

Research Methodology (RM –A)

Paper I

Pre PhD Course Work 2022

Chhatrapati Shahu Ji Maharaj University Kanpur

Lecture 2: 7.9.22



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Syllabus

- Foundation of Research: What is Research? Objectives of Research, **Scientific Research, Research and Theory, Conceptual and Theoretical Models**, Importance of research methodology in scientific research
- Types and Methods of Research: Classification of Research, Pure and applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation of Research/Studies, Action Research, Experimental Research.

Learning Outcomes

- Understanding terms and definitions
- Understand what is theory
- Differentiate between Research and Theory
- Understand the Research Canvas- T and U model
- Define theoretical and conceptual framework
- Distinguish between the frameworks and identify variables in a framework

Scientific Research

- Research conducted for the purpose of contributing towards science by the *systematic collection, interpretation and evaluation of data* in a planned manner is called **scientific research**

Definitions

Phenomenon: Something that is observed to occur or exist

Concepts:

- Describes or names objects or phenomenon that gives them separate identity and meaning
- Can be Abstract with general meanings or specific

Variable:

Concrete, specific and measurable concepts are known as variables

Theory: set of concepts, models that makes sense of a phenomenon by determining relationship between its variables

Framework:

- Underlying structure or model that supports the research effort
- Frameworks are based on key **concepts** and the relationship between them

Research: scientific method based on a framework for careful consideration of study regarding a specific problem or concern

Definitions

Framework can be derived from related concepts (Conceptual Framework) or Theories (Theoretical Framework)

Conceptualization: Process of forming ideas, strategies based on facts, examples and situations

Operationalization: Process of turning abstract concepts into measurable observations

Proposition: Statement of relationship between concepts derived from theory or generalizations from empirical data. Unlike hypothesis, a proposition deals with pure concepts for which no laboratory test/measurement is available

Types of Variables Concrete, specific and measurable concepts are known as variables in research and statistics:

1. **Independent variable** is a singular characteristic that the other variables in your experiment cannot change.
Eg Exam Result
2. **Dependent variable** relies on and can be changed by other components eg Time of Study
3. **Intervening variable/Mediator variable** is a theoretical variable the researcher uses to explain a cause or connection between other study variables—usually dependent and independent ones. Function as independent variables
4. **Moderating or moderator variable** changes the relationship between dependent and independent variables by strengthening or weakening the intervening variable's effect
5. **Control or controlling variables** are characteristics that are constant and do not change during a study
6. **Quantitative variables** are any data sets that involve numbers or amounts.
 - Discrete:** Any numerical variables you can realistically count
 - Continuous:** Numerical variables that you could never finish counting, such as time.
7. **Qualitative, or categorical, variables** are non-numerical values or groupings.
 - Nominal:** Variables you can organize in more than two categories that do not follow a particular order.
 - Ordinal:** Variables you can organize in more than two categories that follow a particular order.
8. **Confounding variable** that can disguise another variable's effects and change the results

Research and Theory (Chicken egg riddle)

➤ Theory:

- Function of theory :to identify a start point of research problem and establish a focus and goal to which the problem is directed
- Abstract system of concepts and their relationships that help understanding a phenomenon
- Generalized thinking or conclusion which is result of analysis that is scientifically proven with evidence- guides research and organizes ideas
- Result of research based on a hypothesis
- Always tentative, never proven- gives rise to new research

➤ Research:

- Way of expanding existing knowledge and creating new knowledge performed scientifically and systematically.
- Practical aspect to research
- Research is preceded by a hypothesis
- If hypothesis is true, it may become a theory
- Research precedes theory. Based on research, theory is made
- Medical research separated from theory when applied research is considered

Difference between Research & Theory

Theory

- Theory is a generalized concept that provide explanation to existing things
- May not include practical elements
- Usually a result of theory

Research

- Research is a scientific method of expanding existing knowledge
- Usually includes practical elements
- Research preceded Theories

Theory

- **A theory is a set of interrelated constructs (concepts), definitions, and propositions that present a Systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena.**
Kerlinger and Lee (2000)

- (1) a theory is a set of propositions consisting of defined and interrelated constructs,**
- (2) a theory sets out the interrelations among a set of variables (constructs), and in so doing, presents a systematic view of the phenomena described by the variables, and**
- (3) a theory explains phenomena; it does so by specifying which variables are related to which variables and how they are related, thus enabling the researcher to predict from certain variables to certain other variables.**

- **Purpose:**
 - Prediction
 - Understanding
- **Theories are usually created never discovered. They can be tested but never proven**
- **Levels of Theory**
 - Abstract Level-based on general ideas beyond what we observe physically
 - Empirical Level- based on observation and measurement of phenomenon, as directly experienced by researcher
- **Process of Theory Development**
 - Induction – aims at developing theory :starts observations, seek patterns and make generalization that form the basis of theory
 - Deduction- based on inference made by an observation/ existing knowledge, affirms with observation and arrives at confirmation

Example

- Deductive reasoning for Theory Development: aimed at testing a theory based on causality
 - Starts exploratory with general idea-----hypothesis-----observations and test it to our original idea
 - Describes how population changes over time by adapting to environmental challenges
 - Newton's Laws of Motion based on unobservables like inertia and gravitation
 - Top Down Approach
- Inductive reasoning for Theory Development (gather data---- look for patterns-----develop hypothesis-----theory)
 - Specific data to General conclusions
 - All cells arise from pre-existing cells
 - Boyle's Law derived from observables
 - Bottom Up approach : start with specific measurements--
 - Base new theory on data rather than previous assumptions

Characteristics of a Theory (Kivunja et al., 2018)

- It has to be logical and coherent
- It has clear definitions of terms or variables, and has boundary conditions
- It has a domain where it applies
- It has clearly described relationships among variables
- It describes, explains, and makes specific predictions
- It comprises concepts, themes, principles and constructs
- It must have been based on empirical data
- It must have made claims that are subject to testing, been tested and verified
- It must be clear and parsimonious
- Its assertions or predictions must be different and better than those in existing theories
- Its predictions must be general enough to be applicable to and in several contexts
- Its assertions or predictions are applicable, and if applied as predicted, will result in the predicted outcome
- The assertions and predictions are not set in concrete, but subject to revision and improvement as social scientists use the theory to make sense of phenomena in their world
- Its concepts and principles explain what is going on and why
- Its concepts and principles are substantive enough to enable us to predict future events

Types of Theory in Research

- Explanatory Theory
 - Specify relationship between characteristics of individuals, groups, situations or events
- Descriptive Theory
 - Describe or classify different characteristics based on common modalities
- Predictive Theory
 - Predict precise relationships between characteristics of phenomenon or differences between groups
- Grounded Theory:
 - Sets to develop theory from data obtained systematically (iteratively and dynamically) from comparative analysis
 - Based on Inductive
 - Used both in qualitative and quantitative research
- Axiomatic theory:
 - Used in mathematics and logic
 - Starts with axioms (statement taken to be true, as starting point for further reasoning)

Theoretical Model/Framework

- Theoretical framework is a structure for conducting research that summarizes concepts and theories, which you develop from previously tested and published knowledge
- It forms the basis for your data analysis and interpretation of the meaning contained in your research data.
- Provides a structure for what to look for in the data, for how you think of how what you see in the data fits together, and helps you to discuss your findings more clearly, in light of what existing theories say.
- It helps you to make connections between the abstract and concrete elements you observe in your data.

Purpose of Theoretical Framework

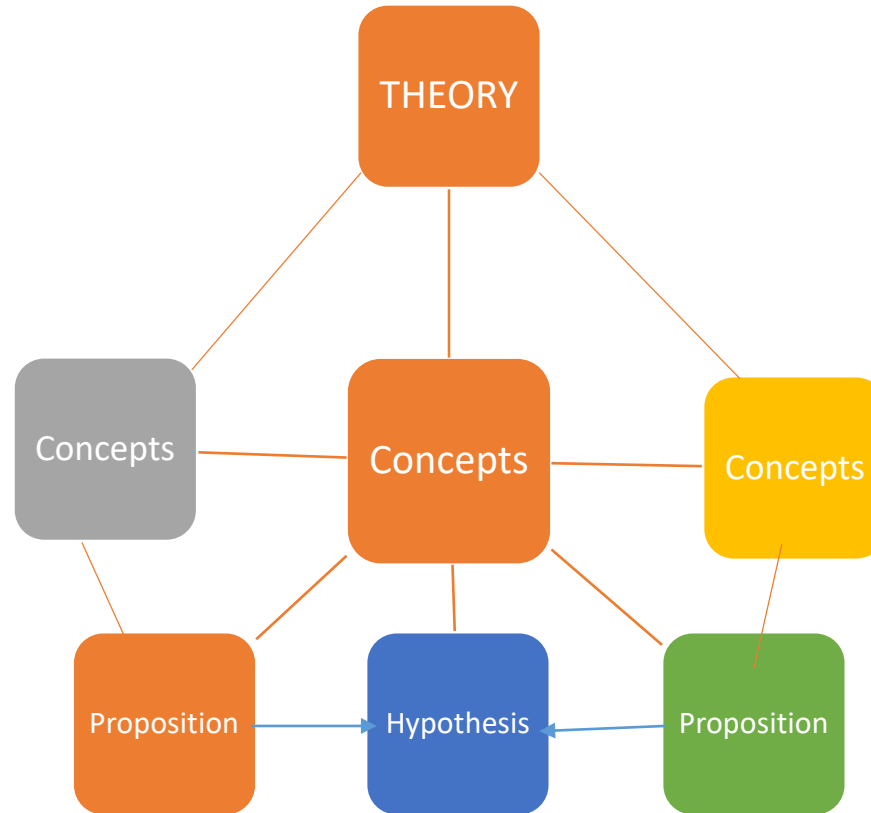
- The theoretical framework is one of the main parts of the [research manuscript](#), usually presented in the first section of all dissertations
- Provides perspective / guidance to examine a topic
- Explains the research problem under study exists
- Demonstrate understanding of theories and concepts relevant to topic of research
- Connects researcher to existing knowledge- given a basis for hypothesis and research methods
- Specifies key variables- fine tunes research question
- Answers 2 important questions regarding research
 - What is your research problem
 - Why is the research approach feasible

Strategies to develop of an effective theoretical framework:

- **Examine your thesis title and research problem.** The research problem anchors your entire study and forms the basis from which you construct your theoretical framework.
- **Brainstorm on what you consider to be the key variables in your research.** Answer the question, what factors contribute to the presumed effect?
- **Review related literature** to find answers to your research question.
- **List the constructs and variables** that might be relevant to your study. Group these variables into independent and dependent categories.
- **Review the key theories** that are introduced to you in your course readings and choose the theory or theories that can best explain the relationships between the key variables in your study
- **Discuss the assumptions or propositions** of this theory and point out their relevance to your research.
- **A theoretical framework is used to limit the scope of the relevant data** by focusing on specific variables and defining the specific viewpoint (framework) that the researcher will take in analyzing and interpreting the data to be gathered, understanding concepts and variables according to the given definitions, and building knowledge by validating or challenging theoretical assumptions.
- (<https://library.sacredheart.edu/c.php?g=29803&p=185919>)

Process of Hypothesis Generation using Th Framework

Hypothesis: express relationship between variables in precise manner based on proposition evolved from Theoretical Framework



Review > Riv Biol. 2006 May-Aug;99(2):273-85.

A theoretical framework for defining some concepts in evolution

Pablo Padilla¹, Pedro Miramontes

Affiliations + expand

PMID: 17115372

Abstract

We present a theoretical framework for biological evolution with the intention of giving precise mathematical definitions of some concepts in evolutionary biology such as fitness, evolutionary pressure, specialization and natural selection. In this framework, such concepts are identified with well-known mathematical terms within the theory of dynamical systems. We also discuss some more general implications in evolution; for instance, the fact that our model naturally exhibits a frequency spectrum of the type $1/f$ for low frequencies of evolutionary events.



Social-Ecological Systems in Transition pp 3–24 | [Cite as](#)

Theoretical Frameworks for the Analysis of Social–Ecological Systems

[Graeme S. Cumming](#)

Chapter | [First Online: 01 January 2014](#)

1466 Accesses | **11** Citations

Part of the [Global Environmental Studies](#) book series (GENVST)

Abstract

Although the growing field of research on social–ecological systems (SESs) deals with some of the most important questions of our time, the study of SESs lacks an overarching theoretical framework. The development of such a framework is desirable because it would greatly improve our ability to generalize from individual case studies, to distinguish important from less important results, and ultimately to draw on the power of the scientific method to predict the consequence of management and policy interventions and to build greater resilience in SESs. Existing frameworks for the analysis of SESs can be grouped into five categories: (1) hypothesis-oriented frameworks; (2) assessment-oriented frameworks; (3) action-oriented frameworks; (4) problem-oriented frameworks; and (5) theory-oriented or overarching frameworks. Focusing on the fifth category, theory-oriented frameworks, seven assessment criteria are proposed that a satisfactory framework should meet: (1) it should provide a clear way of linking social and ecological systems and be strong in both disciplines; (2) it should be

Theoretical framework and engineering applications of Hamiltonian Structural Analysis Method

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Abstract: - The theoretical framework and engineering applications of the Hamiltonian Structural Analysis Method are presented. The proposed method, which allows to solve the structural elastic problem, is based on the solution of a Hamiltonian system made of 1st order differential equations. This method, which is a new way to approach a classical variational problem, leads to the definition of the Hamiltonian system for any elastic problem, by introducing the degrees of freedom and the corresponding compatibility equations, founding equilibrium equations in variational form. In the frame of the General Beam Theory, beam on elastic soil, thin-walled structures with non-uniform torsion, distortion and shear lag as well as temperature distributions inside the sections and other problems can be solved directly, by founding the expression of the Hamiltonian function and by approaching the variational formulation. This fact allows engineers to find the exact solution, based on the system of differential equations of the elastic problem, for straight and curved beams. Numerical applications and validation examples compared to literature data are given in order to show the wide range of applicability of the proposed method.

Key-Words: - Hamiltonian Structural Analysis, transfer matrices, thin-walled structures, curved beam, Winkler soil, non-uniform torsion, distortion, shear-lag, GBT

Conceptual Model/Framework

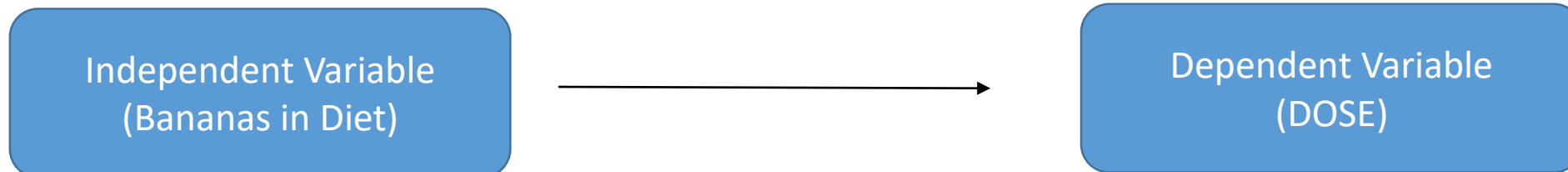
- 1930s by the philosopher Alfred North Whitehead- origin in philosophy and systems theory
- A conceptual framework is the total, logical orientation and associations of anything and everything that forms the underlying thinking, structures, plans and practices and implementation of your entire research project.
- Master plan for your entire research project- created before you start experiments
- Maybe diagrammatic or written format, representing relationship between variables
- Theoretical framework forms an important part of the conceptual model - for understanding how different variables interact with each other

Conceptual Framework

- What do you want to do in your research?
- Why do you want to do it? For example, why is it important to conduct that research? Why it is significant?
- What aims will it seek to achieve? Which specific objectives will it pursue? How much scope will it cover?
- How do you plan to do it? For example, which methodology will you apply? Which methods will you use? Who will be your participants? How will you gather data? How will you analyse the data?
- How will you make meaning of the data? For example, which theoretical framework will you use to analyse the data? Which software will you use? Which skills will you need?
- Which worldview will you locate your research in?
- How will you report your findings? For example, in a research paper, or a seminar paper, or a conference paper, a book chapter, or a book or a thesis?

Creating a conceptual framework

- Sources of Conceptual Framework: Experience, Literature, Theory
- Choose your research question- relationship between eating bananas and happiness (Dopamine, oxytocin, serotonin and estrogen levels)
- Select independent and dependent variables
 - Independent variable (expected cause: bananas (number, ripeness))
 - Dependent variable: (expected effect: levels of DOSE)
- Visualize Cause and Effect relationship- use box and arrow
- Identify other confounding and mediating variables
- Revise conceptual framework



When to use conceptual framework

- Conducting research in a new area
- Using missed methods research
- Working with large amounts of data to identify important variables and relationships
- Communication of scientific ideas

Ways to create Conceptual Framework

1. Use a graphical technique, such as a mind map or concept map. This can be a helpful way to visualize the relationships between concepts.
2. Use a formal modeling language, such as Unified Modeling Language (UML). This can be a helpful way to create a more precise and detailed framework.
3. Use a table or matrix. This can be a helpful way to organize and compare different concepts.
4. Narrative technique, such as storyboarding. This can be a helpful way to communicate your ideas to others.
5. Software tool, such as ConceptDraw Pro. This can be a helpful way to create a professional-looking framework.

How to draw Conceptual Framework

- <https://www.edrawsoft.com/conceptual-framework.html>- free edrawmax online
- Biorender

The screenshot displays the EdrawMax website and its software interface. The website page is titled "5. How to Write A Conceptual Framework?" and includes a table of contents on the left with the following items:

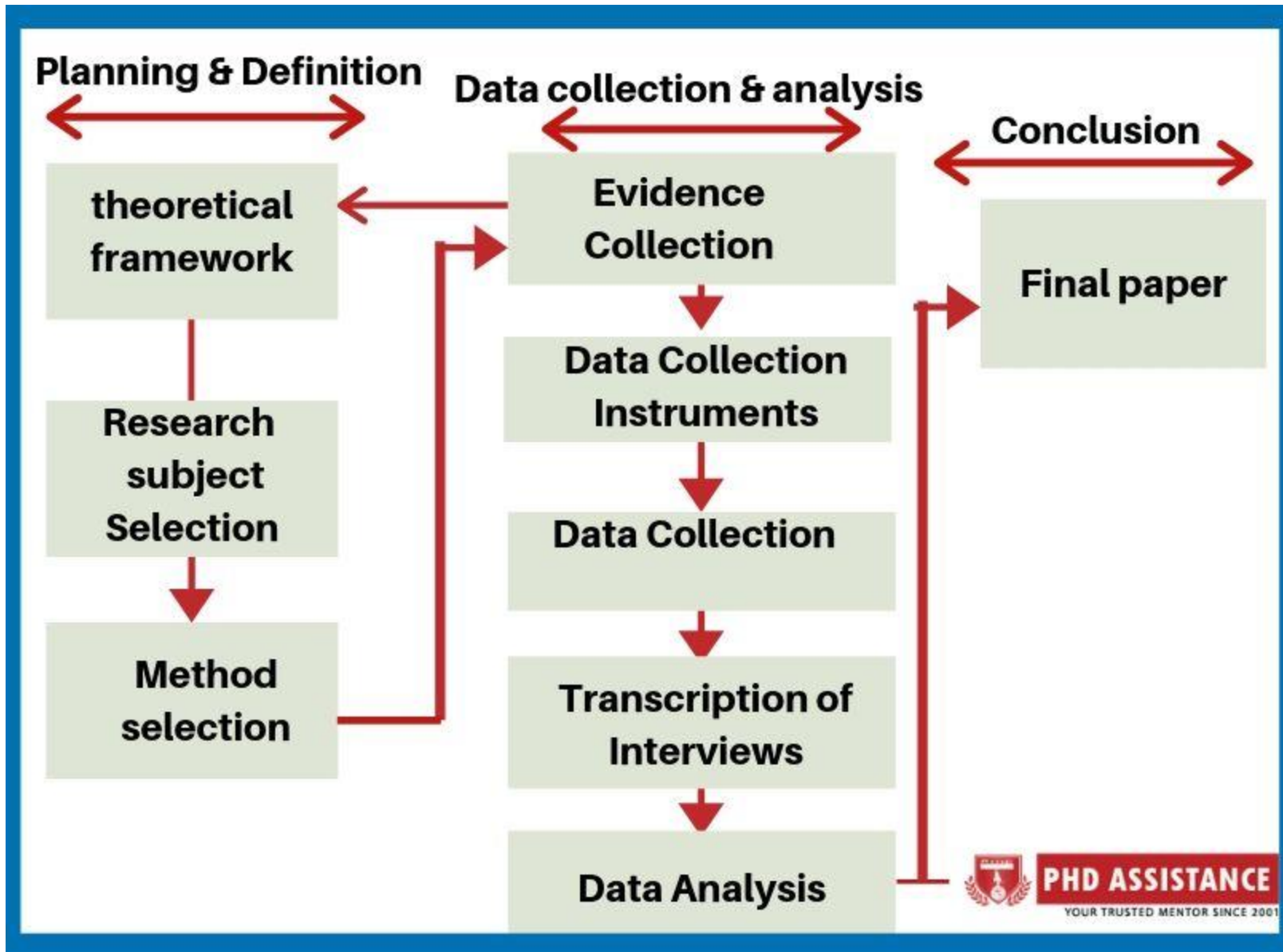
- 1. What is a Conceptual Framework
- 2. What is the Purpose of Using A Conceptual Framework?
- 3. The Types of Conceptual Framework
- 4. Conceptual V.S Theoretical Framework
- 5. How to Create Conceptual Framework
- 6. Conceptual Framework Examples & Templates
- 7. Free Conceptual Framework Software
- 8. Final Thoughts

The main content area of the website explains that constructing a conceptual framework can be time-consuming and stressful, and introduces EdrawMax as a visual workstation application. It lists features like various designs, styles, icons, and symbols, and mentions compatibility with Windows, Mac, and Linux. A "Step 1 Open EdrawMax and Login" section follows, advising users to install the software or use the online version.

The software interface shown below features a sidebar with categories like "Basic Diagram", "Business", and "Form". The main workspace displays a grid of diagram templates, including "Block Diagram", "Arrows", "Timeline", "Circle-Spoke Diagram", "Circular Diagram", "Units", "Venn Diagram", and "Presentation". A "TRY FREE" button is visible at the bottom of the website page.

Difference between Conceptual and Theoretical Framework

Conceptual Framework	Theoretical Framework
It is more about the approach that a researcher takes in answering a research question.	It is developed from existing theory/theories.
It is derived from concepts.	It is derived from theory.
A conceptual framework is composed of several concepts. Further, a conceptual framework may include a theoretical framework.	By itself, one theory alone can serve as a theoretical framework.
Conceptual frameworks identify factors influencing a particular field, e.g., exploration of <u>'masquerade' mimicry</u> in animals based on phenomena such as protective mimicry, crypsis and aposematism.	A theoretical framework arises from outcomes beyond a single study, based on one or more theories, e.g. Darwin's theory of evolution by natural selection.



<https://www.phdassistance.com/blog/why-is-theoretical-framework-important-in-research/>

Research methodology

- Research methodology is a way to systematically solve the research problem.
- Includes the research methods and the logic behind the methods used
- Has to be decided in the context of our research study and explain why we are using a particular method or technique and why we are not using others so that research results are capable of being evaluated either by the researcher himself or by others



Research Methods as opportunity and challenge

- Methods can enable but also limit evidence
- All methods are valuable but have weaknesses/ limitations
- Offset weakness by using different/ multiple methods
- Choose research methods that compliment strengths of one with weakness of the other.
- Empirical (coming from experience) knowledge requires consistency or convergence of evidence across studies from multiple methods

Research methodology

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Research Process

Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.

The various steps involved in a research process are not mutually exclusive; nor they are separate and distinct.

They do not necessarily follow each other in any specific order.

However, the following order concerning various steps provides a useful procedural guideline

regarding the research process:

1. Formulating the research problem
2. Extensive literature survey
3. Development of working hypotheses
4. Preparing the research design
5. Determining sample design
6. Collecting the data
7. Execution of the project
8. Analysis of data
9. Hypothesis-testing
10. Generalizations and interpretation
11. Preparation of the report or the thesis

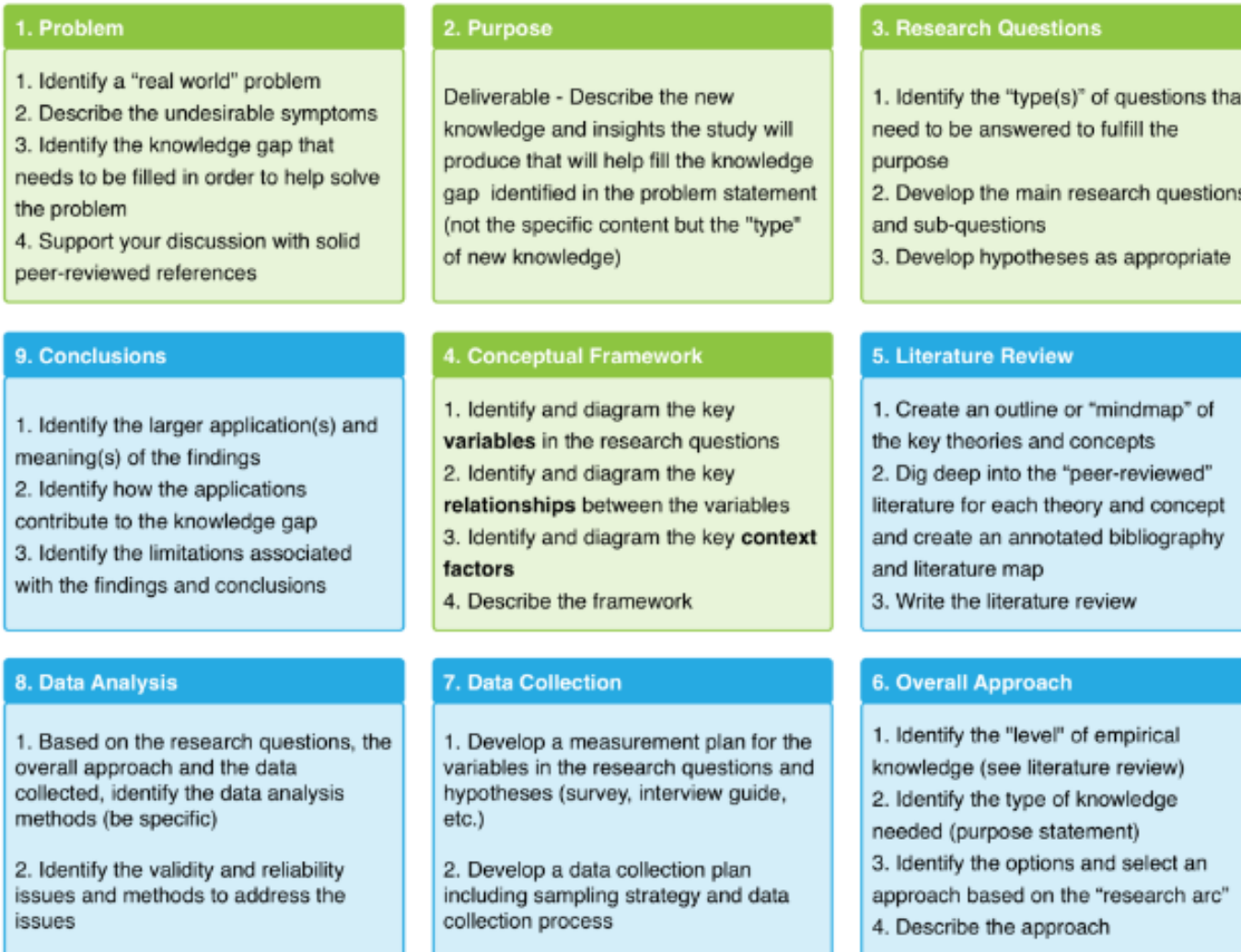
T and U approach to starting Research

1. **Problem**
2. **Purpose**
3. **Research Question/Hypothesis**
4. **Designing Framework:** A **conceptual or theoretical framework** is a diagram that depicts the key constructs or variables (independent, dependent, etc.) along with the relationships between those constructs along with the key contextual factors that influence the constructs and relationships. The development of the conceptual/theoretical framework begins early, and it evolves as the design process unfolds.
5. **Literature survey** Research design begins with theory, and the results of the research contribute back to theory. The amount and specificity of the current empirical knowledge will influence the choice of an appropriate overall research approach
6. **Overall approach** (quantitative, qualitative, mixed) and the specific design (e.g., case study). Ultimately, the approach is determined based on whether it is the best approach to contribute the new knowledge specified in the purpose and problem.
7. **Data Collection** consists of three key components: (a) a sampling plan; (b) a measurement plan and (c) a data collection plan.
8. **Data Analysis:** Plan method used for understanding relationships between variables, constructs
9. **Drawing Conclusions:** Understanding implications and finding answers for research question

Research Canvas https://www.drjohnlatham.com/wp-content/uploads/2021/03/The_Research_Canvas_3-1-1.pdf



Research Canvas https://www.drjohnlatham.com/wp-content/uploads/2021/03/The_Research_Canvas_3-1-1.pdf



Task-2

- Formulate a research question
- Think of sub questions
- Create a Theoretical and a Conceptual Framework
- Make a list of answers/ explanations for your questions
- List of factors influencing your response
- Share with partner
- Partner – critique where assumptions in the response
- Do you need to address assumptions before addressing research question?

Reading Material

- Kerlinger, F. N., & Lee, H. B. (2000). Foundations of Behavioral Research. 4th Edition, Wadsworth / Thomson Learning. ISBN: 0-15-507897-6.
- Kivunia et al Distinguishing between Theory, Theoretical Framework, and Conceptual Framework: A Systematic Review of Lessons from the Field, International Journal of Higher Education Vol. 7, No. 6; 2018
- Wikipedia
- Open Educational Resources (OER commons)