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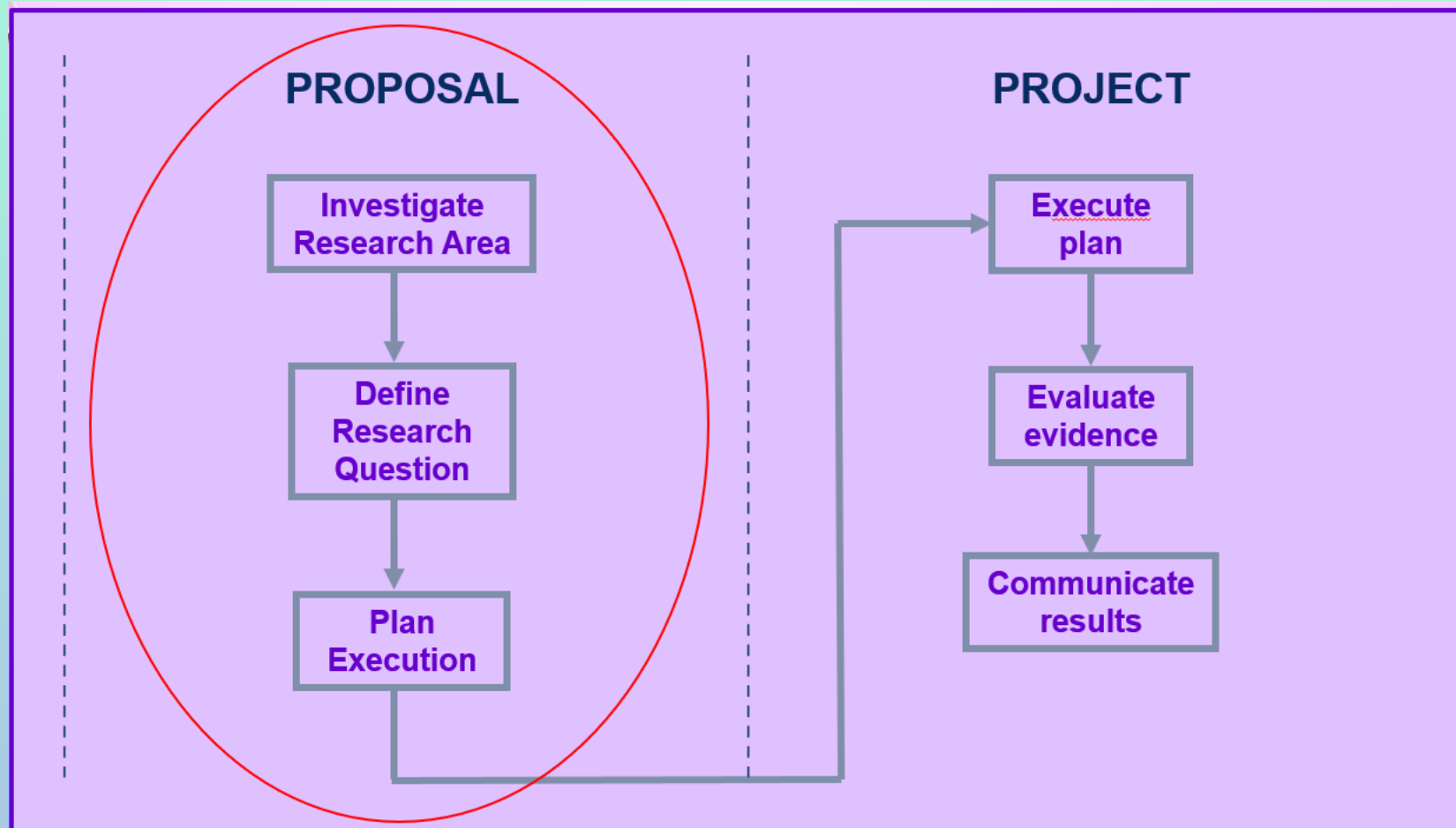
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Research Methods and Professional Development ACFA7004

Research Process; Research Aim and Objectives

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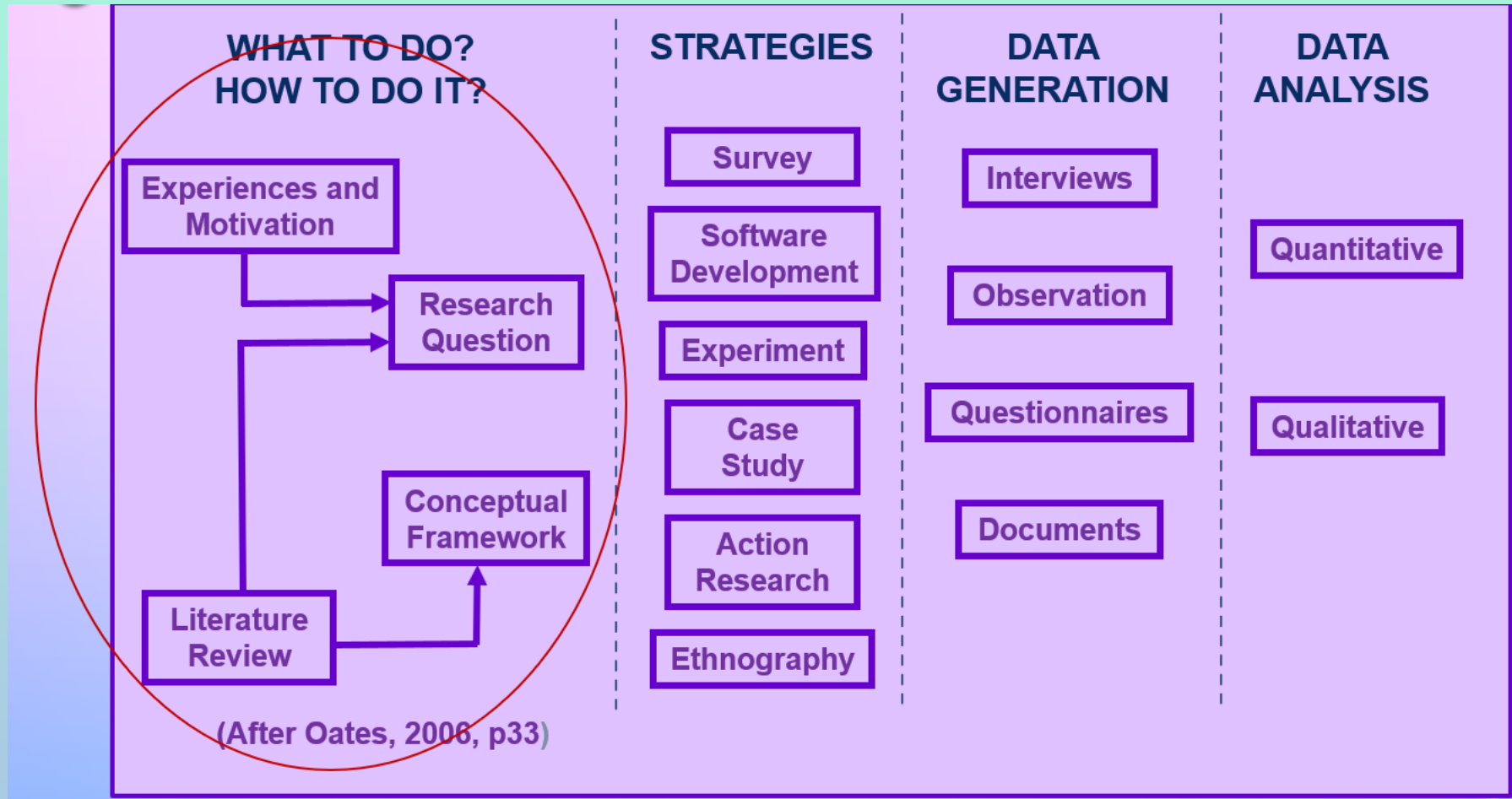
Research Process



Research Process

- How to choose your research topic ?
- What would this project help in answering?
- Would this be of use to others?
- Has the question already been addressed by previous Studies?
- Does it need to be done?
- Will it be of any benefit to the scientific community in General and the public at large?
- Would it be practical?
- Would this fill a gap in the existing pool of knowledge?
- Can the means to do the project be arranged?
- Do you have the necessary time and resources that the Project requires?

Research Process



Research Process

- What topic to research?
- Where can I get ideas?
 - Your strengths and interests
 - Your work, your job
 - Lecturers' ideas
 - The literature
 - Fit with career ambitions
- Must be rooted in academic theory (you'll compare your findings with previous studies & the academic literature)
- Can you access the data you'll need?

Research Aim and Objectives

- Most research topics have one overarching aim
 - The broad thing you are trying to achieve
 - Often mirrored in the title of the research
- This aim is then broken down into research objectives (typically 3 or 4)
 - The things you will do to achieve the aim

Research Aim and Objectives

- Consider the SMART test. Are your objectives:
 - Specific
 - What precisely do you hope to achieve?
 - Measurable
 - How will you determine if you've achieved your objectives?
 - Achievable?
 - Can it be done
 - Realistic?
 - Can you do it?
 - Time bound?
 - Can you deliver the project during the study period?

Research Aim and Objectives

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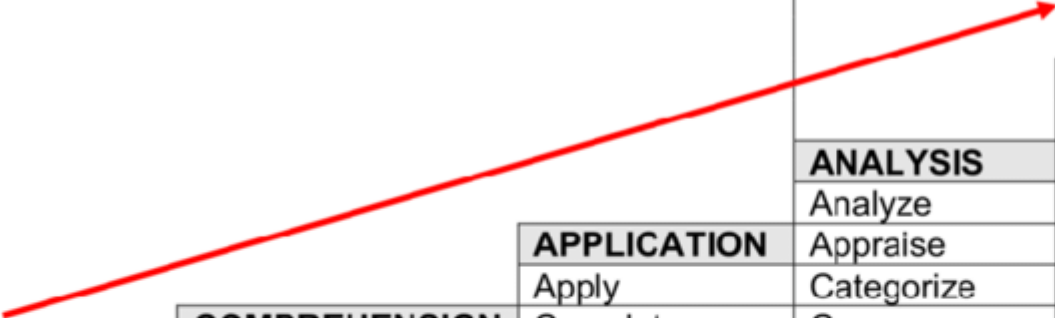
Research Aim and Objectives

Research Objectives

- Once you have a research **aim** or hypothesis you need to define the tasks that you will carry out to meet that aim
- These will be your research **objectives**
- You should have 3-4 research objectives, representing 3-4 parts of your project
- In general these will be:
 - Conduct a review of the relevant literature
 - Design something
 - Build something
 - Evaluate something

Research Aim and Objectives

- Bloom's taxonomy provides a good basis for identifying higher-level verbs for writing objectives
- Aim for those related to analysis, synthesis and evaluation



					EVALUATION
					Appraise
					Argue
					Assess
					Choose
					Compare
					Conclude
					Estimate
					Evaluate
					Interpret
					Judge
					Justify
					Measure
					Rate
					Revise
					Score
KNOWLEDGE	Describe	Demonstrate	Debate	Create	
	List	Dramatize	Diagram	Design	
	Name	Employ	Differentiate	Devise	
	Recall	Illustrate	Distinguish	Formulate	
	Record	Interpret	Examine	Manage	
	Relate	Operate	Experiment	Organize	

Extract of the Bloom's Taxonomy (adapted from (Bloom 1956; Anderson et al. 2001))

How to phrase research objectives

- The phrasing of objectives must include higher order verbs that indicate that this is level 7 standard of work. For example, 'to evaluate critically...', 'to analyse the...', 'to design and develop...', etc. Don't use verbs such as 'list', 'state' because they are too easy to achieve
- **Research question:** why have organisations introduced project teams for software development?
- **Research objective:** to analyse organisations' objectives for software development project teams
- **Research question:** how can the effectiveness of software development project teams be measured?
- **Research objective:** to establish suitable effectiveness criteria for software development project teams

Example – Research aim and objectives

Example 1

Topic - Enhancing Data Security in Cloud Computing Environments

Aim : To improve data security in cloud computing environments through advanced encryption techniques.

Research Objectives:

- To analyze current data security challenges in in cloud computing.
- To design and implement new encryption algorithms tailored for cloud storage and data transmission.
- To evaluate the effectiveness of the proposed encryption techniques.

Example 2

Topic - Improving Software Quality through Automated Testing

Aim : To enhance software quality and reliability through the implementation of automated testing techniques.

Research Objectives:

- To critically analyse the current literature to identity current automated testing tools and methodologies.
- To develop a comprehensive automated testing framework for software projects.
- To evaluate the effectiveness of the automated testing framework.
- To validate the proposed framework through a case study analysis.

Example – Research aim and objectives

Example 3

Topic - AI-Powered Threat Detection in Cybersecurity

Aim : To enhance threat detection capabilities in cybersecurity using machine learning techniques.

Research Objectives:

- To analyze the current AI and machine learning based threat detection.
- To develop a novel threat detection model based on Machine Learning.
- To evaluate the developed machine learning model using well known evaluation metrics.

Example 4

Topic - AI-based predictive model for early detection of anomalies in network traffic data

Aim: To develop an AI-based predictive model for early detection of anomalies in network traffic data.

- To review existing AI techniques for anomaly detection in network security
- To collect and preprocess network traffic datasets for training the model.
- To implement machine learning algorithms for anomaly detection.
- To evaluate the model's accuracy and effectiveness using real-world data.

Example – Research aim and objectives

Example 5

Topic – Developing an Artificial Intelligence model for Early Detection of Lung Cancer

Aim: To improve the accuracy and efficiency of early lung cancer detection using AI.

Research Objectives:

- To critically analyse existing AI models used in lung cancer diagnostics.
- Develop a new AI model that can accurately diagnose early-stage lung cancer.
- To evaluate the developed model using well known evaluation metrics

Example 6

Topic - Enhancing Sentiment Analysis Techniques for Fake News Detection Using Advanced NLP Methods

- Aim: To enhance sentiment analysis techniques using advanced NLP methods to improve the detection of fake news.
- Objectives
 - To critically analyse the current literature to understand current sentimental analysis methods in fake news detection
 - To develop new NLP models that can more accurately detect and interpret sentiment in fake news.
 - To evaluate the performance of the developed models and their potential applications in fake news detection.

Activity

For the following six topics, define an aim and research objectives

1. AI-Powered Incident Response and Forensics.
2. Evaluating the benefits of automated testing in small software projects.
3. AI for Threat Detection and Prevention.
4. Using AI chatbots to improve customer service response times in online retail.
5. Analyzing social media data to identify trends in online shopping behavior.
6. Machine Learning for Anomaly Detection in Network Traffic
 - Generative AI can be used to support this.
 - If you use GenAI, try several systems and compare their answers. Ask for multiple responses. Are they practical? Are they missing anything? Have they made any errors?

Research hypothesis

- Instead of an aim, you may prefer to use a research hypothesis, which is a statement which needs to be proved or disproved.
- A hypothesis is a clear, testable statement predicting the relationship between two or more variables. It serves as a guide to the research process and can be tested through experiments, observations, or data analysis

Research hypothesis

- For example...
- Scenario : to know if using more features in a machine learning model improves prediction accuracy
 - Null Hypothesis (H_0) : Adding more features does not improve the accuracy of the machine learning model
 - Alternative Hypothesis (H_a) Adding more features does improve the accuracy of the machine learning model
- Independent variable : ?
- Dependent variable : ?
- You would then specify the objectives necessary to test that hypothesis

Research hypothesis

- For example...
- Scenario : to know if writing unit tests improves quality of the code.
 - Null Hypothesis (H_0) : Writing unit code does not improve the code quality
 - Alternative Hypothesis (H_a) Writing unit code does improve the code quality
- You would then specify the objectives necessary to test that hypothesis.
- Independent variable : ?
- Dependent variable : ?

Research hypothesis

- For example...
- Scenario : to know if enabling multi-factor authentication (MFA) reduces the likelihood of unauthorized access to user accounts.
 - Null Hypothesis (H_0) : Enabling multi-factor authentication does not reduce the likelihood of unauthorized access.
 - Alternative Hypothesis (H_a) Enabling multi-factor authentication does reduce the likelihood of unauthorized access.
- You would then specify the objectives necessary to test that hypothesis.
- Independent variable : ?
- Dependent variable : ?

Hypothesis or research question

- Refines/scopes the question and sets the AIM
 - Leads to the intermediate OBJECTIVES
 - Determines the work you do and defines when you finish
 - Something capable of proof or otherwise
-
- Having a hypothesis normally implies that you'll do some statistical analysis with your data to look for significant differences between conditions

Key Skills

- Listen, assess and distil
- Read, critique and distil
- Extract and form meaning (opinion?)
- Synthesis of material into your own world view
- Make notes from spoken and written sources by picking out the key points
- Read critically
- Have the argument internally and externally
- Discuss dispassionately but with conviction
- Give your own thoughts on received wisdom, grounded in domain understanding and properly formed
- Write with authority (understanding what authority is in the context of writing)

Next session

- Literature Review