. Formulate questions and refine issues for more systematic inquiry; and  6. Develop techniques and a sense of direction for future research.{}  Some people put *exploratory research* in one line with *descriptive research* and *explanatory research*. However, the distinction *exploratory* vs. *confirmatory* cuts across *descriptive* vs. *explanatory*. Exploration may try to find out what components should go into an *Urban Quality of Life Index*. Or it may try to find out what factors should be investigated as influencing the *Urban Quality of Life Index.* {DS}  For exploratory research, the researcher may use different sources for getting information like (1) experience surveys, (2) secondary data analysis, (3) case studies, and (4) pilot studies.  As part of the experience survey the researcher tries to contact individuals who are knowledgeable about a particular research problem. This constitutes an informal experience survey.  Another economical and quick source of background information is secondary data analysis. It is preliminary review of data collected for another purpose to clarify issues in the early stages of a research effort.  The purpose of case study is to obtain information from one or a few situations that are similar to the researcher’s problem situation. A researcher interested in doing a nationwide survey among union workers, may first look at a few local unions to identify the nature of any problems or topics that should be investigated.  A pilot study implies that some aspect of the research is done on a small scale. For this purpose focus group discussions could be carried out.  {11}  Exploratory research is conducted to explore a group of questions. The answers and analytics may not offer a final conclusion to the perceived problem. It is conducted to handle new problem areas which haven't been explored before. This exploratory process lays the foundation for more conclusive research and data collection. {}  Exploratory research frequently uses qualitative techniques to keenly observe and collect data for analysis {15}, but it may also use exploratory quantitative analysis, including machine learning, often using large datasets (big data). Modeling and simulation can also be used for exploration. {DS}  **Exploratory research** is [research](https://en.wikipedia.org/wiki/Research) conducted for a [problem](https://en.wikipedia.org/wiki/Problem) that has not been studied more clearly, intended to establish priorities, develop operational definitions and improve the final research design.[[1]](https://en.wikipedia.org/wiki/Exploratory_research#cite_note-1) Exploratory research helps determine the best [research](https://en.wikipedia.org/wiki/Research) design, [data-collection](https://en.wikipedia.org/wiki/Data_collection) method and selection of subjects. It should draw definitive conclusions only with extreme caution. Given its fundamental nature, exploratory research often relies on techniques such as:   * [secondary research](https://en.wikipedia.org/wiki/Secondary_research) - such as [reviewing available literature](https://en.wikipedia.org/wiki/Literature_review) and/or data * informal qualitative approaches, such as discussions with consumers, employees, management or competitors * formal [qualitative research](https://en.wikipedia.org/wiki/Qualitative_research) through in-depth interviews, [focus groups](https://en.wikipedia.org/wiki/Focus_group), projective methods, [case studies](https://en.wikipedia.org/wiki/Case_studies) or [pilot studies](https://en.wikipedia.org/wiki/Pilot_studies)   When research aims to gain familiarity with a phenomenon or to acquire new insight into it in order to formulate a more precise problem or to develop a hypothesis, exploratory studies (also known as formulative research) come in handy. If the theory happens to be too general or too specific, a hypothesis cannot be formulated. Therefore, a need for an exploratory research may be realized and instituted to gain [experience](https://en.wikipedia.org/wiki/Experience) that may help in formulating a relevant hypothesis for more definite investigation.[[2]](https://en.wikipedia.org/wiki/Exploratory_research#cite_note-2)  The results of exploratory research are not usually useful for decision-making by themselves, but they can provide significant insight into a given situation. Although the results of [qualitative research](https://en.wikipedia.org/wiki/Qualitative_research) can give some indication as to the "why", "how" and "when" something occurs, they cannot reveal "how often" or "how many".  Exploratory research is not typically generalizable to the [population](https://en.wikipedia.org/wiki/Statistical_population) at large.  Social exploratory research "seeks to find out how people get along in the setting under question, what meanings they give to their actions, and what issues concern them. The goal is to learn 'what is going on here?' and to investigate social phenomena without explicit expectations."[[3]](https://en.wikipedia.org/wiki/Exploratory_research#cite_note-3) This methodology is also at times referred to as a [grounded theory](https://en.wikipedia.org/wiki/Grounded_theory) approach to [qualitative research](https://en.wikipedia.org/wiki/Qualitative_research) or interpretive research, and is an attempt to unearth a theory from the data itself rather than from a predisposed [hypothesis](https://en.wikipedia.org/wiki/Hypothesis).  Earl Babbie identifies three purposes of social-science research: exploratory, descriptive and explanatory.  Earl Babbie identifies three purposes of social-science research: exploratory, descriptive and explanatory.   * Exploratory research takes place when problems are in a preliminary stage.[[4]](https://en.wikipedia.org/wiki/Exploratory_research#cite_note-4) Exploratory research is used when the topic or issue is new and when data is difficult to collect. Exploratory research is flexible and can address research questions of all types (what, why, how). Exploratory research is often used to generate formal hypotheses. [Shields](https://en.wikipedia.org/wiki/Patricia_M._Shields) and Tajalli link exploratory research with the [conceptual framework](https://en.wikipedia.org/wiki/Conceptual_framework) [working hypothesis](https://en.wikipedia.org/wiki/Working_hypothesis).[[5]](https://en.wikipedia.org/wiki/Exploratory_research#cite_note-ecommons.txstate.edu-5) Skeptics[[*which?*](https://en.wikipedia.org/wiki/Wikipedia:Avoid_weasel_words)], however, have questioned the usefulness and necessity of exploratory research in situations where prior analysis could be conducted instead.[[6]](https://en.wikipedia.org/wiki/Exploratory_research#cite_note-6){Wikipedia} |
| **. . 1e2** Confirmatory research |  |
|  |  |
| **1f - 1i What is being studied** |  |
|  |  |
| **. 1f Topic of the study** | From {18}  The general topic area and the specific topic of the study. Can use some classification of disciplines and classifications of specific topics/subjects. {DS} |
| **. . 1f0** Methodological vs. subject matter contribution  of the study | Relative emphasis on shedding light on phenomena vs. developing or testing/validating methods  Some studies do just one or the other, some do some of each. One way of characterizing a study is to express the relative emphasis as a rough percent value. Another, more difficult way is to express the contribution of the study on each of these aspects on a scale, for example 0 - 10; a study may merit a 7 on both if it makes important contributions to both. {DS} |
| **. . . 1f0.1** Emphasis on developing methods  or testing/validating method**s** | * Sometimes a legitimate topic for study is methodological. * For example, development or novel investigation of… * a measuring device * a psychometric instrument (questionnaire or inventory) * a protocol for a physical performance test * a diagnostic test * a method of analysis. * You usually include or focus on a reliability and/or validity study of the measure provided by the method. * Validity = the relationship between observed and true values. * Reliability = reproducibility of observed values. {18} |
| **. . . 1f0.2** Emphasis on shedding light on phenomena |  |
| **. . 1f1** Subject matter of the study | Subject matter is defined narrowly to exclude time and space aspects. The general subject area and the specific topic of the study. Can use some classification of disciplines and classifications of specific topics/subjects. {DS}  Some examples   * **Clinical:** the effect of a herb on performance. * **Psychological**: factors affecting work-place satisfaction. * **Behaviora**l: how can we reduce truancy at this school? * **Economic**: characterize the productivity of new immigrants. * **Social:** develop risk-management procedures at a gym {18}   Below are just a few more examples of characterizing research by content and content-related approaches. These examples provide a glimpse at the vast classification that could be developed. |
| **. . . 1f1.1** Example: Communication research | Investigation of the five communication elements {14}  An example of looking at different research tasks in a content area, each of which may use a specialized set of methods. |
| **. . . . 1f1.1.1** Control analysis (source) | * 1. Refers to the performance of the communicator. These are the essential factors affecting their performance such as their credibility, capability, expertise, functions, structures and needs/problems. {14} |
| **. . . . 1f1.1.2** Content analysis (message) | This determines the nature and characteristics of message, manifestations of any of the scopes and themes, slant and treatment, text or visuals and message appeal. {14} |
| **. . . . 1f1.1.3** Media analysis (channel) | Refers to the media’s comparative advantages, media features, and costs. {14} |
| **. . . . 1f1.1.4** Audience analysis (receiver). | Concerns audience behavior, tastes, interests, opinions, where they reach and can be conducted on the following feedback level, audience level and expectations. {14} |
| **. . . . 1f1.1.5** Impact analysis (effects) | Know the current trends in such areas as community media system, information diffusion, media socialization, children and television, and media motives, uses and gratifications and can be done on an awareness, attitude, change, behavior change and practice level. {14} |
|  |  |
| **. . 1f2** Time scope of the study |  |
| **. . . 1f2.1** Relative time of the study | *Research by relative time of the phenomena studied*  Relative time is determined by the time relative to the time when the study was done.  A study of the social conditions in Calcutta in 1925 done in 1925 is a study of the present.  A study of the social conditions in Calcutta in 1925 done in 2021 is a study of the past. {DS} |
| **. . . . 1f2.1.1** Study of the past | *Research on past phenomena*  *Historical research* {DS} |
| **. . . . 1f2.1.2** Study of the present | *Research on present phenomena* {DS} |
| **. . . . 1f2.1.3** Study of the future | *Research on future phenomena*  Includes prediction {DS} |
| **. . . 1f2.1** Chronological time of the study | The time period ꟷ from very specific to very broad ꟷ covered in the study. Can be specified by giving a time range by starting point and end point (for example using the XML format) or any name of class number specifying a time period. {DS} |
| **. . 1f3** Spatial scope of the study | *Study by place scope*. *Study by geographical scope* {DS}  Specify by coordinates (for places on earth), name, or class number. {DS}  To be elaborated. Two facets: By geopolitical place and by size of area  This might be extended to also deal with research on groups.  Also whether the researcher is a resident of the geopolitical place or a member of the group.  Applies to ethnographic research {DS} |
|  |  |
| **. 1g Unit of analysis in the study** | The ontological status of the type of units investigated  Such as *material thing*; *immaterial thing*; *natural process*; *designed process, technique* {DS, partly from BFO = Basic Formal Ontology}  Several may apply. Also, boundaries may not be sharp and categories may overlap.  This list could be hierarchically structured, but I opted for simplicity. The most specific category applies. For example, while *people* are *living organisms*, use *people* when it applies.  This is intended primarily for studies that shed light on phenomena, but it can also be used for methodological studies that focus on data collection and/or data analysis methods that apply to a given type of unit of analysis.{DS} |
| **. . 1g1** Study deals with mentefacts | Concepts, ideas, words. Excludes 1g2 |
| **. . 1g2** Study deals with natural or designed processes, techniques |  |
| **. . 1g3** Study deals with non-living material objects,  natural or man-made |  |
| **. . 1g4** Study deals with places |  |
| **. . 1g5** Study deals with living organisms and groups thereof |  |
| **. . 1g6** Study deals with people or groups of people | Includes fictional people or groups of people {DS}  Social sciences study individuals and their contexts. {22}  Perspective, subject matter to be studied, approach – all determine the unit of analysis.  e.g. Death –   * Adjustment to death – collect data from terminally ill individuals ꟷ unit of analysis is individuals * Country comparisons of death rates ꟷ unit of analysis is group, the entire country * Study individuals --- micro research [psychology, social psychology, opinion research, sociology] * Large scale research –compare large aggregates of data. macro research . Mostly sociology.   No consensus on the borderline between micro and macro. {22} |
| **. . . 1g6.1** Study deals with individual people | Personality, learning ꟷ use the individual as the unit of analysis  Different characteristics of individuals are studied. – İn each case, the units from which the study sample is drawn consist of a population of persons  Examples   * Test scores of males vs. females * Effects of SES on preference for number of children * Factors influencing specific voting behaviors {22}   Illustration from {22} |
|  |  |
| **. . . 1g6.2** Study deals with groups of people | Examples   * Dissolution of street gangs * Quality of communication in opposite-sex couples * Cohesion of classes of students * Conflict resolution strategies of a couple (husband-wife) {22} |
| **. . . 1g6.3** Study deals with organizations | Examples   * War-proneness of countries * Fundamentalism of churches * Sex discrimination practices of corporations {22} |
| **. . . 1g6.4** Study deals with social artifacts | Examples   * Effects of economic conditions on topics of literary works * Custody decisions in divorce cases {22} |
| **. . . 1g6.5** Comprehensive example | Reviewed 40 studies that examined **factors that lead police officers to engage in various behaviors.**   * **Types of police officer behaviors.** * Providing service (e.g. assisting motorcyclists) * Making arrests * Employing force on suspects. * **4 categories of determinants of police behavior**   1 Individual differences   * Gender, racial attitude, skill   2 Immediate interpersonal situation   * Number of officers, suspect’s conduct, bystanders, weapon   3 Organizational   * Department policy, specialized unit (e.g. narcotics)   4 Community   * Ethnic composition of the community   {22} |
| **. 1h Developing a research topic / research problem**  **and research questions** |  |
| **. . 1h1** Motivation for a research questions |  |
| **. . . 1h1.1** ●Developing a Research Question.  **W-Ch. 2**, p. 11 - 20 |  |
| **. . . 1h1.2** Research question originating from theory  or researcher curiosity **W-Ch. 6**, p. 41 – 48 |  |
| **. . . 1h1.3** ●Research question originating from practice.  **W-Ch. 3**, p. 21 - 27 |  |
| **. . 1h2** Research question by type of study |  |
| **. . . 1h2.1** Research questions for descriptive studies. |  |
| . **. . . 1h2.1.1** ●Descriptions of Phenomena or Settings**.**  **W-Ch. 4,** p. 28–33 |  |
| **. . . 1h2.2** Research questions for explanatory studies |  |
| **. . . . 1h2.2.1** ●Research questions answered by  testing hypotheses. **W-Ch. 5**, p. 34–40 |  |
|  |  |
| . **1i Study by regulatory requirements (depend on topic and unit of analysis)** |  |
| . . **1i1** Study does not require IRB review |  |
| . . **1i2** Study requires IRB review but is exempt |  |
| . . **1i3** Study requires IRB review and IRB approval |  |
| . . **1i4** Study requires other agency review and approval |  |
|  |  |
| **1j - 1k Dimensions related to the creation and distribution of knowledge** |  |
|  |  |
| **. 1j Degree to which the study adds to the general stock**  **of knowledge** | New knowledge produced? New for whom? Closely related to Direct vs. indirect research.  Degree is an important word in this heading. There is a continuum from just assembling existing knowledge to producing entirely new knowledge. A literature review falls under 1j1 or 1j2. Most studies producing new knowledge build on what is known already; they include a literature review to indicate what is known and a section that emphasizes the study's new contribution. |
| **. . 1j1** Study assembles and organizes what is generally known  already | Research gathered existing knowledge, often with the purpose of informing the intended audience (which may be the study author), as in the statement "I did my research."  This could be as simple as a comparative assessment of products given a user's needs  Complex things such as an intelligence briefing |
| **. . 1j2** Study assembles and organizes and reframes  existing knowledge | Emphasis here is on reframing existing knowledge and possibly deriving new insight,  Contributing some amount of novel thought. Sensemaking. Research is on a continuum.  In sum, "a research paper is more than a summarized version of what others have said or written . . . Ideally, your research paper represents a synthesis of your own perceptions, attitudes, ideas, and experiences supported by information gained from other sources" {27}. |
| **. . 1j3** Study changes belief in existing knowledge | For example, strengthen the belief in the effectiveness of a drug or into the effectiveness of an approach to helping students learn division by fractions.  This is the purpose of *replication studies.* Much research is conducted to see whether previous findings can be replicated. But many studies that are not designed as replication studied may produce results that fall under 1j3. |
| **. . 1j4** Study produces new knowledge | New empirical results, new theories, classifications, mathematical theorems, mathematical proofs that add to the general "stock of knowledge. where *new* = nobody knew before (as opposed to being new to the intended audience but previously known to others) |
| **. . 1j5** *ab ovo* study vs. replication study | As most distinctions in this classification, this is not a dichotomy but a continuum. |
| **. . . 1j5.1** *ab ovo* study | {DS term}  A study starting from the beginning rather than replicating another study. A study about a new topic / research question or using a methodology not before applied to a topic.  Note on terminology: In discussions of replication, the study being replicated is usually referred to as the "original study" or "original research". But outside this context, "original research" has many meanings and interpretation, so it would not be a good term to use in a classification. {DS} |
| **. . . 1j5.2** Replication study | A replication study repeats a study’s procedure and observes if the prior findings repeat in similar conditions. A study is replicated when the results of original (ab ovo) study are closely related to the newly collected data. A replication study may changes one or more variables of the original study, such as sample population, industry sector, etc.  The credibility of a scientific studies is established only if it is replicable under similar or closely related conditions. Findings collected from such studies give greater validity to the originally conducted research. Furthermore, it means that the original study is more likely to be generalizable for larger applications and future research scope. From the perspective of contributing to scientific research, replication studies are important for the continued progress of science. Without validation, how do future researchers know whether to build on the findings of that original work?  Replication studies are broadly classified as:   * Exact or Direct replications – repetition of an experimental procedure to the exact degree as possible. It means that exactly same equipment, material, stimuli, design and statistical analysis should be used. * Conceptual replications – research conducted to repeat the original study using different methods . Despite difference in methods, the new data is similar to the original study findings.   Edited from {19} |
|  |  |
| **. 1k Scope of distribution and use of study results`** |  |
| **. . 1k1** Wide distribution and use of study results, public | May be called Scholarly research, defined as promoting public access to knowledge. {14} |
| **. . 1k2** Restricted distribution to only one or  few persons / organizations / groups | Often for specific use, e.g., administrative purposes |
| **. . . 1k2.1** Proprietary research | Results owned by the researcher or the organization who conducts the research or by the organization who sponsored (paid for) the research. Results may be published in patents or guarded as corporate or government secrets. |

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| **2 General ways of gaining knowledge** | This part provides a broad outline of basic assumptions or philosophical foundations researchers apply in their work and the main types of research design or studies used to gain knowledge. Details are elaborated in parts 3 - 5.  The sections are:  2a Underlying basic assumptions guiding the conduct of research  2b Research design by basic approach to gaining insight / type of knowledge produced  Basic type of study  2c Approaches to empirical research  2d How close to original data or thought? Direct vs. indirect research  2e Degree of flexibility of research protocol  2f Stage of a research study  The rationale for this arrangement is as follows:  2a Underlying basic assumptions is naturally first because these assumptions guide everything else in the conduct of research; also these assumptions are related to the purpose of research.  2b follows because each basic type of study as defined in this section provides further guidance for many aspects of the conduct of a study.  2c *Empirical research* belongs logically under 2d1 *Direct research* in the hierarchy and appears there as 2d1.1.1. But the *Approaches to empirical research* are presented here to make them more prominent and more accessible and to put them in closer proximity to Section 2b. The bulk of social science research is empirical, and distinctions under 2c are generally considered very important. With this arrangement, Sections 2a - 2c together provide the most important characteristics for the core description of most research studies in the social sciences.  2a and 2b combine aspects of research purpose and research method, the what and the how. Sections 2d *Direct research vs. indirect research*, of which 2c is a logical part, and 2e *Degree of flexibility of research protocol* focus on methods, the how, on a very general level, with details belonging into parts 3 - 5 (which are only partially elaborated).  Section 2f *Stage of a research study* deals with another aspect of how; it is not elaborated in this document. {DS} |
| **. 2a Underlying basic assumptions guiding the conduct of**  **research** |  |
| **. . 2a1 Philosophical stance or paradigm** | XXX For now, just a collection of items, mainly from {18} and {20}. Needs to be organized.  *Ideology: objective or subjective* {18} *Worldview* {20}  A paradigm sometimes has religious status for its adherents: thou shalt not question it! {18} |
| **. . . 2a1.1** Positivism | *Positivist or objective* {18}   * We make and share observations, identify problems and solve them without disagreement about the nature of meaning or reality. * This so-called dominant paradigm is responsible for our current understanding of life, the Universe, and almost everything. {18} |
| **. . . 2a1.2** Postpositivism | * • Determination * • Reductionism * • Empirical observation and measurement * • Theory verification {20} |
| **. . . . 2a1.2.1** Research focusing on overt behavior | *Behavioral research* {14}; behaviorism; behavioristic research {DS}  Based on the belief that objective knowledge is obtained through careful and systematic observation and measurement of what people do. This is most reliable in operationalism, which is the transformation of abstract concepts into behaviors that can be precisely qualified. The goal is to identify and test laws that can explain, predict and lead to the control of behavior. {14} |
| **. . . 2a1.3** Post-structuralist | {18}   * The researcher views people as subjects of discourses (interrelated systems of unstable social meanings). * Although the subjectivity of research is emphasized, the researchers attempt to achieve objectivity. Do they succeed? * Many people find post-structuralist papers hard to understand. Alan Sokal, a physicist, wrote a nonsensical paper–Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity–and got it accepted by the journal Social Text {18} |
| **. . . 2a1.4** Phenomenological research | Based on the belief that what people do depends on what they perceive or what goes on their minds. It focuses on the internal, psychological meaning that guides behavior, describes how people understand their life experience, tend to be theory-generated or inductive, and aim to shape the development of theory. {14} |
| **. . . 2a1.5** Interpretivist | {18}   * Part of the truth of a situation can be found in the researcher's interpretation of the self-understandings of participants. * Truth is discovered partly by thought as well as by observation. * Grounded theory of social science is interpretivist: truth emerges from your observations; you do not test a hypothesis. {18} |
| **. . . 2a1.6** Constructivism | {20}   * • Understanding * • Multiple participant meanings * • Social and historical construction * • Theory generation {20} |
| **. . . 2a1.7** Transformative | * {20} * • Political * • Power and justice oriented * • Collaborative * Change-oriented {20} |
| **. . . 2a1.8** Pragmatism | * • Consequences of actions * • Problem-centered * • Pluralistic * Real-world practice oriented {20} |
|  |  |
| **. . 2a2 Analytic (as opposed to holistic) vs. holistic approach** | The holism-reductionism dichotomy is often evident in conflicting interpretations of experimental findings and in setting priorities for future research. {13}  Both approaches can work together to understand a system. For example:{DS}  *Illuminative*. Concerned with the interaction of the components of the system being investigated, e.g., investigating the interaction of the components of educational systems to show the connection among student characteristics, organizational patterns and policies, and educational consequences. |
| **. . . 2a2.1** Analytic (as opposed to holistic) approach | Reductionism {13}  Aims to gain understanding of systems by dividing them into smaller composing elements and gaining understanding of the system through understanding their elemental properties.[1] {13}  The researcher attempts to identify and isolate the components of the research situation. {14} |
| **. . . 2a2.2** Holistic approach | Holism in science, Holistic science {13}  An approach to research that emphasizes the study of complex systems. Systems are approached as coherent wholes whose component parts are best understood in context and in relation to one another and to the whole. {13}  Begins with the total situation, focusing attention on the system first and on its internal relationships.{14} |
| **. . 2a3 Political stance. Neutral / impartial**  **vs. engaged / partisan** | {18} |
| **. . . 2a3.1** Political stance neutral / impartial | Most researchers aim to be politically neutral or impartial by presenting all sides of an argument. {18} |
| **. . . 2a3.2** Political stance engaged / partisan | Sometimes the researcher is overtly partisan or adversarial.   * In social science such research is known as critical or radical.   + - The researcher attempts to raise understanding about **oppression** and to facilitate **collective action** against it.     - Some commentators regard critical research as a specific paradigm in social science, but… * In my experience even biomedical researchers sometimes adopt an overtly partisan or adversarial stance on an issue.   + - Or there are often **hidden agendas** and **biased reporting**.     - Maybe that’s OK, because their stance **stimulates debate**. {18}   See also **2a7** Transformative from {20} |
|  |  |
| **. 2b Research design by basic approach to gaining insight**  **/ type of knowledge produced** | Closely related to 1b and 1c *Purpose of research*. {DS}  According to the Level of Investigation {7}{14}  Rather than using a multi-level hierarchy, the many subdivisions of this category are arranged in order of increasing analyticalness, the highest level being the study of cause-effect relationships.  Closely related to the degree to which a study is analytical is the concept of *explanation*. Explanation of X is often understood as giving the causes of X. But causal explanation is just one, albeit a very important, form of explanation. The Wikipedia article is a very good brief introduction. We quote here the introductory paragraph {DS}  An explanation is a set of statements usually constructed to describe a set of facts which clarifies the causes, context, and consequences of those facts. This description may establish rules or laws, and may clarify the existing rules or laws in relation to any objects, or phenomena examined.[1]  Explanation, in philosophy, is a set of statements that makes intelligible the existence or occurrence of an object, event, or state of affairs. Among the most common forms of explanation are causal explanation; deductive-nomological explanation, which involves subsuming the explanandum under a generalization from which it may be derived in a deductive argument (e.g., “All gases expand when heated; this gas was heated; therefore, this gas expanded”); and statistical explanation, which involves subsuming the explanandum under a generalization that gives it inductive support (e.g., “Most people who use tobacco contract cancer; this person used tobacco; therefore, this person contracted cancer”). Explanations of human behaviour typically appeal to the subject’s beliefs and desires, as well as other facts about him, and proceed on the assumption that the behaviour in question is rational (at least to a minimum degree). Thus an explanation of why the subject removed his coat might cite the fact that the subject felt hot, that the subject desired to feel cooler, and that the subject believed that he would feel cooler if he took off his coat.[2]  https://en.wikipedia.org/wiki/Explanation  XXX Explains variance here |
| **2b1 - 2b3 Focus on empirical research** |  |
| **. . 2b1** Descriptive studies | observe and write up what you consider typical, specific, or accidental {7}  Descriptive research presents a picture of the specific details of a situation, social setting, or relationship.  Descriptive research is undertaken in order to ascertain and be able to describe the characteristics of the variables of interest in a situation. {?}  Descriptive research aims to establish a more developed idea about a social phenomenon. Researchers engage in clearly describing or detailing a social setting or relationship. Descriptive research focuses on "what", “how”, and “who” questions. {15, slightly modified}  Descriptive research: The objective of descriptive research is to describe the characteristics of various aspects, such as the market potential for a product or the demographics and attitudes of consumers who buy the product.[9] {10}  A bank manager wants to have a profile of the individuals who have loan payments outstanding for 6 months and more. It would include details of their average age, earnings, nature of occupation, full-time/part-time employment status, and the like. This might help him to elicit further information or decide right away on the types of individuals who should be made ineligible for loans in the future.  The major purpose of descriptive research, as the term implies, is to describe characteristics of a population or phenomenon. Descriptive research seeks to determine the answers to who, what, when, where, and how questions. Labor Force Surveys, Population Census, and Educational Census are examples of such research.  Descriptive study offers to the researcher a profile or description of relevant aspects of the phenomena of interest. Look at the class in research methods and try to give its profile – the characteristics of the students. When we start to look at the relationship of the variables, then it may help in diagnosis analysis.  Goals of Descriptive Research  1. Describe the situation in terms of its characteristics i.e. provide an accurate profile of a group;  2. Give a verbal or numerical picture (%) of the situation;  3. Present background information;  4. Create a set of categories or classify the information;  5. Clarify sequence, set of stages; and  6. Focus on ‘who,’ ‘what,’ ‘when,’ ‘where,’ and ‘how’ but not why?  A great deal of social research is descriptive. Descriptive researchers use most data – gathering techniques – surveys, field research, and content analysis. {11}  For example, in describing a city you could look at the   * demographics of the population, * the quality of public transportation, * the characteristics of the road network, * the quality of the schools, * and many more {DS}   Descriptive Research: Definition, Characteristics, Methods, Examples and Advantages. Long post in {https://www.questionpro.com/blog/descriptive-research/}  Descriptive studies take many forms and serve many purposes. The subdivisions below capture this variety.  Medical: I. Descriptive research examines the distribution of diseases according to their place and time in society. It includes   * case reports, * case series and * surveillance studies. {3} |
| **. . . 2b1.1** Descriptive study by format |  |
| **. . . . 2b1.1.1** Case report | Medical: Case report is the most common type of descriptive study. It is the examination of a single case having a different quality in the society, e.g. conducting general anesthesia in a pregnant patient with mucopolysaccharidosis. {3} |
| **. . . . 2b1.1.2** Case series | Medical: Case Series:The description of repetitive cases having common features. For instance; case series involving interscapular pain related to neuraxial labor analgesia. Interestingly, malignant hyperthermia cases are not accepted as case series since they are rarely seen during historical development. {3} |
| **. . . 2b1.2** Descriptive study by purpose |  |
| **. . . . 2b1.2.1** Descriptive studies for description | to provide baseline data or simply a picture of how things are. |
| **. . . . . 2b1.2.1.1** Comparison, comparative study | list the similarities and differences in order to better understand one or both of the compared things{7} |
| **. . . . . 2b1.2.1.2** Categorization | form a typology of works, personalities, objects, etc.{7} |
| **. . . . 2b1.2.2** Descriptive studies for monitoring  and evaluation | monitoring and evaluation of the effects of changes during and after they have been made. Investigations may be made to compare results in practice with predictions, or to monitor the effects of a policy, management technique or treatment. {}  This is closely related to quasi-experiment. In a quasi-experiment, the focus is on analyzing causal relationships with the idea of generalizing and contributing to the general stock of knowledge; it is close to the basic end of the basic - applied research continuum. Here the emphasis is on assessment: Did an intervention or change have the desired effect; this is applied research |
| **. . . . . 2b1.2.2.1** Surveillance studies | Medical: Surveillance Studies: these are the results obtained from the databases that follow and record a health problem for a certain time, e.g. the surveillance of cross-infections during anesthesia in the intensive care unit. {3} |
| **. . 2b2** Relational studies | Research for discovering relations between/among variables.   * 2 or more variables/conditions. * Series of coordinated observations. * Strength and direction of relation.   E.g.: Children’s failure is related to teachers’ behaviors, such as not paying attention to a child / ignoring the child, not making eye contact with the child. {22}  In a merely relational study, there is no direction. In the example, it could be that being ignored by the teacher leads to children not doing well, or that the teacher tends to ignore children that do not do well, or there could be a factor affecting both the teacher's behavior and the child's performance, such as the child sitting in the back of the class.  A relational study can be a stepping stone to an Explanatory / causal / analytical study. |
| **. . 2b3** Explanatory / causal / analytical studies | Explanation Formulate, clarify, and answer "why" questions. {based on 7 and 15}  Explanation builds on already existing knowledge collected about a social phenomenon as a result of more basic exploratory and descriptive studies. {15}  When we encounter an issue that is already known and have a description of it, we might begin to wonder why things are the way they are. The desire to know “why”, to explain, is the purpose of explanatory research. It builds on exploratory and descriptive research and goes on to identify the reasons for something that occurs. Explanatory research looks for causes and reasons. For example, a descriptive research may discover that 10 percent of the parents abuse their children, whereas the explanatory researcher is more interested in learning why parents abuse their children.  Goals of Explanatory Research  1. Explain things not just reporting. Why? Elaborate and enrich a theory’s explanation.  2. Determine which of several explanations is best.  3. Determine the accuracy of the theory; test a theory’s predictions or principle.  4. Advance knowledge about underlying process.  5. Build and elaborate a theory; elaborate and enrich a theory’s predictions or principle.  6. Extend a theory or principle to new areas, new issues, new topics:  7. Provide evidence to support or refute an explanation or prediction.  8. Test a theory’s predictions or principles {11}  Explanatory research or causal research is conducted to understand the impact of certain changes in existing standard procedures. Conducting experiments is the most popular form of casual research. For example, a study conducted to understand the effect of rebranding on customer loyalty. {8}  Causal research: The objective of causal research is to test hypotheses about cause-and-effect relationships. The objective is to determine which variable might be causing a certain behavior, i.e. whether there is a cause and effect relationship between variables. This type of research is very complex and the researcher can never be completely certain that there are not other factors influencing the causal relationship, especially when dealing with people's attitudes and motivations. There are often much deeper psychological considerations that even the respondent may not be aware of. {10}  Medical: Analytical Scientific Research: the most important difference of this and the descriptive research is the presence of a comparison group [a special case of Explanatory / causal / analytical studies through statistical analysis]. They are categorized as observational and interventional research. {1}  XXX This entire section needs much elaboration and clarification.  **Here is just a collection of notes to be considered.**   |  | | --- | | Causation by definition has a time element, before and after. When a cross-sectional study aims at investigating causation, a time element is implied. For example, a cross-sectional study may ask participants about intake of food and beverages and about arthritis symptoms to see whether there is a connection. The implicit assumption is that participants have been following for some time the diet they are following now. Participants who just started a healthy diet introduce a confounding factor. If the study asks about past food intake, it uses data referring to different times, so it is a longitudinal study. For some person characteristics the issue is clear-cut; in the example, substitute *genetic makeup* for food intake. {DS} | | A trial is eligible if, on the basis of the best available information (usually from one or more published reports), it is judged that:   * the individuals (or other units) followed in the trial were definitely or possibly assigned prospectively to one of two (or more) alternative forms of health care using * random allocation or * some quasi-random method of allocation (such as alternation, date of birth, or case record number).    Trials eligible for inclusion are classified according to the reader’s degree of certainty that random allocation was used to form the comparison groups in the trial. If the author(s) state explicitly (usually by some variant of the term ‘random’ to describe the allocation procedure used) that the groups compared in the trial were established by random allocation, then the trial is classified as a RCT (randomized controlled trial). If the author(s) do not state explicitly that the trial was randomized, but randomization cannot be ruled out, the report is classified as a CCT (controlled clinical trial). The classification CCT is also applied to quasi-randomized studies, where the method of allocation is known but is not considered strictly random, and possibly quasi-randomized trials. Examples of quasi-random methods of assignment include alternation, date of birth, and medical record number.   The classification as RCT or CCT is based solely on what the author has written, not on the reader's interpretation; thus, it is not meant to reflect an assessment of the true nature or quality of the allocation procedure. For example, although ‘double-blind’ trials are nearly always randomized, many trial reports fail to mention random allocation explicitly and should therefore be classified as CCT  https://handbook-5-1.cochrane.org/chapter\_6/box\_6\_3\_a\_cochrane\_definitions\_and\_criteria\_for\_randomized.htm  This is an archived version. For the current version, please go to [training.cochrane.org/handbook/current](https://training.cochrane.org/handbook/current).  https://training.cochrane.org/handbook/current/chapter-23  https://training.cochrane.org/search/site/randomized%20clinical%20tria**l** | | An **experiment** is a procedure carried out to support or refute a [hypothesis](https://en.wikipedia.org/wiki/Hypothesis). Experiments provide insight into [cause-and-effect](https://en.wikipedia.org/wiki/Causality) by demonstrating what outcome occurs when a particular factor is manipulated. Experiments vary greatly in goal and scale, but always rely on repeatable procedure and logical analysis of the results. There also exists [natural experimental studies](https://en.wikipedia.org/wiki/Natural_experiment).  **Contents**   * [1 Overview](https://en.wikipedia.org/wiki/Experiment#Overview) * [2 History](https://en.wikipedia.org/wiki/Experiment#History) * [3 Types of experiments](https://en.wikipedia.org/wiki/Experiment#Types_of_experiments)   + [3.1 Controlled experiments](https://en.wikipedia.org/wiki/Experiment#Controlled_experiments)   + [3.2 Natural experiments](https://en.wikipedia.org/wiki/Experiment#Natural_experiments)   + [3.3 Field experiments](https://en.wikipedia.org/wiki/Experiment#Field_experiments) * [4 Contrast with observational study](https://en.wikipedia.org/wiki/Experiment#Contrast_with_observational_study) * [5 Ethics](https://en.wikipedia.org/wiki/Experiment#Ethics) * [6 See also](https://en.wikipedia.org/wiki/Experiment#See_also) * [7 Notes](https://en.wikipedia.org/wiki/Experiment#Notes) * [8 Further reading](https://en.wikipedia.org/wiki/Experiment#Further_reading) * [9 External links](https://en.wikipedia.org/wiki/Experiment#External_links)   {https://en.wikipedia.org/wiki/Experiment} | | controlled clinical trial  A clinical study that includes a comparison (control) group. The comparison group receives a placebo, another treatment, or no treatment at all.  {https://www.cancer.gov/publications/dictionaries/cancer-terms/def/controlled-clinical-trial}  randomized clinical trial  A study in which the participants are divided by chance into separate groups that compare different treatments or other interventions. Using chance to divide people into groups means that the groups will be similar and that the effects of the treatments they receive can be compared more fairly. At the time of the trial, it is not known which treatment is best.  {https://www.cancer.gov/publications/dictionaries/cancer-terms/def/randomized-clinical-trial} | | Medical Definition of Randomized controlled trial  Medical Editor: Melissa Conrad Stöppler, MD  Reviewed on 3/29/2021  Randomized controlled trial: (RCT) A study in which people are allocated at random (by chance alone) to receive one of several clinical interventions. One of these interventions is the standard of comparison or control. The control may be a standard practice, a placebo ("sugar pill"), or no intervention at all. Someone who takes part in a randomized controlled trial (RCT) is called a participant or subject. RCTs seek to measure and compare the outcomes after the participants receive the interventions. Because the outcomes are measured, RCTs are quantitative studies.  In sum, RCTs are quantitative, comparative, controlled experiments in which investigators study two or more interventions in a series of individuals who receive them in random order. The RCT is one of the simplest and most powerful tools in clinical research.  {https://www.medicinenet.com/randomized\_controlled\_trial/definition.htm} | |  | |  | |
| **. . . 2b3.1** Explanatory / causal / analytical studies by  degree of manipulative control | XXX Needs some elaboration |
| **. . . . 2b3.1.1** Explanatory / causal / analytical  studies through qualitative analysis | tracing chains of events, analyzing texts that influence events, and more |
| **. . . . 2b3.1.2** Explanatory / causal / analytical studies  through statistical analysis of data aboutpeople, organizations, cities, etc. | Hypothesis testing, regression, causal modelling, machine learning {}  Medical: Observational Research: the participants are grouped and evaluated according to a research plan or protocol. Observational research is more attractive than other studies: as necessary clinical data is available, coming to a conclusion is fast and they incur low costs (4). In observational studies, the factors and events examined by the researcher are not under the researcher’s control. They cannot be changed when requested. All the variables, except for the examined factor or event, cannot be kept constant. Randomization can be restrictedly used in some cases. It might not be always possible to apparently and completely detect a cause and effect relationship. The results are considerably similar to real-life situations since the events are examined as they are and special conditions are not created. Since the repetition of the observed cases is impossible most of the times, it may not be possible to recreate the same conditions (5).  [Included to make the quote complete, but these types of studies are classified differently in the outline] [Moreover, some studies may be experimental. After the researcher intervenes, the researcher waits for the result, observes and obtains data. Experimental studies are, more often, in the form of clinical trials or laboratory animal trials (2).  Analytical observational research can be classified as cohort, case-control and cross- sectional studies.] {7} {1} |
| . . . . **2b3.1.3** Quasi-experimental and experimental  studies. | Medical: **Interventional Research (Experimental Studies)**: in this type of research, there is a control group aimed to be tested. The researcher decides upon which effect the participant will be exposed to in this study. Post-intervention, the researcher waits for the result, observes and obtains the data. Interventional studies are divided into two: quasi- experimental and clinical research.{1} |
| **. . . . . 2b3.1.3,1** ●Quasi-experimental Studies.  **W-Ch. 11**, p. 91 – 102 | Medical: Conducted in cases in which a quick result is requested and the participants or research areas cannot be randomised, e.g. giving hand-wash training and comparing the frequency of nosocomial infections before and after hand wash. {1} |
| **. . . . . 2b3.1.3,2** ●Experimental Studies.  W-Ch. 12, p. 103 – 113 | XXX This section needs to be worked out  Some experiments that hold everything but one influencing factor constant do not make sense because the main effect results from the combined action of these factors. {DS}  Medical: **Clinical Research**: Prospective studies carried out with a control group for the purpose of comparing the effect and value of an intervention in a clinical case. Clinical study and research have the same meaning. Drugs, invasive interventions, medical devices and operations, diets, physical therapy and diagnostic tools are relevant in this context (6).  Clinical studies are conducted by a responsible researcher, generally a physician. In the research team, there may be other healthcare staff besides physicians. Clinical studies may be financed by healthcare institutes, drug companies, academic medical centers, volunteer groups, physicians, healthcare service providers and other individuals. They may be conducted in several places including hospitals, universities, physicians’ offices and community clinics based on the researcher’s requirements. The participants are made aware of the duration of the study before their inclusion. Clinical studies should include the evaluation of recommendations (drug, device and surgical) for the treatment of a disease, syndrome or a comparison of one or more applications; finding different ways for recognition of a disease or case and prevention of their recurrence (7).  Clinical research starts with forming a hypothesis. A hypothesis can be defined as a claim put forward about the value of a population parameter based on sampling. There are two types of hypotheses in statistics.  H0 hypothesis is called a control or null hypothesis. It is the hypothesis put forward in research, which implies that there is no difference between the groups under consideration. If this hypothesis is rejected at the end of the study, it indicates that a difference exists between the two treatments under consideration.  H1 hypothesis is called an alternative hypothesis. It is hypothesized against a null hypothesis, which implies that a difference exists between the groups under consideration. For example, consider the following hypothesis: drug A has an analgesic effect. Control or null hypothesis (H0): there is no difference between drug A and placebo with regard to the analgesic effect. The alternative hypothesis (H1) is applicable if a difference exists between drug A and placebo with regard to the analgesic effect.  The planning phase comes after the determination of a hypothesis. A clinical research plan is called a protocol. In a protocol, the reasons for research, number and qualities of participants, tests to be applied, study duration and what information to be gathered from the participants should be found and conformity criteria should be developed.  The selection of participant groups to be included in the study is important. Inclusion and exclusion criteria of the study for the participants should be determined. Inclusion criteria should be defined in the form of demographic characteristics (age, gender, etc.) of the participant group and the exclusion  criteria as the diseases that may influence the study, age ranges, cases involving pregnancy and lactation, continuously used drugs and participants’ cooperation.  The next stage is methodology. Methodology can be grouped under subheadings, namely, the calculation of number of subjects, blinding (masking), randomization, selection of operation to be applied, use of placebo and criteria for stopping and changing the treatment.{1} |
|  |  |
| **. . . 2b3.2** Explanatory / causal / analytical studies  by function | Information for policy-making will therefore serve one or more of the following functions. https://research-methodology.net/research-methodology/research-types/ |
| **. . . . 2b3.2.1** Explanatory / causal / analytical studies  for explanation | to understand why things are the way they are, what factors explain the way things are.  answer the question: why? {7} |
| **. . . . 2b3.2.2** Explanatory / causal / analytical studies  for prediction | to predict how systems will change under alternative scenarios (modelling). {}  on the basis of past correlations, tell how probable a future event, action, outcome, etc. could be. {7} |
| **. . . . 2b3.2.3** Explanatory / causal / analytical studies  for prescription and planning (decision-making) | prescription and planning relating to changes in existing systems. |
| {2} | |
|  |  |
| . . . **2b3.3** Modeling and simulation | Models can be symbolic or physical. Here we focus on symbolic models that can be "run" to imitate / simulate a real-world process as it evolves over time.  A symbolic model is a symbolic representation of a system ꟷ the system components and their characteristics (represented as variables) and the interactions of the system components. (Picture a concept map on steroids.) For example, in a model of the economy, one could test the effects of lowering the interest rate on the rate of building new housing units and the cost of housing, which may in turn reduce the number of homeless people as well as improve living conditions for many families, which may lead to children doing better in school. The model would quantify these effects so that the effects of different interest rates could be studied.  **Sample application areas**   * Weather (local / regional), climate change (global) * Biology and medicine, for example modeling the complex processes in a cell and interactions among molecules or, on a larger scale, modeling the processes and interactions in the human body (the digital human). Could be used for identifying promising new drugs: * generate a large number of variations of some molecule to consider as candidate drugs for treating a condition (such as killing a virus or preventing plaque accumulating in the brain). * Simulate for each variation what happens if a molecule is injected into a cell or into the body ꟷ these are in silico (in the computer) experiments; they serve as a first screen for identifying molecules that appear somewhat promising. * For the remaining molecules, conduct in vitro (in a glass dish) and in vivo (in a living organism) experiments to further narrow to drugs to be tested in a clinical trial. * Economics * Ecosystems, urban planning (as in the serious computer game SimCity) * Education: Model the effect of a program to reduce bullying abuse in a school on the overall school climate, and then the effect of school climate on learning, looking in particular at learning outcomes of students who are in danger of being bullied.   **Sample uses** (uses are overlapping) {DS} with acknowledgments to {26}   * Understanding systems, explaining how they work * Exploration * What-if analysis (in silico experiments) * Prediction and retrodiction * Design, generating and evaluating solutions * Decision making * Education and training (in many ways: exploration, explanation, presenting cases to medical students, flight simulator)   **Uses of Simulation (**S.M. Manson, in International Encyclopedia of Human Geography, 200  Simulation models are used in a variety of interrelated ways across research, policy, and educational contexts. At their simplest, simulations can explain a system and examine how the system will look in the future or times past, or in many possible futures or pasts. They also support human decision making, especially in systems that are too complicated for any one person to easily understand. The process of simulation can also help elucidate new information by making clear what the modeler does and does not know. Finally, simulation is increasingly used in education and entertainment.  Explanation: Simulation is one way to understand and explain the underlying processes of a given pattern in a system or the potential patterns associated with processes in a system. While some critics of simulation see it merely as a way of encoding existing knowledge, the ability of a simulation to link together data and theory about multiple system components actually allows it to generate better explanations. Simulations of the global climate system or transportation networks, for example, combine the research and data from multiple scientific and policy domains to create a better understanding of how these systems work.  Prediction: Simulations are used to predict aspects of the future state of a system when the simulations can adequately capture some of its underlying processes. Simulation models are regularly used to project the complex properties of human systems such as populations, cities, or economies. In an urban setting, for example, modelers can use socioeconomic predictions to answer questions like how many schools to build in a city or where to route transportation and infrastructure to minimize future ecological harm.  Simulation is also a means to recreate past events in a manner analogous to predicting future ones. This use of simulation is especially useful for understanding how past cultures or civilizations changed, or in cases such as the Classic Maya in modern-day Central America or Anasazi peoples of the present-day southwest United States, collapsed or disappeared.  Prediction and retrodiction often imply that simulations are designed to identify a single past or future outcome, but simulation is often used to construct different scenarios, or plausible stories, of possible futures or pasts that vary with changes in model inputs or structure. Scenarios have been used to assess the effects of different irrigation schemes on a dam project, for example, and to examine the impacts of variations in future climate change on global sea levels and agriculture.  Simulation can supplement or replace expert knowledge in decision making. This use of simulation is widespread in industry and commerce, for example, where it is used to help plan product rollouts or guide the choice of materials in manufacturing. There is also a growing number of simulations designed to allow various publics and policy makers come to better informed decisions about situations like responding to disease pandemics or siting of nuclear power plants.  In order to build a simulation, a modeler must understand much about the system being simulated. At the same time, the process of creating a simulation model also helps the modeler order and integrate current knowledge. Simulation can also identify gaps in current knowledge and thereby help prioritize research needs. Finally, simulation also provides, and relies on, approaches such as qualitative interviews or expert elicitation to encode personal knowledge in a way that makes it available to others.  Simulation has long been used for educational and entertainment purposes, and the growth of simulation in general has increased these uses as well. Simulation has long been used in the military, industry, and medicine to train people in situations where actual activities are difficult, dangerous, and expensive (such as flying airplanes, engaging in combat, and conducting surgery, respectively). Simulation is also used in schools and universities to provide a form of ‘virtual laboratory’ to model urban planning processes or changes in the climate.  There are more excellent summaries and links to the original sources on this Web page.  {https://www.sciencedirect.com/topics/social-sciences/simulation-models} |
| **2b4 - 2bx Focus on general methods and thought research** |  |
| . . **2b4** Critical reflection |  |
|  |  |
| **. 2c Approaches to empirical research** | This section presents important subdivisions of 2d1.1.1 *Empirical research*, pulled up to make them more prominent and more accessible and put them in closer proximity to Section 2b.  For remarks on the definition of *empirical research* see 2d1.1.1.{DS} |
| **. . 2c1** The qualitative ꟷ quantitative research continuum. | This may be more fundamental than mixed methods. I hope to develop a lecture that describes a multi-dimensional space of types of research where any research study can be examined on a number of characteristics or dimensions and is positioned in the space accordingly. Some positions in the space would be clearly called quantitative, others clearly qualitative, but many would be in a grey zone in-between. See. for example, Cooper et al. Challenging the qualitative-quantitative divide. (The key person behind the book is the alphabetically last author, Martyn Hammersley.) {DS}  Data: Data are not the decisive distinction, data analysis is. Some data are amenable only to qualitative analysis, some only to quantitative data analysis, but quite a few types of data are amenable to both.  Patron satisfaction qualifies as a qualitative study  Can have 0-4 scale for satisfaction and use that for a quantitative analysis.  Why a patron was satisfied or not would at first seem a qualitative study, and a narrative account would be useful. But one could discern the major reasons and do a quantitative analysis of these. {DS} |
| **. . . 2c1.1** Qualitative research | With qualitative methods…   * You gather information or themes from texts, conversations or loosely structured interviews, then tell a coherent story. * Software such as NVivo can help [or Atlas.ti plus more, see https://www.predictiveanalyticstoday.com/top-qualitative-data-analysis-software/ * The open-ended nature of these methods allows for more flexibility and serendipity in identifying factors and practical strategies than the formal structured quantitative approach. * The direction of the research may change mid-stream. * Formal procedures enhance trustworthiness of the information. * Triangulation–aim for congruence of info from various sources. * Member checking or respondent validation–the subjects check the researcher’s analysis. * Peer debriefing–colleagues or experts check the analysis. {18}   Quantitative methods provide limited opportunity to understand what is going on in users' minds and how they search for and process new information. Yet knowing exactly that is very important for designing usable and effective systems. So what we find through good qualitative research is absolutely actionable. {DS} |
| **. . . 2c1.2** Quantitative research | With quantitative methods…   * You gather data with an instrument, such as a stopwatch, a blood test, a video analysis package, or a structured questionnaire. * You derive measures or variables from the data, then investigate relationships among the variables. * Some people think you have to do it by testing hypotheses. * Error of measurement is an important issue. * Almost all measures have noise or other errors. * Errors affect the relationship between measures. * You attend to errors via validity and reliability. * A pilot study to investigate error can be valuable. {18} |
| **. . . 2c1.3** ●Mixed Methods. W-Ch. 13, p. 114 – 122 | Hybrid or mixed method: analyze a sample of cases qualitatively, then code information into values of variables to make inferences about a population quantitatively. {18} |
| **. . 2c2** Relationship data collector - data analyst  Primary vs. secondary data analysis | The terms primary research and secondary research are also used; they often have different and imprecise meanings |
| **. . . 2c2.1** Primary analysis (analyst = collector) | The data are analyzed by the researcher or group who collected the data or oversaw data collection. This is important because the data analyst could specify the definition of variables and the methods used in data collection, making sure the data collection parameters supported his or her research objectives. |
| **. . . 2c2.2** Secondary analysis (analyst ≠ collector) | The data are (re-) analyzed by a researcher or group different from the researcher or group who collected the data or oversaw data collection, perhaps to test different hypotheses. This is cheaper than new data collection (which may not even be possible), but the data analyst could not specify the definition of variables and the methods used in data collection, so the data collection parameters may not be well aligned with the analysts research objectives. Secondary analysis may combine several datasets with the same kind of data (for example, people's opinions on smoking in public). The resulting larger sample size may support more certain results, but data interoperability is a huge problem: Are variables defined the same way? Did slight variations in the questions posed research participants influence their answers. |
| **. . . . 2c2.2.1** Meta-analysis | A meta-analysis is a statistical assessment of the data provided from multiple studies or sources that attempt to ask/answer the same question. {24}  A meta-analysis is a statistical analysis that combines the results of multiple scientific studies. Meta-analysis can be performed when there are multiple scientific studies addressing the same question, with each individual study reporting measurements that are expected to have some degree of error. The aim then is to use approaches from statistics to derive a pooled estimate closest to the unknown common truth based on how this error is perceived.  {https://en.wikipedia.org/wiki/Meta-analysis}  The studies used for a meta-analysis must have used research designs that are sufficiently similar (definition of variables, data collection methods, for meta-analyses of type (2): statistics used in reporting results) to make the combination of data or results meaningful. There are two kinds of meta-analysis:  (1) Pool data from several studies to produce a larger sample to allow for stronger hypothesis testing and more precise estimates of effect sizes and for analyzing subgroups that in individual studies are too small for statistical analysis. This type of meta-analysis is direct research.  (2) Do statistical analysis of the results of multiple studies to discover to what extent results agree or diverge, what population characteristics may explain divergence, or to compute a better estimate of effect size and other statistics as a weighted average from multiple studies. This type of meta-analysis is indirect research; it does not use original data but rather works with the results derived by others. This type of meta-analysis is a highly analytic form of literature review.  While meta-analysis is commonly used to imply statistical analysis, the concept can be broadened to include an analysis of multiple qualitative studies in either type (1) or type (2) fashion. Even more broadly, a meta-analysis could use a body of quantitative and qualitative studies. {DS} |
|  |  |
| **. 2d How close to original data or thought? Direct vs. indirect research** | The terminology *Direct vs. indirect research* as used here is from {DS}. |
| **. . 2d1** Direct research | The term *direct research* is used in  https://www.sba.gov/business-guide/plan-your-business/market-research-competitive-analysis  in the sense of going directly to the consumer to collect data rather than relying on existing sources.  DS term. What is usually meant by research in academia and by funding agencies {DS}  Direct research works with   * data collected from the units under study (including data obtained from documents they produced) and/or * data collected through observation of the units under study * Original thought of the researcher / scholar, as in philosophy, mathematics. |
| **. . . 2d1.1** Empirical vs non-empirical research | Empirical research   * Empirical research uses data from direct experience, observation, or experimentation. A laboratory experiment involving mice is an example of empirical research{27}. It typically involve systematic collection and analysis of data. Can be quantitative or qualitative   Non-empirical research   * The prototype for non-empirical research is research in mathematics. This involves dealing with mathematical structures (known or invented by the researcher) and statements that can be made about these structures, proving the statements right (a theorem) or wrong. If a statement cannot be proven either right or wrong, it remains a conjecture, and generations of mathematicians might work on it. Mathematical logic is very important in designing databases. Much of computer science is also non-empirical research, as is much of philosophy and law. {DS} |
| **. . . . 2d1.1.1** Empirical research | Empirical research is research that works with empirical data (often referred to simply as data), collected by the researcher or by someone else. Empirical data come in many forms and can describe or make statements about many things. You can get an intuitive understanding on what is meant by (empirical) data by looking at part 4. *Sources of Data and Methods of Data Collection.*  Note: Anyone who thinks they can give a simple definition of *data* suffers from philosophical naiveté, so I am not going to try here. An intuitive understanding ("I know data when I see it.") is sufficient for this course.  Empirical research accounts for the greatest fraction of research done in academia and special research institutes. Also the majority of funded research. {DS}  Important distinctions fall within *empirical research*. To make these more prominent and more easily accessible, they have been pulled out from here into their own section 2c *Approaches to empirical research*. {DS}  Empirical research is research using empirical evidence. It is also a way of gaining knowledge by means of direct and indirect observation or experience. Empiricism values some research more than other kinds. Empirical evidence (the record of one's direct observations or experiences) can be analyzed quantitatively or qualitatively. Quantifying the evidence or making sense of it in qualitative form, a researcher can answer empirical questions, which should be clearly defined and answerable with the evidence collected (usually called data). Research design varies by field and by the question being investigated. Many researchers combine qualitative and quantitative forms of analysis to better answer questions which cannot be studied in laboratory settings, particularly in the social sciences and in education. {https://en.wikipedia.org/wiki/Empirical\_research}  Terminology  The term empirical was originally used to refer to certain ancient Greek practitioners of medicine who rejected adherence to the dogmatic doctrines of the day, preferring instead to rely on the observation of phenomena as perceived in experience. Later empiricism referred to a theory of knowledge in philosophy which adheres to the principle that knowledge arises from experience and evidence gathered specifically using the senses. In scientific use, the term empirical refers to the gathering of data using only evidence that is observable by the senses or in some cases using calibrated scientific instruments. What early philosophers described as empiricist and empirical research have in common is the dependence on observable data to formulate and test theories and come to conclusions. {https://en.wikipedia.org/wiki/Empirical\_research} |
| **. . . . 2d1.1.2**Non-empirical research, thought research | The researcher develops original thought, the result represents the researchers original thinking, as in philosophy or mathematics or theoretical physics. A review of several studies of this type is indirect research. {DS} |
| **. . 2d2** Indirect research | What is often meant by research when talking about the work of K - 12 and undergraduate students: Writing a paper or report selecting and assembling information from a number of sources, without doing any direct research  Indirect research works with   * results of direct research found in sources. Maybe several steps removed from direct data Bibliographic research (any research in which information is gathered from published materials),  library research, Internet / Web research   Note: Subdivisions for direct research apply in terms of the types of research results obtained from sources {DS}  Cochrane Library: Cochrane Reviews https://www.cochranelibrary.com are important to medical practitioners  Modern clinical guidelines identify, summarize and evaluate the highest quality evidence and most current data about [prevention](https://en.wikipedia.org/wiki/Preventive_medicine), [diagnosis](https://en.wikipedia.org/wiki/Diagnosis), [prognosis](https://en.wikipedia.org/wiki/Prognosis), therapy including dosage of medications, [risk/benefit](https://en.wikipedia.org/wiki/Risk-benefit_analysis) and [cost-effectiveness](https://en.wikipedia.org/wiki/Cost-effectiveness). Then they define the most important questions related to clinical practice and identify all possible [decision options](https://en.wikipedia.org/wiki/Decision-making) and their [outcomes](https://en.wikipedia.org/wiki/Upside_outcomes). Some guidelines contain decision or computation [algorithms](https://en.wikipedia.org/wiki/Algorithm_(medical)) to be followed. Thus, they integrate the identified decision points and respective courses of action with the [clinical judgement](https://en.wikipedia.org/w/index.php?title=Clinical_judgement&action=edit&redlink=1) and experience of practitioners. Many guidelines place the treatment alternatives into classes to help providers in deciding which treatment to use. {https://en.wikipedia.org/wiki/Medical\_guideline} |
| **. . . 2d2.1** Literature review. State-of-the-art report | Most research papers contain a literature review section. There are also self-standing literature reviews, the main emphasis here. Systematic literature review.{DS}  A state-of-the-art report is a comprehensive analysis of available knowledge (published and unpublished) on the status of a particular subject area or mission, frequently written for the use of a specific reader audience. {21} |
| **. . . . 2d2.1.1** Systematic literature review | A systematic literature review is a method to review relevant literature in your field through a highly rigorous and 'systematic' process. The process of undertaking a systematic literature review covers not only the content found in the literature but the methods used to find the literature, what search strategies you used and how and where you searched. A systematic literature review also importantly focuses on the criteria you have used to evaluate the literature found for inclusion or exclusion in the review. Like any literature review, a systematic literature review is undertaken to give you a broad understanding of your topic area, to show you what work has already been done in the subject area and what research methods and theories are being used [, and to synthesize the findings] . The literature review will help you find your research gap and direct your research.  {https://libraryguides.griffith.edu.au/systematic-literature-reviews-for-education}  In Medicine, where the concept of a systematic literature review originated, the emphasis is on synthesizing findings {DS}:  A systematic literature review attempts ‘to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a given research question’ (Cochrane definition, 2013). {24}  A systematic review attempts to collate all the empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question. It uses explicit, systematic methods that are selected with a view to minimizing bias, thus providing more reliable findings from which conclusions can be drawn and decisions made (Antman et al 1992, Oxman and Guyatt 1993). Systematic review methodology, pioneered and developed by Cochrane, sets out a highly structured, transparent and reproducible methodology (Chandler and Hopewell 2013). This involves: the a priori specification of a research question; clarity on the scope of the review and which studies are eligible for inclusion; making every effort to find all relevant research and to ensure that issues of bias in included studies are accounted for; and analyzing the included studies in order to draw conclusions based on all the identified research in an impartial and objective way.  {https://training.cochrane.org/handbook/current/chapter-01}  Excellent source: https://instr.iastate.libguides.com/gradlitrev/TypeSR |
| **. 2e** **Degree of flexibility of the research protocol** | The term *research protocol* originated in medicine, in particular in clinical research (see the definition at the end of this annotation, but it is now used for any kind of research. Many IRBs (Institutional Review Board) use the term in this very general sense. A research protocol codifies the research design and the manner of its execution.  Of particular importance in this context are the following elements of the research protocol   * Definition of variables * Research questions * Selection of participants, sampling * Data collection instruments (which determine how well the data collected match the variable definitions * Data analysis procedures, especially formulas for computing indicators   Flexibility is a double-edged sword. Strict adherence to a fixed protocol promotes consistency within a study and comparability of results among studies. Adapting the protocol based on evolving findings may lead to deeper insights. For example, the researcher could modify interview questions or adding some to get better data from data collection later in the study or the researcher may modify the Quality of Urban Life Index envisioned at the outset of the study.  Flexibility may be different for different components of the research protocol. For example, a study might use the *Career and College Readiness scale* which measures the extent to which secondary students perceive their self-efficacy and preparedness for post-secondary education and/or future careers. (http://cayci.osu.edu/wp-content/uploads/2015/01/03-09-16\_CAYCISES\_CareerCollege\_MSHS.pdf)  **2e1- 2e3 represent several overlapping aspects of protocol flexibility{DS}.**  **Definition.** A research protocol is a document that describes how a clinical trial will be conducted: the background, rationale, objectives, design, methodology, statistical considerations, and organization of a clinical research project, in particular a clinical trial. It ensures the safety of the trial subjects and integrity of the data collected. By the ICH Good Clinical Practice guidelines [https://database.ich.org/sites/default/files/E6\_R2\_Addendum.pdf], **a protocol should include the following topics:**   * Title Page (General Information) * Background Information * Objectives/Purpose * Study Design * Selection and Exclusion of Subjects * Treatment of Subjects * Assessment of Efficacy * Assessment of Safety * Adverse Events * Discontinuation of the Study * Statistics * Quality Control and Assurance * Ethics * Data handling and Recordkeeping * Publication Policy * Project Timetable/Flowchart * References * Supplements/Appendices {25} |
| **. . 2e1** Origin of the protocol. Control of the protocol | Origin and control is a matter of degree. A protocol could be based on a standard but adapted for use in the present study. |
| **. . . 2e1.1** Official or widely accepted standard |  |
| **. . . 2e1.2** Protocol used by another research team |  |
| **. . . 2e1.3** Protocol used in another study  by the same research team |  |
| **. . . 2e1.4** Protocol developed specifically for the study |  |
| **. . 2e2** Research protocol by degree of advance specification |  |
| **. . . 2e2.1** Detailed advance specification |  |
| **. . . 2e2.2** Develop the protocol as you go | In my experience, historical research involves compiling as much information as possible on the front end, and then spending a substantial amount of time sifting through your information, using it to build an argument. On the other hand, scientific research involves much more work on the front end in order to design a study that will capture accurate data. The focal point here is on the preparation phase, because without proper planning such studies will not achieve their intended results. {XXX} |
| **. . 2e3 Research design by strictness of adherence to protocol** |  |
| **. . . 2e3.1** Research process with strict adherence to protocol |  |
| **. . . 2e3.2** Protocol adaptation following exact rules  specified in the protocol | Example 1  In statistics, sequential analysis (sequential hypothesis testing, sequential parameter, such as effect size, estimation) is statistical analysis where the sample size is not fixed in advance. Instead data are evaluated as they are collected, and further sampling is stopped in accordance with a pre-defined stopping rule as soon as significant results are observed. Thus a conclusion may sometimes be reached at a much earlier stage than would be possible with more classical hypothesis testing or estimation, at consequently lower financial and/or human cost.  {https://en.wikipedia.org/wiki/Sequential\_analysis}  Example 2  Clinical trial protocols include a provision on stopping when observed adverse effects by number and seriousness make the risk for participants too high.{DS}  Example 3  The protocol may include less structured ways in which a sample may be created as the study goes along. In a qualitative study the researcher may observe that collecting data from or about more people or situations does not lead to new insights ꟷ a saturation point is reached and data collection stops. This is an informal version of sequential analysis. Or new participants may be added to a study through referrals from existing participants. This is on the borderline to 2e3.3 or may even fall under 2e3.4 {DS} |
| **. . . 2e3.3** Protocol adaptation by researcher judgment | Looking at data collected so far or qualitative coding completed so far, the researcher uses judgment to adapt data collection procedures, interview or questionnaire questions, even variables. In much qualitative research this approach is used routinely; it is part of the method. |
| **. . . 2e3.4** Local protocol adaptation | An example would be that an interviewer who is not the researcher adapts the conduct of an interview (sequencing questions, emphasizing certain interview topics over others, pursuing a train of thought that goes beyond the original research plan. |
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| **. 2f Stage of research stud**y (just one example) | A research study or an overall research program may proceed in several stages. The stages may be different for different types of studies. One study may do just one stage or several stages. {DS} |
| **. . 2f1** Stages of Human-Centred Design {6} |  |
| **. . . 2f1.1** Immerse mode | Actively look for problems that need solving and opportunities for change {6} |
| **. . . 2f1.2** Inspire mode | Turn observations into insights, creating meaning from the opportunities, needs, goals, behaviour and values we have observed. People sometimes think inspiration arrives as a flash, but it’s a process of looking for meaning. {6} |
| **. . . 2f1.3** Imagine mode | Generate, develop and test ideas. {6} |
| **. . . 2f1.4** Invent mode | Develop ideas into concrete solutions – real products, services or experiences that make a meaningful difference to people. {6, p. 2} |
| . **2g Research by organizational arrangement** |  |
| . . **2g1** Research by number of disciplines involved |  |
| . . . **2g1.1** Monodisciplinary research |  |
| . . . **2g1.2** Interdisciplinary research | *Multidisciplinary research, pluridisciplinary research, transdisciplinary research* |
| . . **2g2** Research by number of researchers involved |  |
| . . . **2g2.1** Small research group, one principal investigator |  |
| . . . **2g2.2** Team research. Team science.  Collaborative research |  |
| . . . **2g2.3** Big science |  |
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| **Parts 3 - 5. Detailed research methods in the social sciences** | XXX Later versions will go into more detail of method and refer to more sources  parts follow Wildemuth, Part 3 - 5. With the exception of some subsections of 3, they are not elaborated in detail. parts 4 and 5 do not go into much detail at all. {DS} |
|  |  |
| **3 Research design by scope, participants, context,**  **and overall protocol** |  |
|  |  |
| **. 3a Research Design by scope of study and sampling** | The main characteristic of subdivision in this dimension is the number of instances of the unit of analysis (the number of people, the number of buildings, etc., see 1g) a study covers, ranging from a case study of one to millions (the US Census covers about 120 million households). As a general rule, at a given cost, the more instances of the unit of analysis a study covers, the lower the amount of data it can collect for each instance.  The next important characteristic is the method of sampling, how the instances of the units of analysis (the people, the buildings) to be covered in the study are selected from the total "population" (the set of all instances of the unit of analysis that fit in the study topic). This is related to fraction of the population covered in the study, from very small, as in most case studies, to 1 (the total population).  Scope may also refer to *time scope* and *geographic scope*, which in this classification are grouped under *1f Topic of the study: 1f2 Time scope of the study* and *1f3 Spatial scope of the study.* |
| **. . 3a1** Studies of limited scope or extent |  |
| **. . . 3a1.1** ●Case Studies. W-Ch. 7, p. 51 – 59 | **Case studies and generalizability.** General knowledge vs specific case knowledge  Case studies explore one particular entity or set of entities, often in their natural setting, yielding results so detailed and specific to their context that one must take great care in considering generalizing the results. Some authors state apodictically that results from case studies cannot be generalized.  However, that the results of a case study are never generalizable is a wide-spread misconception . It is true that results from a case study cannot be unthinkingly generalized universally to all cases (but then I do not know of any results having to do with living organisms or behavior or societies that are universally applicable). The results of a case study can be applied to similar cases with some caution (*case-based reasoning*). Causal mechanisms discovered in one case may be at work in cases that are not otherwise similar. Medical knowledge and medical practice are full of examples.  Generalizability is not YES or NO. It has many gradation along at least two dimensions  1 The scope of cases or circumstances to which results (obtained by whatever method) are applicable  2 How directly results are applicable.  Also, case studies can address causality by following a chain of events in a specific case. For example, the study of an organization could show (through interviews with staff) that the attitudes and behavior of the leader (in the worst case denigrating staff, bullying, and sexual harassment) are the root cause of a poor organizational culture and a lack of morale / motivation. This finding in one case clearly makes sense and may lead to a presumption that such a dynamic is present in other organizations with similar poor leadership. The board of directors of any organization may be well advised to consider this in appointing leaders.  So one might actually observe phenomena, interdependencies, causal chains that hold in the particular case but could reasonably be assumed to hold in similar cases. Examining a similar case may yield similar observation, strengthening our belief that we are onto something more general. If a seemingly similar case yields different observations we will then dig deeper, observe reasons for the differences and slowly build up a general understanding case by case.  **Specific case knowledge vs. general knowledge**  See also 1d Idiographic vs. nomothetic research  If we want to effect change in one city or one school system or one person, we need to understand the special case really well. A general theory of how city's function will be helpful, but our city may not follow the general pattern, perhaps due to the influence of one special person or clan.  Thus a case study can be undertaken with idiographic intent (as described in the previous paragraph) or with nomothetic intent, as discussed above. Regardless of the original intent, the results of case study can be used idiographically and sometimes nomothetically. {DS}  In a longitudinal case study a researcher examines in depth many features of a few cases over a long duration of time. Often times the data collected includes very detailed and personal information about a person, organization, etc. {15} |
| **. . . 3a1.2** ●Sampling for Intensive Studies.  **W-Ch. 15**, p. 136 – 144 |  |
| **. . 3a2** Studies of larger Scope. Extensive Studies |  |
| **. . . 3a2.1** ●Sampling for Extensive Studies.  **W-Ch. 14**, p. 123 – 135 |  |
|  |  |
| **. 3b Studies by population studied** |  |
| **. . 3b1** ●Studying Special Populations.  **W-Ch. 16,** p. 145 – 151 | Serving a population properly ꟷ providing useful information in the right framing and format, providing medical services, providing access to healthy food and accompanying culturally appropriate education in nutrition and preparing healthy meals, etc. ꟷ requires knowledge of the population. But recruiting members of special populations ꟷ minoritized racial / ethnic groups, women, children, the LGBTQIA+ community, people with disabilities ꟷ for clinical studies or information behavior / information needs studies is difficult. It requires special methods that are implemented with great sensitivity. |
| **. .**  **3b2** Cohort studies | Cohort is used in different meanings. Here we define cohort as a group of people who were participants, observers, in or otherwise contemporary with an event or happening in a specified time period, possibly further specified by additional criteria. Examples;   * People born on 2015-01-21, or in 2015-01, or in 2015, or in 2015 in California, or born in 2015 and female * People graduating from high school between 2018 - 2021, or between 2018 - 2021 from Interlochen Arts Academy * People entering college in 2020 or entering SUNY Fredonia in 2020 or entering the University at Buffalo MS in Information and Library Science program in 2020 * People in the audience for the performance of Tosca on January 21, 1964 in Covent Garden with Maria Callas in the lead role * People who died in 2019 (for a retrospective study)   This definition can be extended to units of analysis other than people, such as  companies in California grossing $1 Billion or more in 2020 or  buildings constructed Belo Horizonte, Brazil, between 1940 - 1959.  Cohort study usually means a longitudinal cohort study, but a cohort study could be cross-sectional, perhaps compared with other contemporaneous cohorts, such as comparing the entering classes at several academic programs along various demographic characteristics.  A longitudinal cohort study could be repeated cross-sectional or panel. The important point is that all samples are drawn from the same cohort.{DS}  Cohort Studies (Prospective, Retrospective and Ambidirectional): A cohort is a group formed by patients having common characteristics. A cohort study is the one in which a group of patients is followed-up in time, e.g. comparison of academic performances of children (who underwent anesthesia in their neonatal period) in their adolescence.  Firstly, the participants are controlled with regard to the disease under investigation. Patients are excluded from the study. Healthy participants are evaluated with regard to the exposure to the effect. Then, the group (cohort) is followed-up for a sufficient period of time with respect to the occurrence of disease, and the progress of disease is studied. The risk of the healthy participants getting sick is considered an incident. In cohort studies, the risk of disease between the groups exposed and not exposed to the effect is calculated and rated. This rate is called relative risk. Relative risk indicates the strength of exposure to the effect on the disease.  Cohort research may be observational and experimental.{1} |
|  |  |
| **. 3c Study by how phenomena are followed over time** | *Cross-sectional vs longitudinal* {}  Temporal aspects of how a study is planned and conducted. Studies vary widely in how they deal with this, and many studies cannot be clearly assigned to one of the categories in the hierarchy below.{DS}  Some studies give us a snapshot of a single, fixed time point and allow us to analyze it in detail. Other studies provide a moving picture that let us follow events, people, or sale of products over a period of time. In this way from the angle of time research could be divided into two broad types {11}  Not a matter when data are collected, but the time period data refer to  Cross-sectional: All data are about one fairly short period, like a snapshot.  Data can be collected at one time, but refer to a long period going back in time. The data then support retrospective longitudinal analysis.  For a prospective longitudinal study, data are collected "now" and at different times in the future.  {DS} |
| **. . 3c1** Cross-sectional studies | *Synchronic studies*, one time slice. This is the default {DS}  Researchers observe at one point in time. Cross-sectional research is usually the simplest and least costly alternative. Its disadvantage is that it cannot capture the change processes. Cross-sectional research can be exploratory, descriptive, or explanatory, but it is most consistent with a descriptive approach to research. {11}  Medical: Patients or events are examined at a particular point in time. Prevalence studies (the percentage of a population having a disease at a certain time) are the ones in which the diagnosis and disease mechanism are detected and the cause and effect relationship is examined at the same level.  Cross-sectional studies are advantageous since they can be concluded relatively quickly. It may be difficult to obtain a reliable result from such studies for rare diseases (2).  Cross-sectional studies are characterized by timing. In such studies, the exposure and result are simultaneously evaluated. While cross-sectional studies are restrictedly used in studies involving anesthesia (since the process of exposure is limited), they can be used in studies conducted in intensive care units. {1} |
| **. . 3c2** Before-and-after studies, one-time  outcome measurement | Category introduced by {DS}  Many experiments introduce a change in one variable (the independent variable), then, after sufficient time has passed for the independent variable to have an effect, any change in one or more dependent variables (the outcome) is observed once, and the experiment is completed. Many authors would classify this as a cross-sectional study, but it is clearer to treat it as a separate category.  On the other hand, such a study is not generally considered longitudinal.  If data on outcomes are collected several times (in education: several tests over the year, in agriculture: Collect some data on plant growth over time, harvest at the end), we would have a longitudinal study. A more prototypical example of a longitudinal study in education would be following a group of students in a school that uses a constructivist approach with many discovery activities over several years with regular collection of data about outcomes, repeating data collection about performance  Need more XXX  {DS} |
| **. . 3c3** ●Longitudinal Studies. W-Ch. 9, p. 71 – 80 | Longitudinal Studies use data referring to different time slices, often collected at different times. But data about different times in the past could be collected at the same time, such as asking people about past behavior or past observations or in examining strata in an archeological or paleontological dig. (This is different from using a dataset for which data have been collected at different times in the past.) Repeated data collection may use different samples each time (repeated cross-sectional data collection) or it may follow the same sample (called a panel) over time. There are cases where the question of a sample does not arise, for example in economic time series (year-by-year wheat production in France or the exchange rate between the US Dollar and the Chinese Yuan at the first of every month).{DS}  Remember that the definition of *longitudinal* hinges not on when the data were collected (or added to a study's data set) but what times the data used refer to. A study is longitudinal if it uses data referring to several times so that a phenomenon can be followed over time.  Longitudinal studies often need a lot of effort, but they tend to be the most useful. They are used very heavily in medicine (clinical trials, the National Health and Aging Trends Study (NHATS) that has been going for 10 years, the National Health and Nutrition Examination Survey (Continuous NHANES) that started in1999, after shorter longitudinal studies that started 1960, the Perry Preschool Study Through Age 40 that followed students who "graduated" from Perry preschool in 1970 and a control group that did not for 35 years to study the effects of preschool on all aspects of life. In cautioning about the expense of longitudinal studies, Willdemuth and other research method books write mostly to the individual researcher (often to PhD students planning dissertation research); these large longitudinal studies require strong institutions and millions of dollars. But individua medical researchers do conduct clinical trials were effects can be observed in shorter time. XXX get citations for all of the studies  {DS}  Two lists of longitudinal studies: <https://teaching.sociology.ul.ie/DCW/confront/node6.html>  <https://en.wikipedia.org/wiki/Longitudinal_study>  A good example: <https://highscope.org/perry-preschool-project/> |
| **. . . 3c3.1** Longitudinal studies by retrospective  vs prospective | Medical: [**Note: In this quote, *cohort study* is used in the meaning of *panel study***.] The follow-up of patients prospectively is called a prospective cohort study. The results are obtained after the research starts. The researcher’s following-up of cohort subjects from a certain point towards the past is called a retrospective cohort study. Prospective cohort studies are more valuable than retrospective cohort studies: this is because in the former, the researcher observes and records the data. The researcher plans the study before the research and determines what data will be used. On the other hand, in retrospective studies, the research is made on recorded data: no new data can be added.  In fact, retrospective and prospective studies are not observational. They determine the relationship between the date on which the researcher has begun the study and the disease development period. The most critical disadvantage of this type of research is that if the follow-up period is long, participants may leave the study at their own behest or due to physical conditions. {1} |
| **. . . . 3c3.1.1** Retrospective longitudinal studies |  |
| **. . . . . 3c3.1.1,1** Case-control study | Case-referent study  A retrospective observational panel study with a control group {DS}  used to identify factors that may contribute to a medical condition by comparing subjects who have that condition/disease (the "cases") with patients who do not have the condition/disease but are otherwise similar (the "controls").[1] They require fewer resources but provide less evidence for causal inference than a randomized controlled trial. A case–control study produces only an odds ratio, which is an inferior measure of strength of association compared to relative risk. {https://en.wikipedia.org/wiki/Case%E2%80%93control\_study}  Medical: Patients who have developed a disease are identified and their past exposure to suspected etiological factors is compared with that of controls or referents who do not have the disease. {https://www.bmj.com/about-bmj/resources-readers/publications/epidemiology-uninitiated/8-case-control-and-cross-sectional}  Examines the cause- and-effect relationship from the effect to the cause. The detection or determination of data depends on the information recorded in the past. The researcher has no control over the data (2). {1} |
| **. . . . 3c3.1.2** Prospective longitudinal studies |  |
| **. . . . 3c3.1.3** Ambidirectional longitudinal studies | Medical: Cohort studies that begin after exposure and before disease development are called ambidirectional studies. Public healthcare studies generally fall within this group, e.g. lung cancer development in smokers. [7] {1}  Note: In source 1 cohort studies are understood as **3c3.2.2** Panel studies in which the sample is a cohort {DS} |
| **. . . 3c3.2** Longitudinal studies by changing sample  vs. following sample |  |
| **. . . . 3c3.2.1** Repeated cross-sectional study | Longitudinal study, different sample each time {DS} |
| **. . . . 3c3.2.2** Panel study. Following the same sample  over time | Longitudinal study, same sample followed over time. Most often refers to a sample of people, but could be a sample of organizations, countries, buildings, or many other unit. {DS} |
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| **. 3d Research by context / environment** | Many of the concepts in this dimension evolved in specific disciplines (for example, **3d1** in biology) and some are still primarily used in these disciplines. However, they all can be used across many disciplines, often in an interpretation that is broadened from the original definition.  **3d1** and **3d2** are two widely overlapping perspectives on subdividing **3d**. **3d1** has a strong association with research methods used. |
| . . **3d1** In silico, in vitro, in vivo, in situ research |  |
| . . . **3d1.1** In silico research | an **in silico** ~~experiment~~ [study] is one performed on computer or via [computer simulation](https://en.wikipedia.org/wiki/Computer_simulation).  {https://en.wikipedia.org/wiki/In\_silico } |
| . . . **3d1.2** In vitro research | *test-tube research*  In biology, *in vitro* refers to studies performed with microorganisms, cells, or biological molecules outside their normal biological context. Colloquially called "test-tube experiments", these studies in biology and its subdisciplines are traditionally done in labware such as test tubes, flasks, Petri dishes, and microtiter plates. Studies conducted using components of an organism that have been isolated from their usual biological surroundings permit a more detailed or more convenient analysis than can be done with whole organisms; however, results obtained from in vitro experiments may not fully or accurately predict the effects on a whole organism.  {https://en.wikipedia.org/wiki/In\_vitro }  In a broader meaning, includes all physics and chemistry experiments.  This is always **3d2.1** Laboratory research.  {DS} |
| . . . **3d1.3** In vivo research | In biology, studies in which the effects of various biological entities are tested on whole, living [organisms](https://en.wikipedia.org/wiki/Organism) or [cells](https://en.wikipedia.org/wiki/Cell_(biology)), usually animals, including humans, and plants, as opposed to a [tissue extract](https://en.wikipedia.org/wiki/Biopsy) or dead organism. … Consequently, animal testing and clinical trials are major elements of in vivo research. In vivo testing is often employed over in vitro because it is better suited for observing the overall effects of an experiment on a living subject. In drug discovery, for example, verification of efficacy in vivo is crucial, because in vitro assays can sometimes yield misleading results with drug candidate molecules that are irrelevant in vivo (e.g., because such molecules cannot reach their site of in vivo action, for example as a result of rapid catabolism in the liver).[4]  {https://en.wikipedia.org/wiki/In\_vivo } |
| . . . **3d1.3** In situ research | In situ (/ɪn ˈsɪtjuː, - ˈsaɪtjuː, - ˈsiː-/; often not italicized in English)[1][2][3] is a Latin phrase that translates literally to "on site"[4] or "in position."[5] It can mean "locally", "on site", "on the premises", or "in place" to describe where an event takes place and is used in many different contexts. For example, in fields such as physics, geology, chemistry, or biology, in situ may describe the way a measurement is taken, that is, in the same place the phenomenon is occurring without isolating it from other systems or altering the original conditions of the test. The opposite of in situ is ex situ.  {https://en.wikipedia.org/wiki/In\_situ }  This is includes **3d2.2** Clinical research - in hospitals, prisons, classrooms and **3d2.3** Research in open nature or society  {DS} |
| . . **3d2** Laboratory, clinical, field research |  |
| . . . **3d2.1** Laboratory research | Scientific study conducted in a laboratory or other such workplace, where the investigator has some degree of direct control over the environment and can manipulate the [independent variables](https://dictionary.apa.org/independent-variables). Although laboratory research generally has greater [internal validity](https://dictionary.apa.org/internal-validity) than [field research](https://dictionary.apa.org/field-research) does, it tends to be less generalizable to the real world (i.e., has less [external validity](https://dictionary.apa.org/external-validity)). See [experimental research](https://dictionary.apa.org/experimental-research).  {https://dictionary.apa.org/laboratory-research } |
| . . . **3d2.2** Clinical research - in hospitals, prisons,  classrooms, zoos, farms | In medicine: Studies in which people participate as consenting patients or healthy volunteers, often patients in hospitals or medical practices. In *clinical trials* participants are recruited to be patients. Prototypically, clinical research is conducted in hospitals or medical practices, but some clinical research falls under 3d2.3  See  https://www.fda.gov/patients/clinical-trials-what-patients-need-know/what-are-different-types-clinical-research  This can be generalized to research in other somewhat controlled environments, such a prisons or classrooms. All such research fits somewhere between **3d2.1** Laboratory research and **3d2.3** Research in open nature or society. Unlike laboratories, hospitals, prisons, or classrooms are environments that are part of everyday life, but on the other hand they are more controlled than, for example, a family, a company, or a large audience at a concert or sports event. {DS} |
| . . . **3d2.3** Research in open nature or society |  |
| . . . . **3d2.3.1** Field research | Studies conducted outside the laboratory, in a “real-world” setting, which typically involve observing or interacting with participants in their typical environments over an extended period of time. Field research has the advantages of ecological validity and the opportunity to understand how and why behavior occurs in a natural social environment; it has the disadvantages of loss of environmental control and ability to do precise experimental manipulations. Thus, field research is often said to have more external validity and less internal validity than laboratory-based research. In studies of the behavior of nonhuman animals, field research stands in contrast to studies conducted on animals in captivity.  {https://dictionary.apa.org/field-research }  Includes field experiments {DS} |
| . . . . **3d2.3.2** ●Naturalistic Research.  **W-Ch. 8**, p. 60 - 70 | A naturalist is a person who studies nature in the field. Naturalistic research in the behavioral and social sciences that studies people, groups, social phenomena in their "natural" environment, where "natural" here refers to the everyday setting in which people act, a setting characterized by the culture of the group. (This example illustrates the complexity of language and meaning). Naturalistic research is usually understood to avoid value judgments or assessments; it studies people, groups, social phenomena as they are and tries to understand them from their own perspective. It often takes an phenomenological or interpretivist or hermeneutic approach. It uses mostly qualitative methods. {DS} |
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| **. 3e Research design by role of participant** |  |
| **. . 3e1** Participants as subjects being studied | This is the most common case. Examples:   * Opinion polls. * Student assessment. In a study testing students in mathematics, students are subjects being studied. * How well can participants search? * Ethnographer doing a field study of a people using observation and conversations with members of the people studied to learn about that persons feelings, perceptions, and relationship to others and to the culture.   In a survey of staff, the question  "On a scale from 0 to 4, what is your preference for working from home?" uses staff as subjects being studied |
| **. . 3e2** Participants as experts / informants | Not as frequent. Examples.   * Ethnographer doing a field study (possibly the same study just mentioned), using senior members of the people who have deep knowledge about the people and its culture as informants to get their explanations of how the society and culture functions. * Course evaluations: Students as informers about the course. * Participants in a usability study of a search engine. This is not about how many mistakes a participant makes but about learning from such mistakes to improve the search engine.   A survey of virologists asking their expert opinions on the state of the pandemic and appropriate prevention measures uses participants as informants. |
| **. . . 3e2.1** ●Delphi Studies. **W-Ch. 10**, p. 81 - 90 | A Delphi study requires a group of experts that are highly knowledgeable on the subject and represent a cross-section of opinions about the subject of the study. It may require experts from different disciplines. Calling this group a sample is far-fetched. A Delphi study does not aim at making statements about the participants.  Delphi study. From UBLIS 575DS 2020-08 Megan Scott essay  Asking only experts to participate in a study seems counterproductive to learning more about best practices. I see issues with this method because I am unsure of how to determine that the selected experts have the best insights without recommendations, peer reviews, or student feedback. While these studies are used to plan for the future I think it would better serve the study to pair the sample of experts with a sample of those who will be affected by the topic being studied.  An interesting thought. I wonder whether there is a study out there where this was done. |
| **. . 3e3** Participants in a dual role:  As subjects studied and as informants | Participants in a study can be cast in both roles, as subjects being studied for some questions, as informants for other questions. Even more complex, the role of the participants is not always clear-cut; for the same question, participants could be both subjects and informants.   * In a survey of staff, questions such as  "How satisfied with your work environment?" or  "Do you feel safe or are you afraid of sexual harassment or microaggressions?" uses staff as subjects being studied (even though one could argue that participants also make a statement about the organization, thus serving as informants). On the other hand, the question   "Have you observed acts of microaggression?" uses staff as informants * Asking in a poll, the question  "Do you think the country is on the right track" uses the participant as subjects, but it could also be construed as using the participants as informants, certainly if we poll a group of economists * In a course evaluation by students, students' answers could be used both as information about the course and as information about the student. Looking at a given student's answers in the evaluations of several courses, we could tell what kind of course this student likes or does not like. In an intelligent course selection system this information could be used to recommend courses to the student. Recommender systems, such as the International Movie DataBase (IMDB) use participants movie ratings in this dual role.   In a Delphi study, we may be interested in getting background data about the participants to put their opinions into perspective. If we want to study how the background of the expert participants influences their opinions, then we treat the opinions as characteristics of the participants even though we treated the participants as informants and we collected their opinions for the primary purpose of producing a consensus opinion on some forecasting question, a design question, or some other issue. |
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| **. 3f Research design by getting individual opinion**  **vs getting consensus opinion** |  |
| **. . 3f1** Research design for getting individual opinion |  |
| **. . 3f2** Research design for getting  mutually informed individual opinion |  |
| **. . 3f3** Research design for getting consensus opinion |  |
| **. . . 3f3.1** Focus group |  |
| **. . . 3f3.2** Delphi-like design | Using a Delphi design to help a group of students to explore their reactions and feelings towards online learning is an interesting idea. In this case the participants in some way have the role of experts but they are also the subject of study. It is similar to focus groups, except that the interaction between participants is not immediate but happening over time. {DS} |
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| **4 Sources of Data and Methods for Data Collection** | This entire classification is focused on social and behavioral science research.  This limited scope applies to this part in particular.  There is no sharp line between sources that provide material to which measurement is applied to create data and sources that provide data obtained by previous measurement. On the one end of the spectrum would be texts to which content analysis is applied, for example to investigate the attitudes to gender issues conveyed in early 20th century teen fiction. In the middle would be texts, audio recordings and images that are mined for dates and participants of historical events (using face recognition for the analysis of images). On the other end would be using data from student records or electronic health records.  If we ask a participant about past life events, we are using their (error-prone) as a database from which to extract data. |
| **. 4a Existing documents as data sources** |  |
| **. . 4a1** Existing texts and databases as data source**s** |  |
| **. . . 4a1.1** ●Historical Research. **W-Ch. 17**, p. 155 – 164 | focuses on text, but could be any medium {DS} |
| **. . . 4a1.2** ●Existing Documents and Artifacts as Data.  **W-Ch. 1**8, p. 165 - 172 |  |
| **. . . 4a1.3** ●Transaction Logs (pre-existing or  created for research). **W-Ch. 20**, p. 185–197 |  |
| **. . 4a2** Existing audio recordings as sources of data |  |
| **. . 4a3** Existing images as sources of data |  |
|  |  |
| **. 4b Observation** (of individual participants, groups, events, **. . .**) | Observation is a data collection method applicable in research in many domains, the examples here are from social and behavioral science research {DS} |
| **. . 4b1** ●Direct Observation. **W-Ch. 22**, p. 209 – 218 |  |
| **. . 4b2** ●Participant Observation. **W-Ch. 23**, p. 219 – 227 |  |
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| **. 4c** **Eliciting free-form, mostly spoken, answers**  **to open-ended questions** |  |
| **. . 4c1** ●Think-aloud Protocols. **W-Ch. 21**, p. 198 – 208 |  |
| **. . 4c2** ●Research Diaries**. W-Ch. 24**, p. 228 – 238 |  |
| **. . 4c3** ●Unstructured Interviews. **W-Ch. 25**, p. 239 – 247 |  |
| **. . 4c4** ●Semistructured Interviews**. W-Ch. 2**6, p. 248–257 |  |
| **. . 4c5** ●Focus Groups**. W-Ch. 2**7, p. 258 – 271 |  |
| **. . 4c6** ●Visual Data Collection Methods**.**  **W-Ch. 1**9, p. 173 – 184 |  |
|  |  |
| **. 4d Eliciting ✓ or scale value answers to closed questions.**  **Structured questionnaires and interviews** |  |
| **. . 4d1** ●Survey Research**. W-Ch. 28**, p. 272 – 283 |  |
| **. 4e Specific types of variables** |  |
| **. . 4e1** ●Measuring Cognitive and Affective Variable**s.**  **W-Ch. 29**, p. 284 – 290 |  |
| **. . 4e2** ●Developing New Measures**. W-Ch. 30**, p. 291–304 |  |

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| **5 Methods for Data Analysis** | Again, the focus here is on social and behavioral science research |
| **. 5a Methods for qualitative analysis** |  |
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| **. 5b Methods for qualitative and structural analysis**  **(qualitative or quantitative)** |  |
| **. . 5b1** ●Content Analysis. **W-Ch. 31**, p. 307 – 317 |  |
| **. . 5b2** ●Qualitative Analysis of Content.  **W-Ch. 32**, p. 318-329 |  |
| **. . 5b3** ●Discourse Analysi**s**. W-**Ch. 33**, p. 330 - 338 Optional |  |
| **. . 5b4** ●Social Network Analysis**.** **W-Ch. 34**, p. 339 – 350 |  |
|  |  |
| **. 5c Methods for quantitative analysis. Statistical Analysis** |  |
| **. . 5c1** ●Descriptive Statistics. **W-Ch. 35**, p. 351 – 360 |  |
| **. . 5c2** ●Frequencies, Cross-tabulation,  and the Chi-square Statistic. **W-Ch. 36**, p. 361 – 372 |  |
| **. . 5c3** ●Analyzing Sequences of Events.  **W-Ch. 37**, p. 373-386 |  |
| **. . 5c4** ●Correlation**.** W-**Ch. 38**, p. 387 – 394 |  |
| **. . 5c5** ●Comparing Means: t Tests and Analysis of Variance**.**  **W-Ch. 39**, p. 395 – 404 |  |
| **. 5d Machine learning** | Machine learning (ML) is high-powered exploratory data analysis. It is driven by data, not by hypotheses. It may be informed by theory, which may help the variables (in ML often called features) that should be used in the machine learning algorithms. There are two caveats to what follows:  (1) Machine learning works best with very large data sets. Techniques now grouped under machine learning have been used for decades, but the breadth and quality of the uses of machine learning have increased exponentially with the availability of big data.  (2) The quality of machine learning results is limited by the quality of the data on which machine learning works. Garbage in - Garbage out reigns supreme in machine learning.  **Machine learning discovers patterns in data.** Knowledge of these patterns supports design (1b2.1 *Support Design / produce a product / artefact / mentefact*), other areas of applied research, and, to a lesser extent, basic research. A pattern could be used to formulate a hypothesis, which can then be tested.  Patterns are discovered based on relationships between features. We give here just a few examples.   * **Sequence patterns**, such as learning the frequency of word sequences in text or Google queries. This knowledge is used by smart phone text applications to suggest the next word and by Google to suggest a longer query based on what the user typed in so far (with an often uncanny ability to guess what the user has in mind). Another example is detecting common patterns of steps users take in searching or sensemaking. * **Classification patterns.** A classifier is a system that from manifest (clearly detectable or directly measurable) features of an object or event can assign one or more latent features from an existing classification, such as * assigning one Dewey class or several ERIC descriptors (latent) based on words in the text (manifest); * diagnosing a disease from overt symptoms; * recognizing a person (identity of a person is considered here a latent feature) from facial features visible in an image or from sound features in a voice recording.   A classifier learns associations between manifest features and latent features from a training set, a collection of objects or events (or whatever the unit of analysis) for which manifest features are known or detectable and the latent features of interest are also known (such as a collection of books for which at least some text is available and to which Dewey classes have been assigned). The type of learning that uses a given classification of latent features and a training set of examples is an example of supervised learning. The ML algorithm may be given a list of manifest features to use for classification or the algorithm may be designed to discover which manifest features work best. The quality of the training set is all-important. If half the Dewey numbers in the training set are wrong, the resulting classifier is not worth having.   * **Predictive patterns**. If the manifest features of a state of affairs (objects, events, …) are determined at Time 1 and the latent features are to be inferred for the state of affairs at a later Time 2, then a classification pattern can be used for prediction. * **Clustering**. Assume we have a large set of objects, such as 500 search results or 1M patient records, and we want to get an overview of the structure of this set. We could use a classifier to sort the objects into a classification of known categories. But what if there is no suitable classification, or even if there is a classification, we do not have a classifier? We can use a clustering algorithm that (1) computes for each pair of objects the similarity (e.g., based on how many words two documents have in common) and then (2) divides the objects into groups, called clusters, of similar objects. Some algorithms can even produce a hierarchy of clusters. Numerical biological taxonomy uses data sets where each record represents a specimen of some organism, such as a virus, a bacterium, a plant, or an animal; clustering then produces a local taxonomy for the set of specimens  For web search try <https://search.carrot2.org/#/search/web> , search for *simulation* or any other broad topic To find some links, Google cluster Kohonen map * **Causation**. Patterns and clusters produced by machine learning can be examined to see whether the co-occurrence of variables might be explained by causation and then use other studies to investigate a cause-effect relationship.   The knowledge gained through machine learning can be used directly in designing systems and it can be used in simulation models.  We did not get into how the algorithms work. This is beyond LIS 575. For a short introduction see: <https://examples.javacodegeeks.com/machine-learning-with-python/>  Does not give much detail, but you will at least see some of the terminology.  **3. Promising Machine Learning Applications [in library and information services}**  3.1 Crowdsourcing.  3.2. Discoverability In and Across Collections.  3.2.1. Clustering and Classification  3.2.2. Pre Processing  3.2.3. Optical Character Recognition  3.2.4. Handwriting Recognition  3.2.5. Metadata Recognition and Extraction  3.2.6. Historical Tabular Data Extraction.  3.2.7. Visual Data Annotation.  3.2.8. Audio Data Annotation  3.2.9. Linking Collections.  3.3. Library Administration and Outreach  3.3.1. Collection Management  3.3.2. Preservation and Conservation.  3.3.3. ML Literacy Education  3.3.4. Supporting Patron ML Experiments  3.4. Creative and Activist Interventions  Machine Learning + Libraries. A Report on the State of the Field  https://labs.loc.gov/static/labs/work/reports/Cordell-LOC-ML-report.pdf  Explorations of Machine Learning and Cultural Heritage  https://labs.loc.gov/static/labs/work/experiments/final-report-revised\_june-2020.pdf  **Uses of machine learning in education: Personalized learning**  Learning analytics is the process of collecting, measuring, and using data about learners to build profiles and analyze student behavior. Machine learning algorithms are used to create these profiles and then design learning paths for each student. This process is known as adaptive learning. Each student can learn and work through the material at their own pace. These recommendations and learning paths are based on previous successes or failures. Teachers then can use this information to change the overall pacing of how they are delivering the material. In the classroom, learning analytics can collect attendance and assessment data and then provide personalized feedback about achievement."  <https://resources.experfy.com/ai-ml/applications-of-machine-learning-in-education/>  There is much more, including uses in assessment and keeping track of student performance. |
|  | **More information if you are interested** |
|  | **Here is a nice picture of some applications of machine learning**    From https://www.javatpoint.com/applications-of-machine-learning |
|  | **Another nice picture**    **Figure 2: Machine Learning applications across industries**  Source: Tata Consultancy Services, Using Big Data for Machine Learning Analytics in Manufacturing TCS  From https://www.business2community.com/business-innovation/machine-learning-redefining-enterprise-2016-01569528#tfrTTQLQeIm7GZpr.97 |
|  | Another list of machine learning applications   * Education (Duolingo) * Virtual Personal Assistants * Social Media Services * Targeted Emails (Optimail) * Sorting, tagging and categorizing photos (Yelp) * Online Customer Support * Customer Lifetime Value (Asos) * Determining Credit Worthiness (Deserve) * Online Fraud Detection * Product Recommendations * Recommendation Engines (Netflix) * Refining Search Engine Results * Fighting Web Spam * Automatic Translation * Video Surveillance * Predicting Music Choices * Drug Discovery * Disease Diagnosis * Patient Sickness Predictions (KenSci) * Face Recognition * Pricing Insurance Plans * Self-Driving Cars (Waymo) * In health care add: Disease prediction, prevention and treatment, prognosis. Precision medicine (DS added)   Merged from two sources. Both have more information  <https://builtin.com/artificial-intelligence/machine-learning-examples-applications> (company in ())  <https://data-flair.training/blogs/applications-of-machine-learning/> |
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