Formulating Research Hypothesis

by

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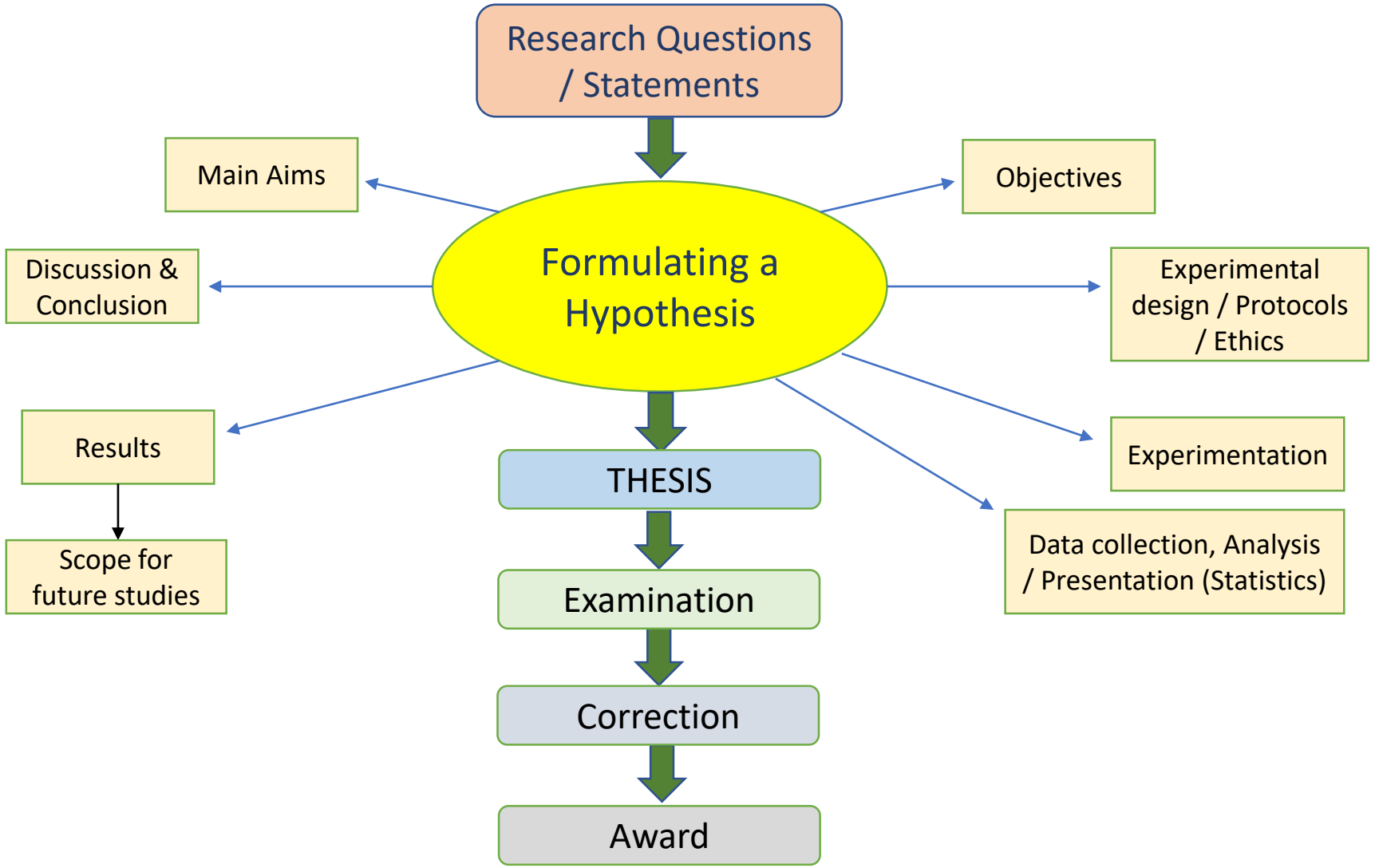
Scope for a Research Degree



Formulation the hypothesis leading to thesis

- In formulating the hypothesis, please consider
- Research Statement (a summary of your proposed research)
- Hypothesis (A tentative answer to a research problem to be tested)
- Main Aim (s) (An aim is a general statement of intent based on the research)
- Objectives or specific aims, normally a few for a research project (An objective is a more specific statement of intent based on the research and experimental protocol and design) -testing hypothesis
- Reading around the subject area
- They all come together in a research project to form Thesis

Background Information-For Real

- **In a recent PhD examination, the External Examiner spent 2-3 hours discussing the hypothesis with the student teasing out information on the study. I was the Internal Examiner.**
- **Via repeated and several questions based on the hypothesis, the examiner was able to appreciate as to why the student was doing the research study and how he arrived with the results, the answers to the research statement and achieving main aim(s) and objectives. Student was awarded the PhD.**
- **Note that the research objectives come after the Hypothesis**
- **A hypothesis is the tentative answer to research questions, research aims and objectives outline the path to determine the validity of the hypothesis.**
- **I will give several examples later**

Some external opinions on formulating Hypothesis

- What other researchers think on hypothesis.
- After the research questions come research objectives for which hypotheses could be formulated. These hypotheses will be tested to confirm achievement of specific objectives.
- Appropriately, hypothesis follows the specific research questions. Research objectives come after hypothesis. As hypothesis is the tentative answer to research questions, research objectives outline the path to determine the validity of the hypothesis.
- Research question generates hypothesis and objectives are tested to justify the merits of hypothesis.
- Up to me, there is no clear rule but it is logical to set our objectives first, then write the research questions that enable us to generate hypotheses that we will test in our study.

Three more external opinions

- Based on the scientific problem to solve, research questions generate objectives (solutions) and hypotheses (tentative solution/proposition based on assumption and later applied in the work field) are tested to reach the objectives (permanent solution).
- I think objectives are the main pillars of research questions which are created for objectives
- My opinion is that the order is research question, hypotheses then objectives. I also think that some fields of study have their peculiarities.

How is the hypothesis related to research questions and research objectives?

- **Research objectives are clear statements of what you aim to achieve through your research (Experiments)**
- **A research hypothesis is a predictive statement about the possible outcomes of a study.**
- **Each objective via experimental design/protocol is tested**

How to Formulate an Effective Research Hypothesis?

1.State the problem that you are trying to solve. Make sure that the hypothesis clearly defines the topic and the focus of the experiment.
2.Try to write the hypothesis as statement. Some people use questions.
3. Define the variables
4.(I will explain later)

Formulating a research hypothesis

- A research hypothesis is a statement of expectation or prediction that will be tested by research
- Before formulating your research hypothesis, read about the topic of interest to you. From your reading, which may include research articles, books and/or cases, theses, you should gain sufficient information about your topic that will enable you to narrow or limit it and express it as a research question.
- The research question flows from the topic that you are considering. The research question, when stated as one sentence, is your Research Hypothesis

Formulating a research hypothesis: Easy life

- If you are worried or confused about hypothesis then best is to join an ongoing or well established research group/team
- They have many testable hypotheses via ongoing research and recent awards
- Most PhD theses have a section at the end entitled: Scope for Future Studies
- There are many unanswered research questions or statements or proposals derived from the thesis.
- You just need to read the thesis and follow up Scope for future studies for a new PhD research project
- This is what most established groups do for grant application and new PhD studies

What is a Research Hypothesis? Rreminding you

- A research hypothesis is usually a tentative statement that introduces a research question and proposes an expected result (s)
- In your hypothesis, you are predicting the relationship between two elements/ variables (Independent and dependent) that are in relation to each other
- The hypothesis is a specific and testable prediction about what you expect to happen in a study
- It is an integral part of the scientific method that forms the basis of scientific experiments (Experimental protocols and designs)

What is a research Hypothesis : Reminding you

- Hypothesis encompasses a number of objectives or specific aims which you need to achieve on completion of a thesis (related to your experiments)
- What makes a very good hypothesis?
- A solid research question
- Background research: Read widely around the subject area
- Make sure that the hypothesis is testable or workable
- Best is to read a few theses before you start your research study
- It has independent and dependent variables

Dependent and Independent variables

- V**ariables** are any characteristics that can take on different values, such as height, age, species, or exam score.
- In scientific research, we often want to study the effect of one variable on another one.
- The variables in a study of a cause-and-effect relationship are called the **independent and dependent variables**.
- The **independent variable** is the **cause**. What causes it? Its value is *independent* of other variables in your study.
- The **dependent variable** is the **effect**. Its value *depends* on changes in the independent variable.
- See examples next

Examples of independent and dependent variables

- Research question
- **What is the effect of diet and regular soda on blood sugar levels?**
- **Independent variable(s)**
- The type of diet you eat or soda you drink (diet or regular)
- **Dependent variable(s)**
- Outcome or Your blood sugar levels

Dependent and Independent variables: Example

- Experiment example
- You are studying the impact of a new medication on the blood pressure of patients with hypertension.
- To test whether the medication is effective, you divide your patients into two groups. The experimental group takes the medication, while the control group takes a sugar pill or placebo.
- Your independent variable is the treatment that you vary between groups: which type of pill the patient receives.
- Your dependent variable is the outcome that you measure/outcome: the blood pressure of the patients.

Research Aims

- The term research aim usually refers to **the main goal or over**
- **arching purpose of a research project**.
- **Aim:**
- The main aim of this study was to **inves**tigate factors associated with partner violence
- The main aim of this study was to investigate the risk factors and prevalence on non-communicable diseases in Guyana
- Note that aims come naturally once you have a research topic/proposal in mind
- Normally, a research aim follows by a series of statements describing the objectives of the research project

Specific Research Aims or Objectives

- Research objectives indicate, in more detail, the specific research topics or issues of the project plans to be investigated (different experimentations), building on the main theme stated in the research aim (see later in examples). Each objective carries a series of experiments
- Normally 5-6 or more research objectives will be stated.
- It is good practice to put these in a numbered list so they can be clearly identified later in a proposal or report. Here is an example of a set of research objectives
- Note that each objective is a research design to be tested
- experimentally (see relationship in next 2 slides)

Formulating hypothesis and experimental design

- **What is the relationship between hypothesis and research design?**
- **Hypothesis:** • As mentioned, earlier, it is a formal statement that presents the **expected relationship between an independent and dependent variable**
- The research question is essentially a hypothesis asked in the form of a question.
- **What is hypothesis? Why is it important to an experimental research?**
- When conducting scientific experiments, researchers develop hypotheses to guide experimental design. A hypothesis is **a suggested explanation that is both testable and falsifiable**. You must be able to test your hypothesis, and it must be possible to prove your hypothesis true or false.

Formulating hypothesis and experimental design

- **Does experimental research have hypothesis**?
- Experimental research is a study that strictly adheres to a scientific research design. It includes a hypothesis, **a variable that can be manipulated by the researcher**, and variables that can be measured, calculated and compared (statistics).
- Most importantly, experimental research is completed in a controlled environment.
- **What is experimental research design**?
- Experimental research design is **centrally concerned with constructing research that is high in internal validity. Are the findings or results valid enough?**
- I will now give a number of examples on research questions, hypotheses, aim and objectives and experimental design for PhD or similar

A Typical Research Proposal/Question/ Objectives etc

- Is chronic myeloid leukaemia (CML) a cancerous disease infiltrating hematopoietic bone stem cells and blood platelets in our body?
- Can we treat this type of blood cancer with Imatinib, a major commercial anti-cancer drug which inhibits the enzyme tyrosine kinase?
- What would be our control(s) compared to drug treatment?
- Can we use isolated hematopoietic bone stem cells and blood platelets from healthy control, and cancer patients before the start of Imatinib treatment and after treatments for 6 months
- How does Imatinib exert its anti-cancer effect?
- Does Imatinib have side effects? If yes, How can we measure these?
- **What is the working hypothesis**? Angiogenic-, apoptotic- and autophagic levels are decreased in platelets of chronic myeloid leukaemia patients after six months of treatment with the anti cancer drug, Imatinib (drug is treating the cancer)
- **What is the main aim**? The main aim of this study is to determine the angiogenic-, apoptotic- and autophagic profiles of chronic myeloid leukaemia in patients *ex vivo* on platelets before and after treatment with Imatinib compared to healthy control subjects.

A typical research proposal/Question/ Objectives

- **What are the specific objectives based on the experimentations?**
- This study carries several scientific techniques including (1) microscopy of the platelets to examine their morphology, (2) flow cytometry –cell numbers,(3) apoptosis and caspase 3 activity (cell death), (4) autophagy (or cell death), (5) angiogenic markers and TGF-beta and (6) Western blotting using established scientific techniques in tackling the problems either before or after treatment.
- **These 6 specific objectives are based on the different techniques and literature search**

Objectives

- 1.To undertake a thorough literature around the subject area.
- 2. To conduct Wright staining and subsequent visualization by light microscopy on healthy participants' blood and CML patients to determine leukocyte counts.
- .3. To determine morphological effects of platelets of controls and of CML patients at diagnosis and after treatment by utilizing electron microscopy including scanning electron microscopy and transmission electron microscopy.
- 4. To determine platelet counts, viability and activation by human cluster of differentiation 41 and 62 using flow cytometry.
- 5. To investigate the apoptotic effects by measurement of the phospholipid flip via Annexin V-fluorescein isothiocyanate (FITC) and caspase 3 measurement by flow cytometry.

Specific objectives

- 6. To examine the autophagic profile via investigating LC3-I to LC3-II conversion through Western blotting and quantification of autophagy-related gene 5 levels using flow cytometry.
- 7. To establish the plasma angiogenic profiles by measurement of angiogenic biomarkers released from platelets.
- 8. To analyse the data statistically and write up the PhD study

Another PhD/research example

- Can moderate daily exercise be used beneficially to treat type 2 diabetes mellitus and in preventing or delaying diabetic–induced heart failure and sudden cardiac death?
- How does exercise help to treat type 2 diabetes and repairing the heart?
- What are the mechanisms of action of daily moderate exercise?
- Do exercise have beneficial effect on the endocrine pancreas? If yes, how? Can exercise help with blood flow in the body. Can exercise reduce blood pressure, glucose and lipids such as cholesterol and fatty acids.
- Is exercise beneficial to healthy individuals as well?

Hypothesis, Aim and specific objectives

- **Hypothesis**:- Regular daily exercise can be used beneficially to treat type 2 diabetes mellitus and repairing the heart
- **Main Aim**:- This study investigated the beneficial effect and mechanism of action of exercise in type 2 diabetes mellitus.
- **Specific Objectives or Aims**:-
- 1. To undertake a thorough literature search around the subject area
- 2.To implement or decide on the experimental animal model (control and diabetic) and to design and undertake the exercise regime over a period of 3-4 months

specific objectives

- 3. To measure blood glucose levels on a daily basis until end of experimental period
- 4. To measure the function of the heart in control and exercise states
- 5. To investigate the structure of the heart in control and exercised conditions
- 6. To measure fibrosis, hypertrophy, Apoptosis, TGF-beta 2 and gene expression for calcium proteins in the hearts of control and exercised conditions
- 7. To analyse the data and write up the PhD thesis

Another example : Research questions and statements

- Can bitter melon or corilla be used beneficially and cost-effectively to treat triple negative breast cancer (TBNC) which kills more women on earth including Guyana?
- What components of the vegetable possess anti cancer properties? Whole, extracts or isolated compounds
- How can we extract and purify the active compounds?
- What types of experimental techniques can be used to tackle the scientific problems?

Example continues

- Are breast cancer cell lines (Secondary) good experimental models to use in this research proposal or should we use original (Primary) breast cancer tissues?
- What should we use as a control model?
- Should we compared bitter melon extract with other known commercial anti cancer drugs, such as cisplatin and others?
- What are the cellular mechanisms of action of cancer cell death?

Hypothesis and Aims

- **Hypothesis**: Alcoholic extract and isolated compounds of corilla can be used to treat TNBC cost-effectively and safely compared to cisplatin either alone or in combination
- **Aim:** To investigate anti cancer effects of (*Momordica Charantia) corilla/bitter melon* extract, alpha beta momorchin (2 compounds extracted from bitter melon) , and cisplatin on triple negative breast cancer cell line viability compared to healthy breast cancer cell line either alone or in combination.
- **Aim**: To investigate the cellular and molecular mechanisms of action on cancer cell death

Specific objectives

1. To undertake a thorough literature search around the subject area
2. To prepare the alcoholic extract from of corilla
3. To learn the technique of breast cancer cell culture
4. To undertake both time –course and dose dependent effects of corilla extract, its isolated compounds and cisplatin on cell death/viability
5. To investigate the cellular mechanisms of breast cancer cell death measuring a number of biochemical parameters
6. To analyse the data and write up the PhD thesis

Other research projects

- The 270 miles of coastal region in Guyana is battered constantly by the mighty Atlantic Ocean especially during high spring tides. What can be done in preventing this?
- The planting of mangrove trees throughout the entire 270 miles of coast is the best way forward to prevent flooding and also to enhance the biodiversity of the area, thus preventing adverse effects due to the climate
- You can now build a whole thesis from these two statements
- Currently, Guyana cannot cope with a sudden natural disaster such as oil spillage, hurricane, earthquakes, forest fires and others since no emergency procedures and preventative strategies are in place to address/tackle these natural disasters
- According to the BBC news, Guyana has the highest number of suicides among young male subjects globally and to date, the Government has failed miserably to address this issue

Other research projects

- The best ways to tackle climate changes in Guyana must involve the planting of millions of trees annually accompanied by the use of renewable energy to generate electricity using water, sun, wave and hydrogen power
- Non-Communicable diseases such as obesity, diabetes and hypertension are very prevalent in Guyana killing more people compared to other diseases but the Ministry of Health in Guyana is either not or slowly addressing these major health problems
- With the advent of Covid-19, Guyana now encounters a massive shortage of medically qualified health Care Professionals to tackle or solve the problem. What can be done to alleviate the problem?
- Mental health problems, including depression and anxiety, are very extremely prevalent in Guyana but the Ministry of Health and Social Care and the Ministry of Education are not addressing these major health issues. How can we solve these major health problems

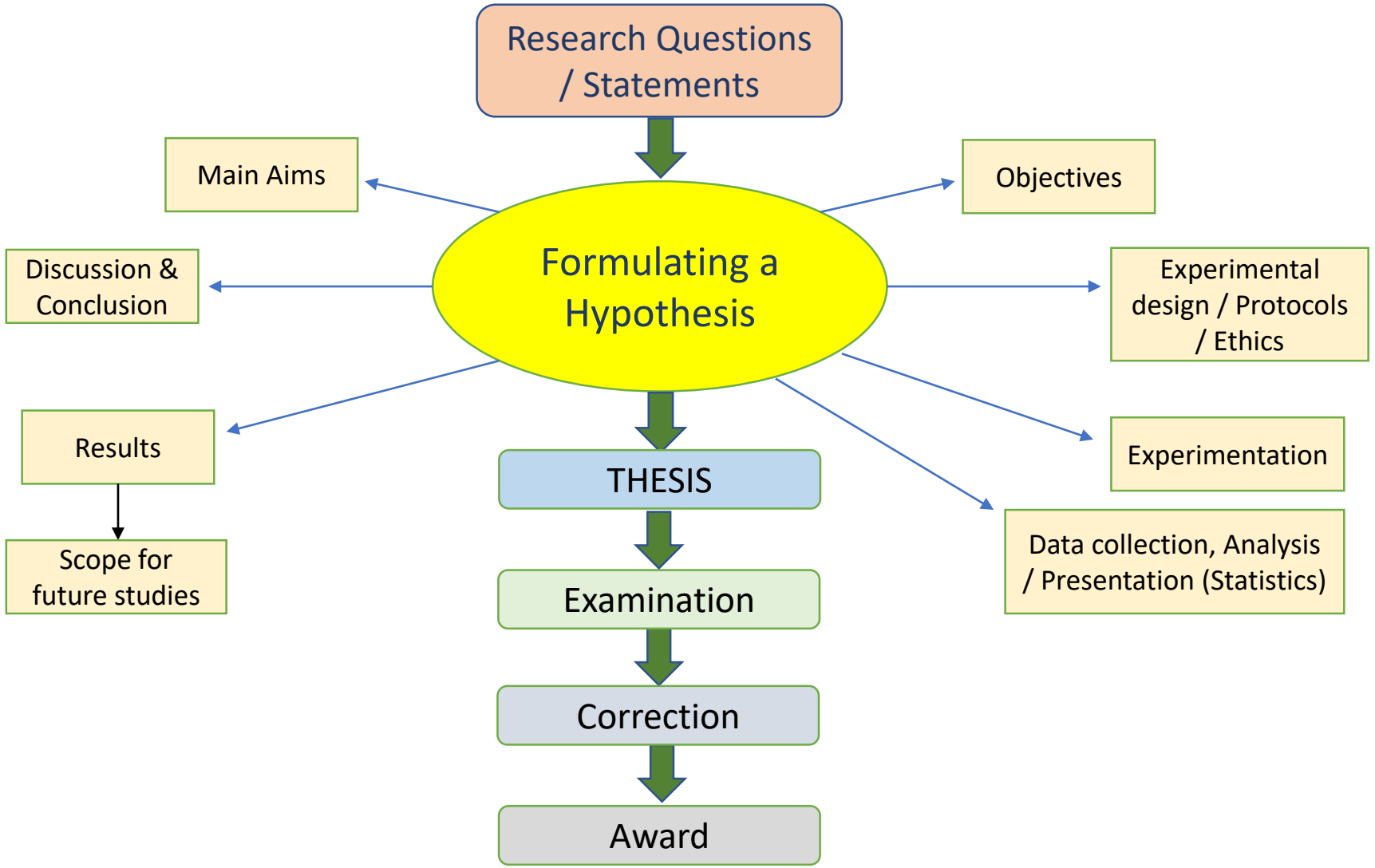
Other examples

- Making Georgetown a free port like Dubai, Panama City, Singapore etc will increase employment (jobs) for Guyanese and investment for the country, including development of a deep sea harbour for cruise ships and others, housing development of the Demerara water front on both sides of the River and link Brazil by road and railway to Georgetown and open up the interior
- Eating plenty of virgin oil in your daily diet can reduce the incidence of heart attacks and strokes.
- Epidemiological evidence reveals that less people die from heart attacks and strokes in the Mediterranean since they consume more olive oil.
- How much olive oil should I consume daily (1-5 grams)
- How does olive oil work in preventing heart attacks and strokes
- Mease blood parameters
- Effects in different ethnic groups and genders
- Can olive oil help to prevent obesity, diabetes, cancers and hypertension?

Other examples

- Tourism in Guyana is on the decline or a fledgling industry due to a number of factors including wide –spread of crimes, unsafe roads due to numerous road traffic accidents daily, reduce holiday facilities for tourist compared to neighbouring countries, no deep-sea harbour for cruise ships to dock, little or no effort by Government to promote tourism nationally (domestic tourism) and internationally (diaspora) and others.
- How can the Government or the Ministry of Tourism address these issues since tourism is a major source of income for the country?
- The Ministry of Tourism needs to promote or sell the positive attractions which Guyana has in order to attract tourism
- The Kaieteur Falls and others, Natural habitats for tropical animals and virgin forest (Iwokrama), Historical buildings and monuments, Rodeo in Lethem, Water skiing at Bartica, Indigenous villages, beaches in the Essequibo River and afew holiday resorts in different places in the country

Scope for a Research Degree



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- QUESTIONS AND ANSWERS OR DICUSSION

Second part of talk – 6 slides only

- Responsibilities of the Research Candidate

Responsibilities of the Research Candidate

- PhD/Research candidates have a number of responsibilities including:-
- They should accept that the degree requires them to work towards intellectual independence within a supportive supervisory environment.
- They must demonstrate a high level of commitment and personal initiative.
- They must be prepared to "drive" the research project and to raise matters of concern promptly, without waiting for others to do so for them.

Responsibilities of the Research Candidate

- They should not go out of tangent since they can waste money and valuable time

- They should expect to take the lead in most matters pertaining to the project, adhering to the principle that theirs is the main responsibility for the conduct and progress of the research.
- They should also ensure that they have acquainted themselves with the regulations and procedures governing the PhD/or similar research programme, to which end they are strongly encouraged to attend the orientation sessions etc run by the University.

Specific responsibilities of PhD candidates

- To commit and manage adequate time and effort to the project (Time/Project management skills)
- To display initiative in identifying and resolving problems relating to the research
- To manage their work efficiently so as not to place unreasonable demands on supervisors
- To be well organised and capable of setting and meeting deadlines for various phases of the research (Leading the research)

Specific responsibilities of PhD candidates

- To acquire any new skills required as part of the project
- To maintain frequent and regular contact with the supervisors
- To seek and accept in good faith advice from supervisors and advisory panels
- To fulfil tasks required by the supervisors as part of the project
- To produce self-review documents as part of the reporting process

Specific responsibilities of research candidates

- To meet the normal scholarly and professional standards required by their discipline
- To start writing their thesis as early as is practicable
- To ensure that all written work is of a high standard of expression and organization
- To present seminars where appropriate and participate in the academic, professional and social life of the department
- To attend and present papers at conferences and publish sections of the work where appropriate under the guidance of their supervisors

Advice to Research candidates/students

- It is essential that candidates accept that, just as it is a requirement of supervisors to provide advice and criticism, it is necessary for them to listen when such advice and criticism are offered.
- Ideally, this should take the form of a constructive dialogue, but there will, inevitably, be times when this is the source of some tension.
- In cases where such dialogue is proving difficult or impossible, this must be addressed as soon as possible with the help of the HOS.
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END

- Questions and Answers