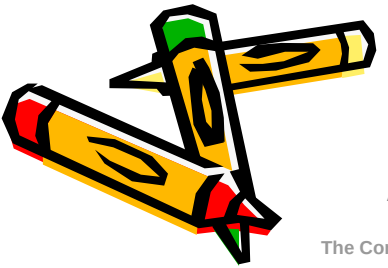
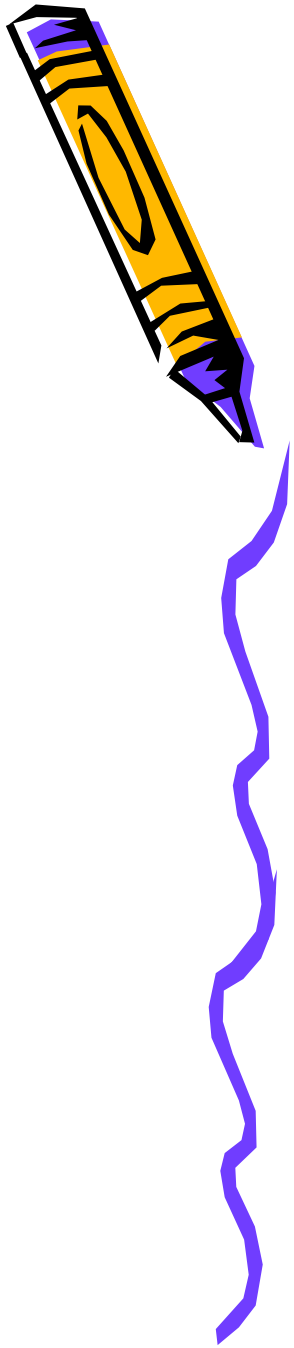
Overview of RESEARCH and RESEARCH METHODOLOGIES

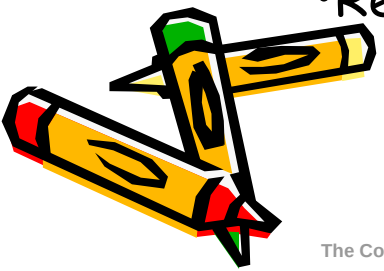


Introduction

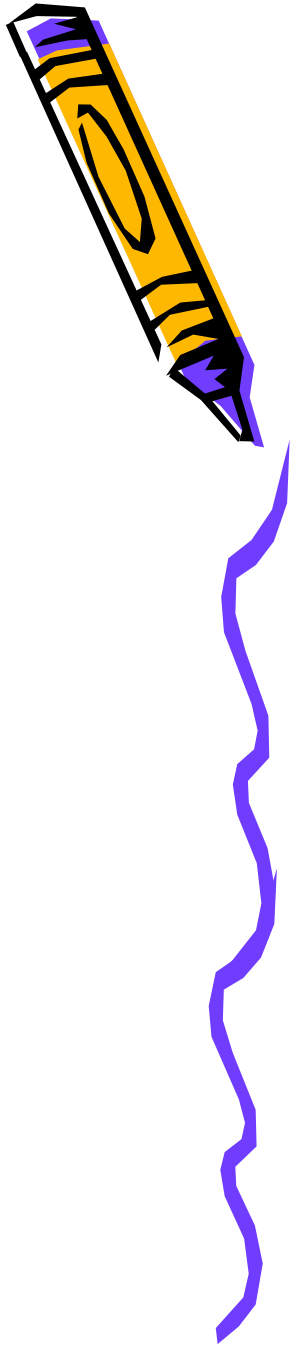


Overview of Research and its Methodologies

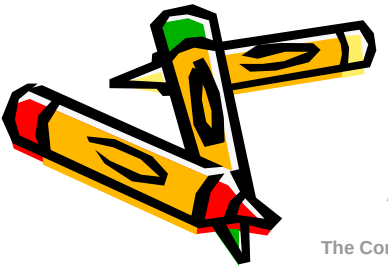
- Concepts of "Research"
- The need for "Research"
- Types of "Research"
- Steps in conducting "Research"
- Where to do "Research"?
- What is a "Research paper"?
- Research at the University



Concepts of Research



What is research?



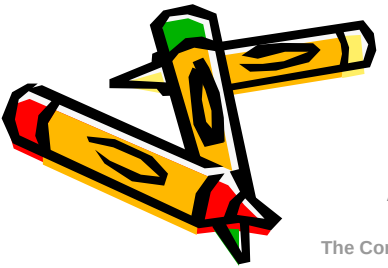
Concepts of Research

Which of these can be classified as research?

[1] "A" prepared a paper on "computer usage in secondary schools" after reviewing literature on the subject available in his university library and called it a piece of research.

[2] "B" says that he has researched and completed a document which gives information about the age of his students, their SPM results, their parents income and distance of their schools from the District Office.

[3] "C" participated in a workshop on curriculum development and prepared what he calls, a research report on the curriculum for building technicians. He did this through a literature survey on the subject and by discussing with the participants of the workshop.



Concepts of Research

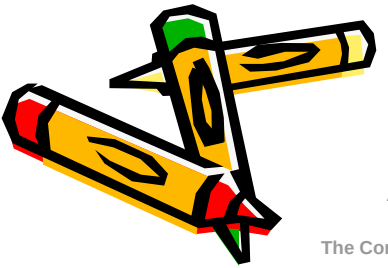
None of the above examples

can be classified under the name "Research".

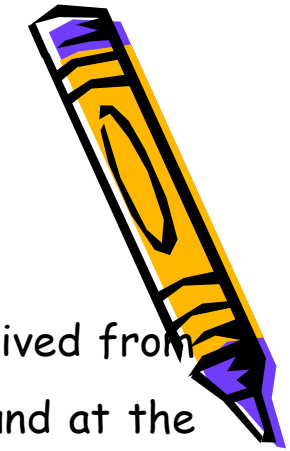
WHY ?

You will know it when you have understood

the concept of the term 'Research'.



Concepts of Research



Consider the following case which is an example of RESEARCH:

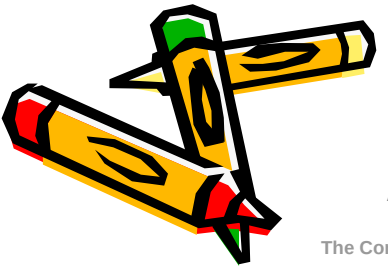
•General manager of a car company was concerned with the complaints received from the users that the cars they produce have some problems with rattling sound at the dash board and the rear passenger seat after few thousand kilometers of driving.

•He obtained information from the company workers to identify the various factors influencing the problem.

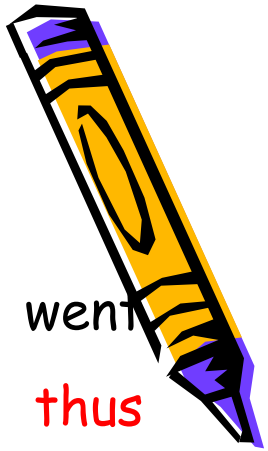
•He then formulated the problem and generated guesses (hypotheses).

•He constructed a checklist and obtained requisite information from a representative sample of cars.

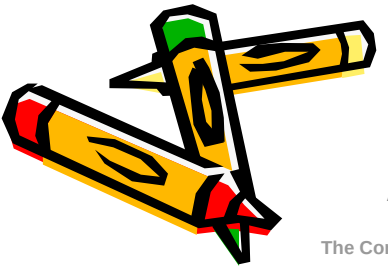
•He analyzed the data thus collected, interpreted the results in the light of his hypotheses and reached conclusions.



Concepts of Research



- You will notice in the example above that the manager went through a sequence of steps which were in order and thus systematic.
- Secondly, the manager did not just jump at the conclusions, but used a scientific method of inquiry in reaching at conclusions.
- The two important characteristics of research are: it is systematic and secondly it follows a scientific method of enquiry.



Concepts of Research

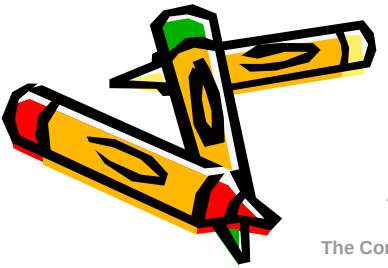
Definition of Research

"Research is formalized curiosity."

Zora Neale Hurston

"Research is to see what everybody else has seen, and to think what nobody has thought."

Albert Szent-Gyorgy

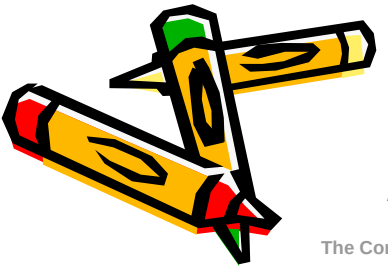


Concepts of Research

What is Research?

Research is systematic process which follows certain steps:

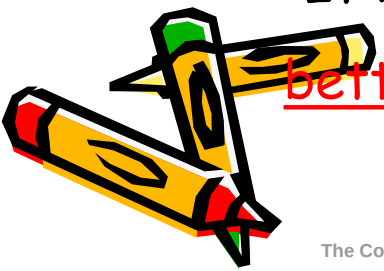
- Understanding the nature of problem to be studied.
- Reviewing literature to understand how others have approached or dealt with the problem.
- Collecting data in an organized and controlled manner so as to arrive at valid decisions.
- Analyzing data appropriate to the problem.
- Drawing conclusions and making generalizations.



Concepts of Research

High Quality Research!

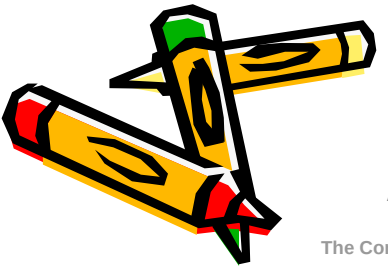
- It is based on the work of others.
- It can be replicated (duplicated).
- It is generalizable to other settings.
- It is based on some logical rationale and tied to theory.
- It is doable!
- It generates new questions or is cyclical in nature.
- It is incremental.
- It is apolitical activity that should be undertaken for the betterment of society.



Concepts of Research

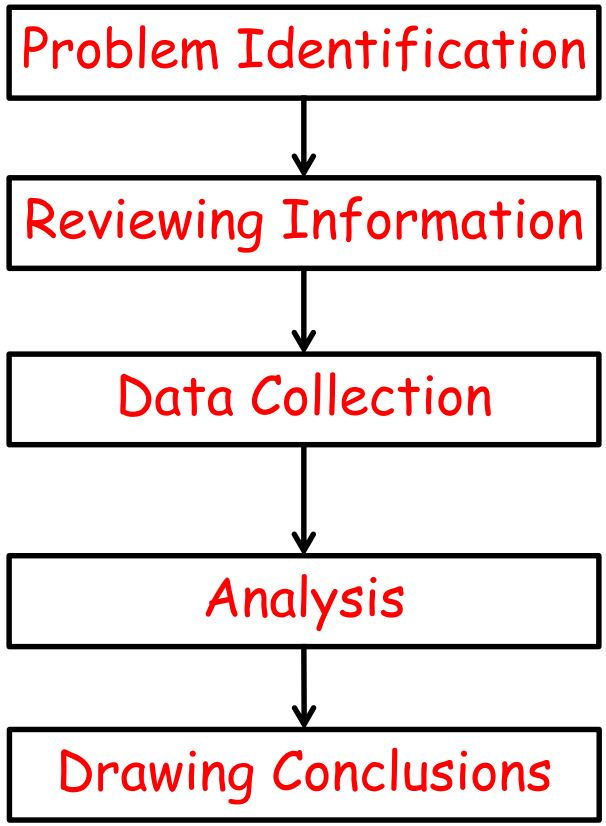
Then, what is bad research?

- The opposites of what have been discussed.
- Looking for something when it simply is not to be found.
- Plagiarizing other people's work.
- Falsifying data to prove a point.
- Misrepresenting information and misleading participants.



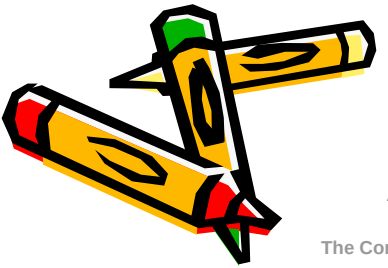
Concepts of Research

This general systematic characteristic of research is illustrated below.

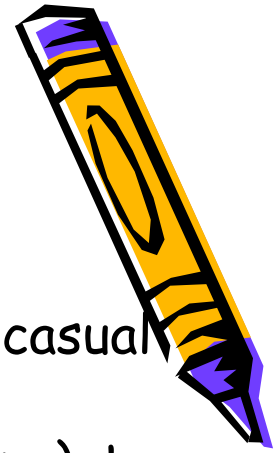


Concepts of Research

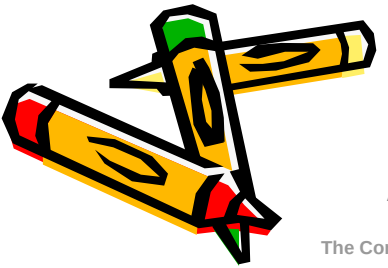
- Research follows a scientific method - means it makes an integrated use of **inductive** and **deductive** reasoning.
- Therefore, it is very useful for explaining and/or predicting phenomena.
- The basic assumption of the scientific method is that every effect has a cause.



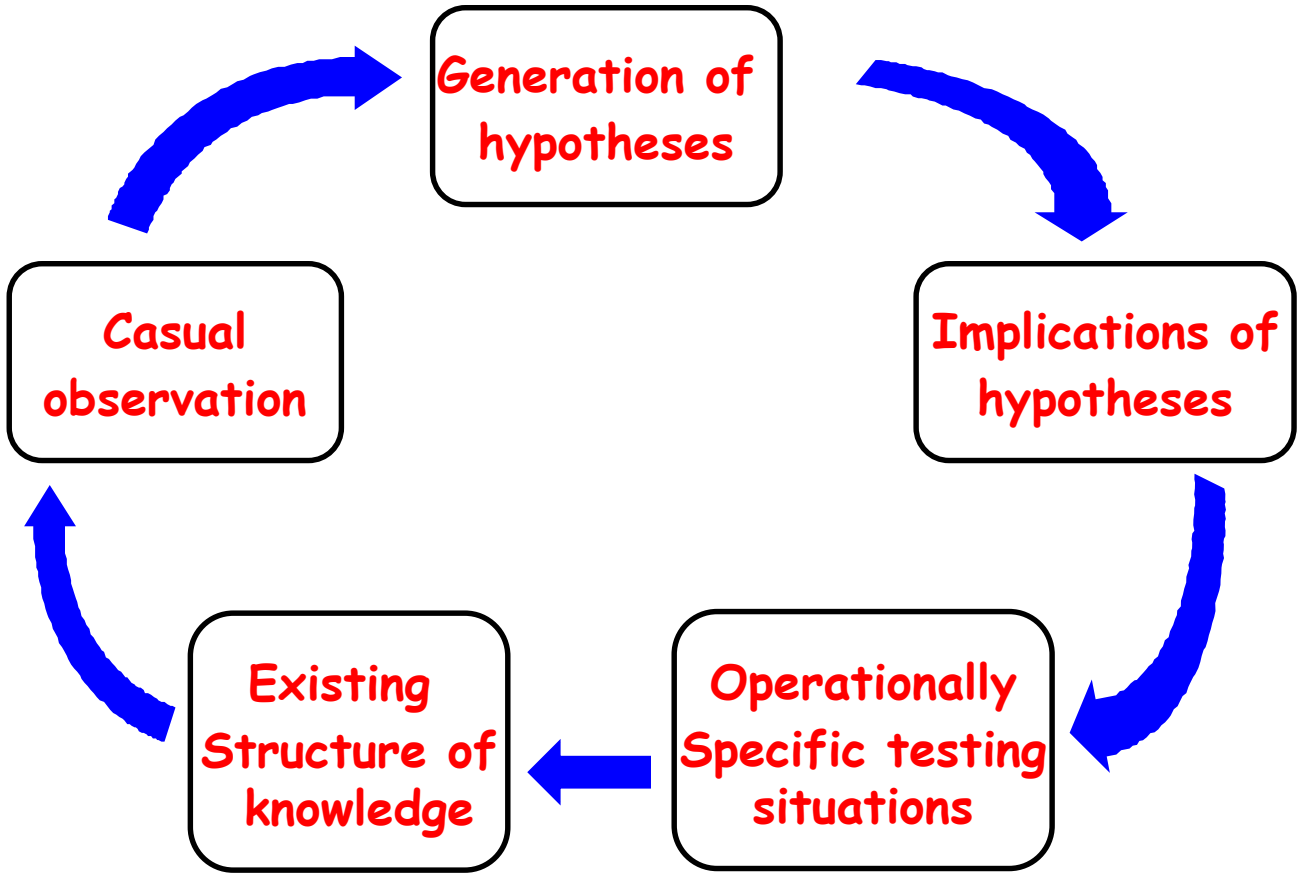
Concepts of Research



- It starts with the construction of hypotheses from casual observations and background knowledge (inductive reasoning) to reasoning out consequences or implications of hypotheses (deductive reasoning) followed by testing of the implications and confirmation or rejection of the hypotheses.
- Integrated use of inductive and deductive reasoning is, therefore, the essence of scientific method.

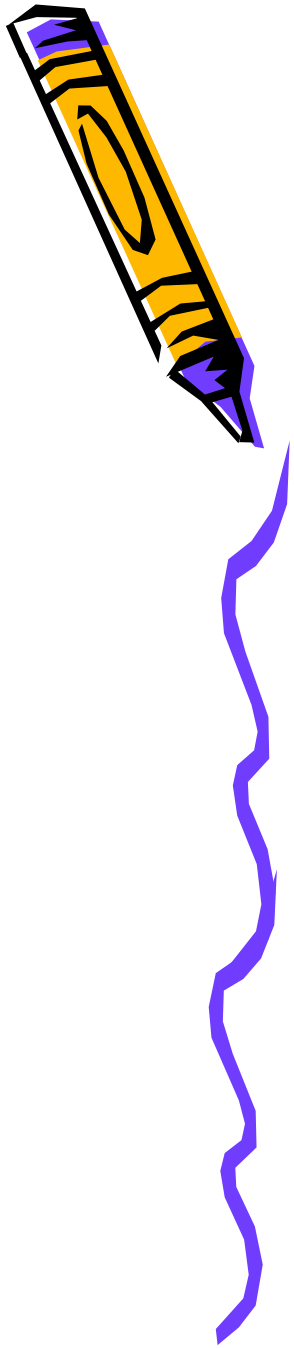


Concepts of Research

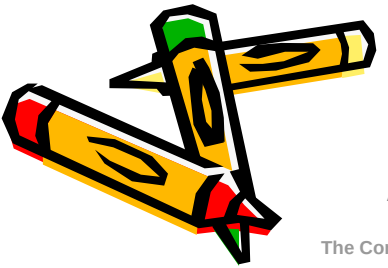


Scientific Method of Acquiring Knowledge of Problem Solving
(By courtesy of Yadav & Menon)

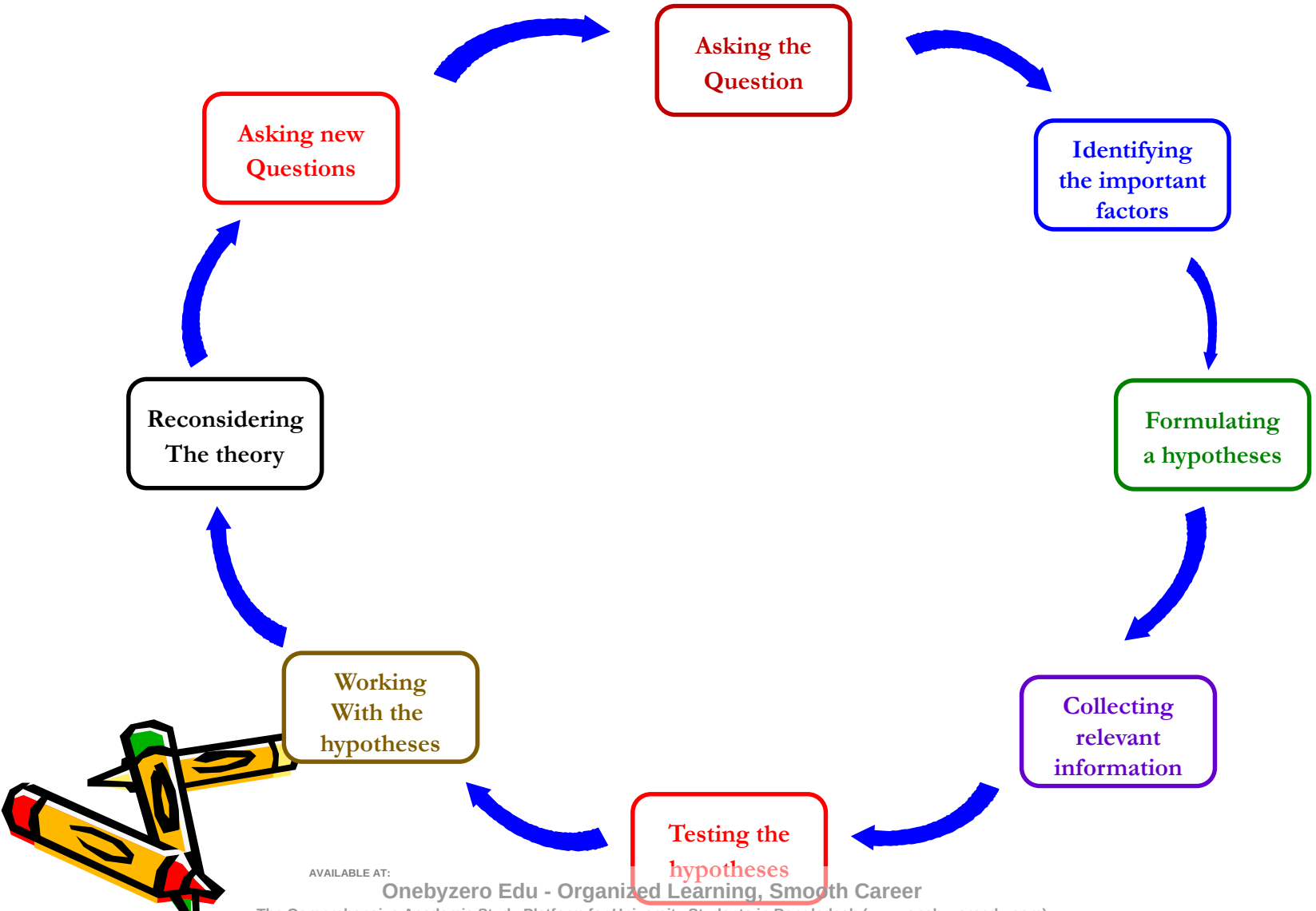
Concepts of Research



Where do I begin?



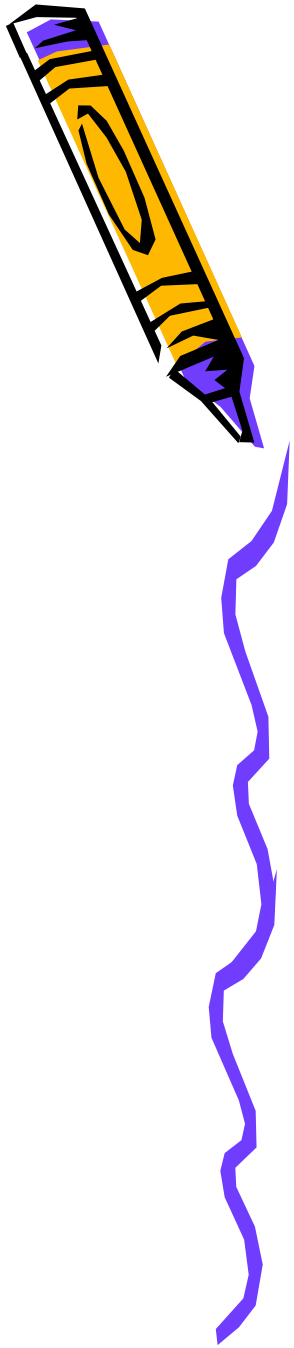
Concepts of Research



The Need for Research

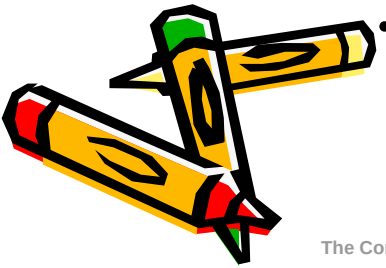
Why do Research?

The Need for Research



Why do we need Research?

- To get PhDs, Masters and Bachelors??
- To provide solutions to complex problems
- To investigate laws of nature
- To make new discoveries
- To develop new products
- To save costs
- To improve our life
- Human desires



The Need for Research

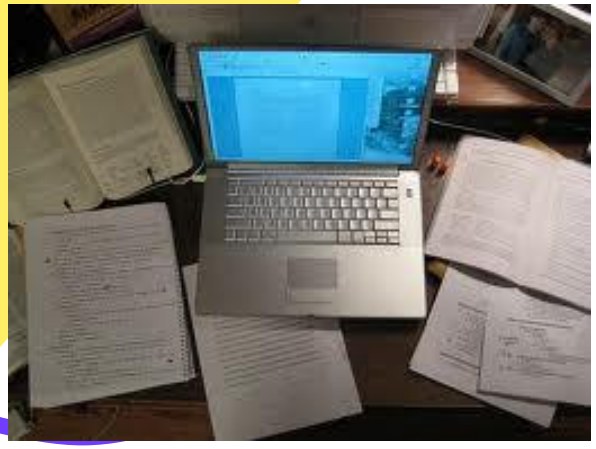
Why do Research?

- To become familiar with topical vocabulary (e.g. key concepts, terminology)
- To gain insight into the topic, facts, opinions, and theories
- To be aware of inconsistencies or shortcomings in one's knowledge and understanding
- To support and enrich ideas
- To increase credibility
- To become familiar with gaps in the literature (lacking, inconclusive, contradictory, and limited evidence)

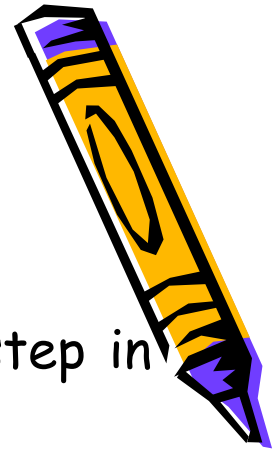
And most importantly;

- TO CREATE KNOWLEDGE

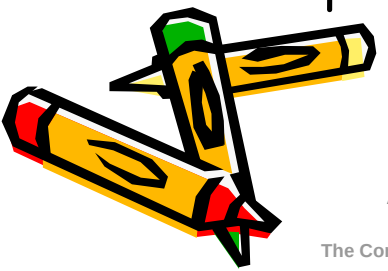
Types of RESEARCH



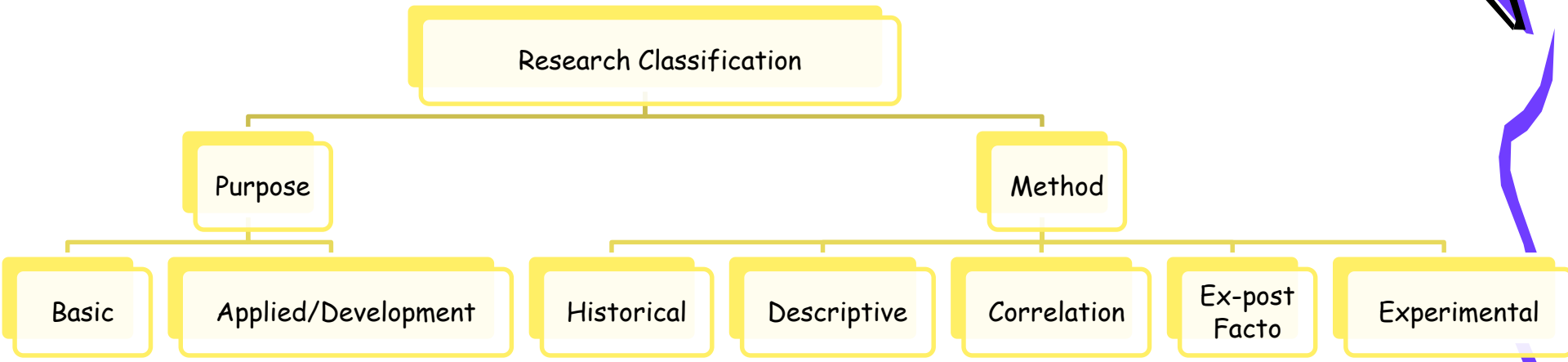
Types of Research



- Reviewing related past research studies is an important step in the process of carrying out research as it helps in problem formulation, hypothesis construction and selection of appropriate research designs.
- It is beneficial if you can classify a research study under a specific category because each category or type of research uses a specific set of procedures.



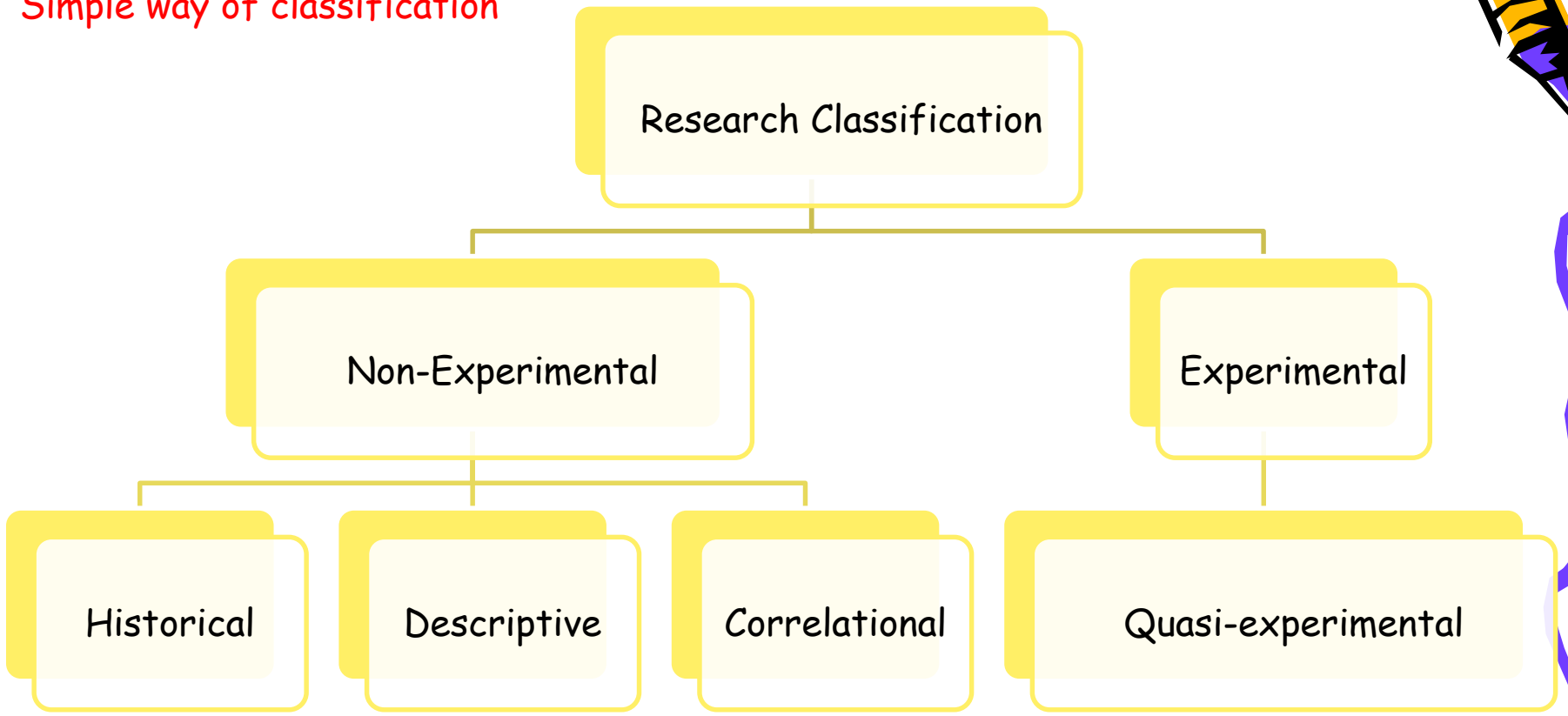
Types of Research



- Purpose - the degree to which the research findings are applicable to an educational setting and the degree to which they are generalizable.
- Method – Method/techniques employed in collecting and analyzing data

Types of Research

Simple way of classification

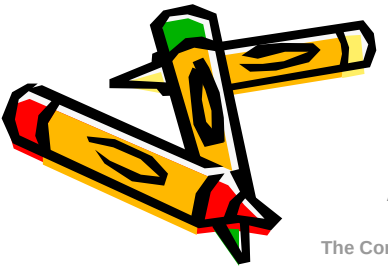


Types of Research

Applied Vs. Basic Research

•Basic Research is research that has no immediate application whereas applied research is research that does.

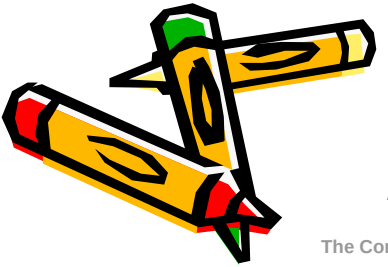
•However, such distinctions are somewhat ambiguous as almost all basic research eventually results in some worthwhile application in the long term.



Types of Research

Historical Research

- The purpose of historical research is to arrive at conclusions concerning trends, causes or effects of past occurrences.
- This may help in explaining present events and anticipating future events.
- The data are not gathered by administering instruments to individuals ,but …



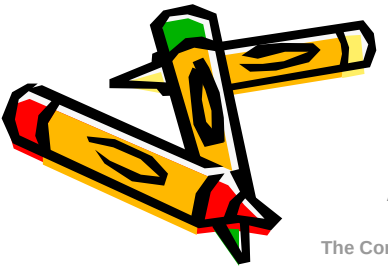
Types of Research

Historical Research

•Rather, they are collected from original documents or by interviewing the eye-witnesses (primary source of information).

•In case primary sources are not available, data are collected from those other than eye-witnesses (secondary sources).

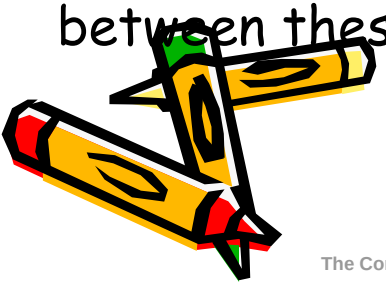
•The data thus collected are subjected to scientific analysis to assess its authenticity and accuracy.



Types of Research

Historical Research: Example

- Nancy Burton and Lyle Jones (1982) examined trends in achievement levels of African American versus White children.
- They examined high school graduation rates between these 2 ethnic groups who were born before 1913, between 1913 and 1922, between 1923 and 1932, etc.
- They also examined a variety of historical indicators in more recent groups of African American and White children.
- One of their conclusions is that differences in achievements between these groups are decreasing.



Types of Research

Descriptive Research

- Descriptive research studies deal with collecting data and testing hypotheses or answering questions concerning the current status of the subject of study.
- It deals with the question "WHAT IS" of a situation.
- It concerns with determining the current practices, status or features of situations.
- Another aspect of descriptive research is that data collection is either done through asking questions from individuals in the situation (through questionnaires or interviews) or by observation.

Types of Research

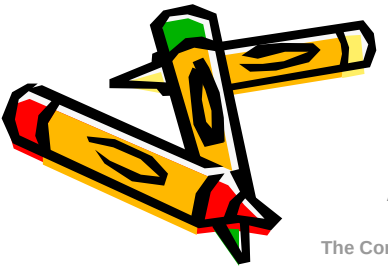
Descriptive Research: Example

- Peter O. Peretti and Kris G. Majecen (1992) interviewed 58 elderly individuals, from 68 to 87 years of age, using a structured interview to investigate the variables that affect emotional abuse among the elderly.
- As a result of the interviews, they found 9 variables are common to elderly abuse, including lack of affection, threats of violence and confinement.

Types of Research

Correlation Studies

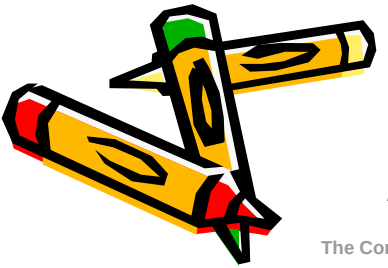
- Descriptive and historical research provide a picture of events that are currently happening or have occurred in the past.
- Researchers often want to go beyond mere description and begin discussing the relationship that certain events might have to one another.
- The most likely type of research to answer the relationship among variables or events is called correlational research.



Types of Research

Correlation Studies

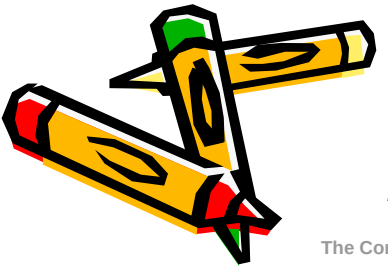
- A correlation study aims at determining the degree of relationship between two or more quantifiable variables.
- Secondly, the relationship thus determined could be used for making predictions.
- A high value of relationship, however, does not signify a cause and effect relationship which must be verified through and experimental study.



Types of Research

Correlation Studies

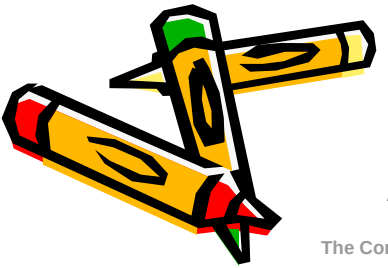
- Correlational research are studies that are often conducted to test the reliability and predictive validity of instruments used for division making concerning selection of individuals for the likely success in a course of study or a specific job.
- Some authors consider this research as a type of descriptive research, since it describes the current conditions in a situation.
- However, the difference lies in the nature of condition studies.
- A correlational study describes in quantitative terms the degree to which the variables are related.



Types of Research

Correlation Studies: Example

- For example, imagine that the health psychologist surveys two groups of 50 people: hospital patients being treated for chronic diseases and healthy community members.
- In other words, one of her variables is categorical with the two values *hospital patient* and *community member*.
- Then she compares the two groups in terms of the mean number of friends by making a bar graph and concluding that there is a moderate tendency for healthy community members to have more friends than hospital patients.



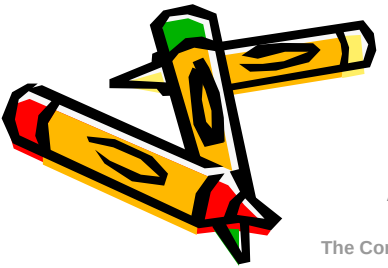
Types of Research

EX-POST FACTO STUDIES

- There is some research where both the effect and the alleged cause have already occurred and are studied by the researcher in retrospect.
- Such research is referred to as EX-POST FACTO (after the fact).
- Kerlinger (1973) defines Ex-post Facto research as :

"Systematic empirical inquiry in which the scientist does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable".

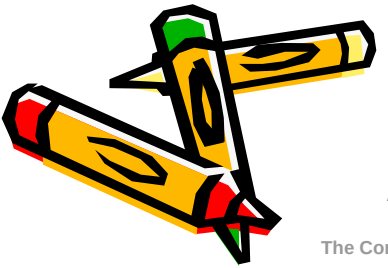
- Thus, in ex-post facto research or causal-comparative research, the researcher has no control on the variables or he cannot manipulate the variables (independent variables) which cause a certain effect (dependent variables) being measured.



Types of Research

EX-POST FACTO STUDIES

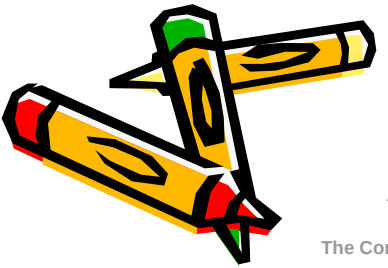
- Since this type of a study lacks manipulation of variables, the cause-effect relationship measured are only tentative.
- Some authors categorize Ex-post facto studies into the category of descriptive research.
- Though it too describes conditions that exist in a situation, it attempts to determine reasons or causes for the current status of the phenomena under study.
- The procedures involved in this study are quite different than those in descriptive research.



Types of Research

Experimental Research

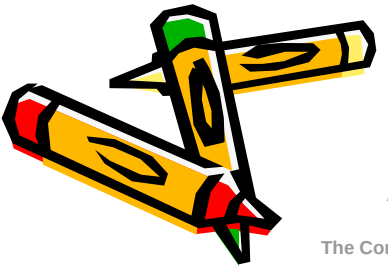
- We already know that correlational research can help establish the presence of a relationship among variables but not give us any reason to believe that variables are causally related to one another.
- How does one find out if the characteristics or behaviors or events are related in such a way that the relationship is a causal one?
- Two types of research can answer this: (1) quasi-experimental research and (2) experimental research.



Types of Research

Experimental Research

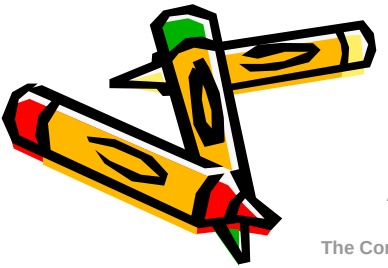
- Experimental research is where participants are assigned to groups based on some selected criterion often called treatment variable.
- Quasi-experimental research is where participants are pre-assigned to groups based on some characteristic or quality such as differences in sex, race, age, neighborhood, etc.
- These group assignments have already taken place before the experiment begins, and the researcher has no control as to what the people will belong to each group.



Types of Research

Experimental Research

- The primary characteristic of experimental research is manipulation of at least one variables and control over the other relevant variables so as to measure its effect on one or more dependent variables.
- The variable(s) which is manipulated is also called an independent variables, a treatment, an experimental variables or the cause.
- Some of the examples of an independent variables could be: temperature, pressure, chemical concentration, type of material and conductivity.



Types of Research

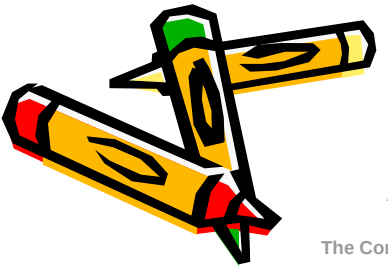
Experimental Research: Example

- Experimental research will always have two or more groups for comparison on the dependent variables.
- It is the only type of research which can establish truly the cause and effect relations.
- Consider an Example
  - A researcher in technician education is interested in studying the effects of two methods of instruction-structured lecture method and programmed instruction on the achievement of students in a course of one semester in Applied Mechanics.
  - Sixty students in the class are divided randomly into two groups of thirty each.

Types of Research

Experimental Research: Example

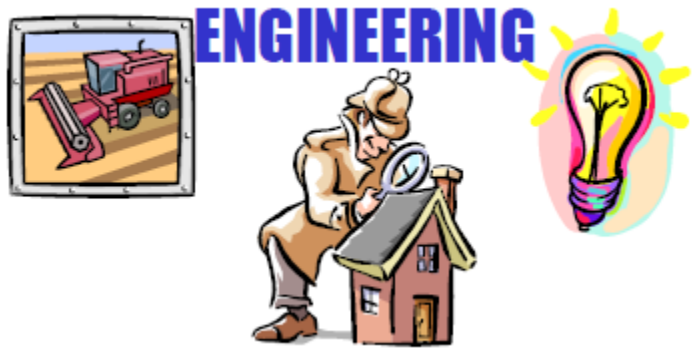
- Consider an Example
  - The groups receive the specified treatment for an equal amount of time during the semester.
  - The participants are measured for their performance on the achievement test before and after the program so as to measure the gain.
  - In this experiment, the experimental or independent variables is the method of instruction and the dependent variable, is the achievement of students.
  - The difference in the gain on achievement between the two groups will show the effect of the methods of instruction.



Types of Research

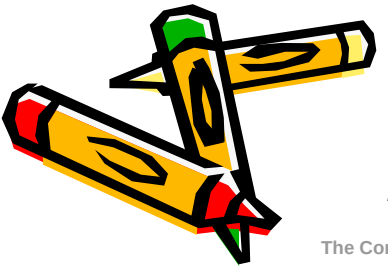
Various fields of technologies/disciplines at the university level

- Engineering
- Business/Economics
- Law
- Medicine
- Biology
- Psychology/Behavioral Science
- Mathematics
- Pure Science (Chemistry, Physics, etc.)



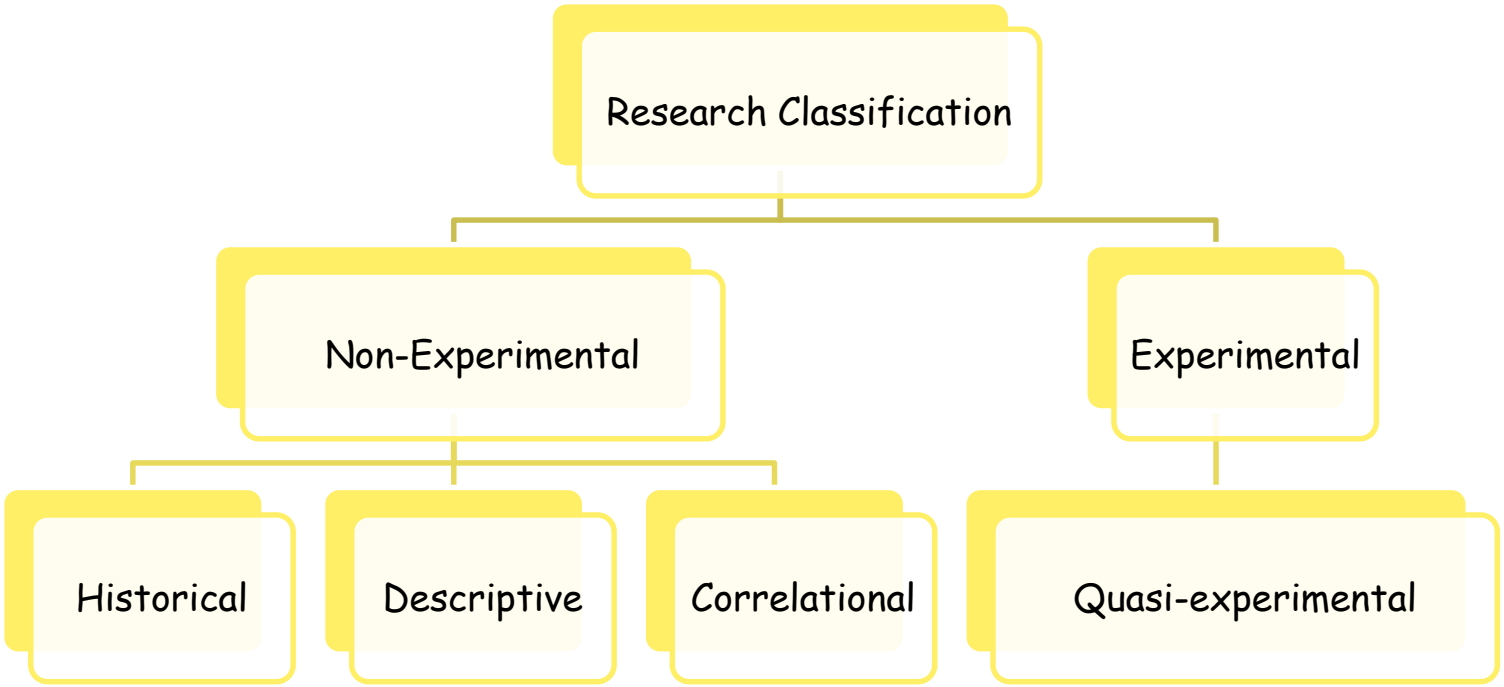
Our Focus: Engineering

(Electrical and Electronics)



Is there a difference in conducting research or in the research activities among the various fields of technologies/disciplines?

Types of Research



Which types of research does "Engineering" fall into?

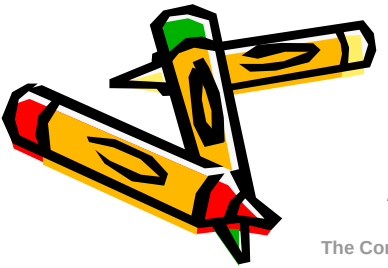
Types of Research

Lets have a look at some research topics in "Engineering"

"Learning and tuning of fuzzy logic controllers through reinforcements", Berenji, H. R. and Khedkar, P. S., *IEEE Trans. on Neural Networks*, Vol. 3, No. 5, pp. 724-740, 1992.

"A neural network controller for a temperature control system", M. Khalid and S. Omatu, ***IEEE* Control Systems Magazine**, Vol. 12, No.3, pp. 58-64, June, 1992.

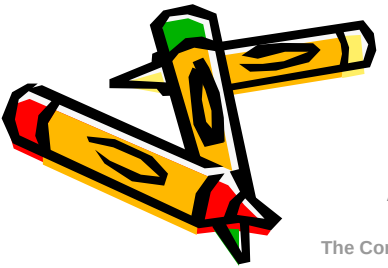
"Effects of Different Genetic Operators on Minimum Time Motion Planning Of an Industrial Manipulator", Ang Mei Choo and Dr.A.M.S. Zalzala, Elektrika, Vol. 4 No. 1, 2001.



Types of Research

Activities in Engineering Research

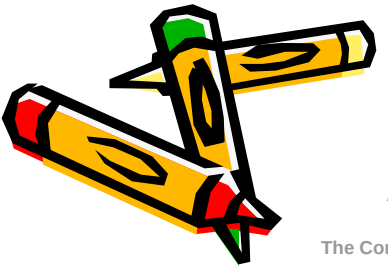
- Involve in the development of new algorithms/techniques/methodologies.
- Involve in the confirmation of newly proposed algorithms (applications to benchmark problems or laboratory equipment).
- Involve in the application of some proposed algorithms in novel applications.
- Involve in the design of new products/circuits.
- Involve in comparing a number of different methodologies.



Types of Research

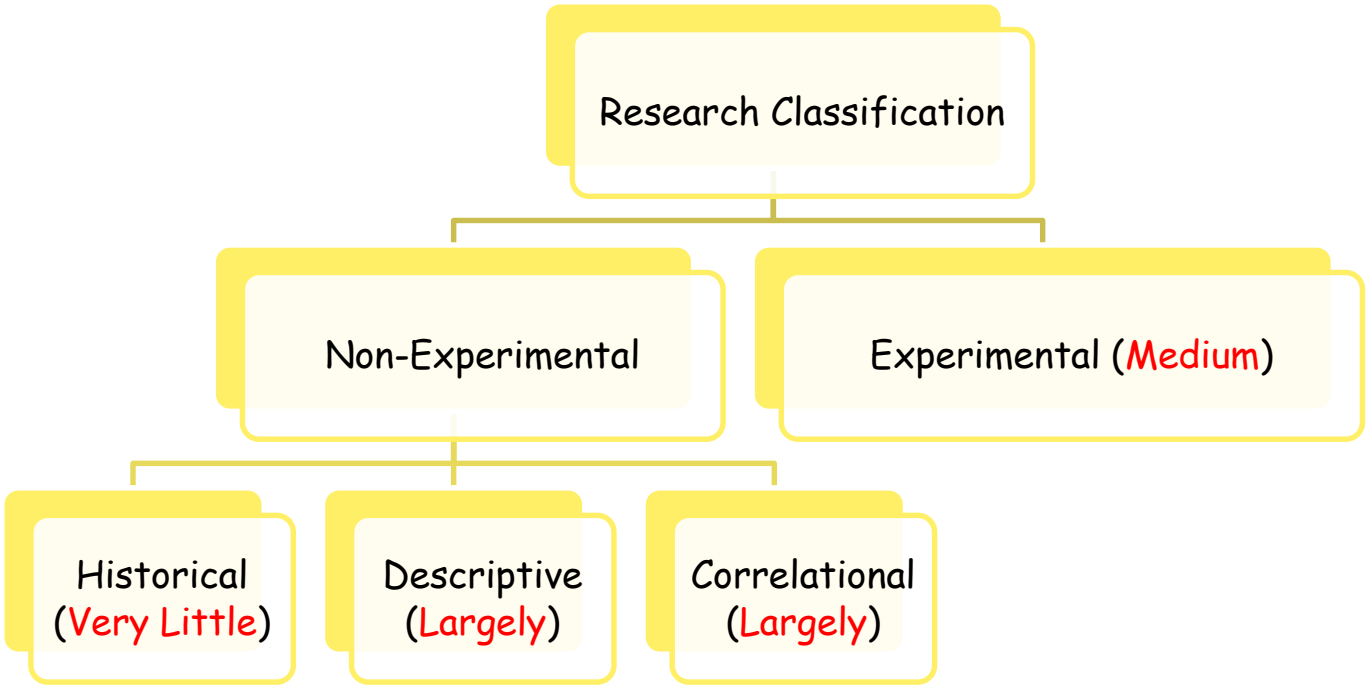
Activities in Engineering Research

- Stability analysis on newly proposed algorithms.
- Involve in the study of certain aspects of dynamics (behavior) of plants/systems.
- Involve in market study of certain engineering products.
- Involve in the study on the effects of environmental factors on a particular product/design.
- Involve in improving the design of existing products.



Types of Research

Thus research in "Engineering" would largely fall into the following categories:



Types of Research

Differences between Research Activities in the Engineering Discipline and Others?

- Engineering research are more formulative in nature.
- A lot is based on mathematics.
- Experiments are conducted on machines, rather than humans or animals.
- Data to be collected differ significantly.
- Hypotheses arrived at are largely based on mathematical proofs, rather than just an educated guess.

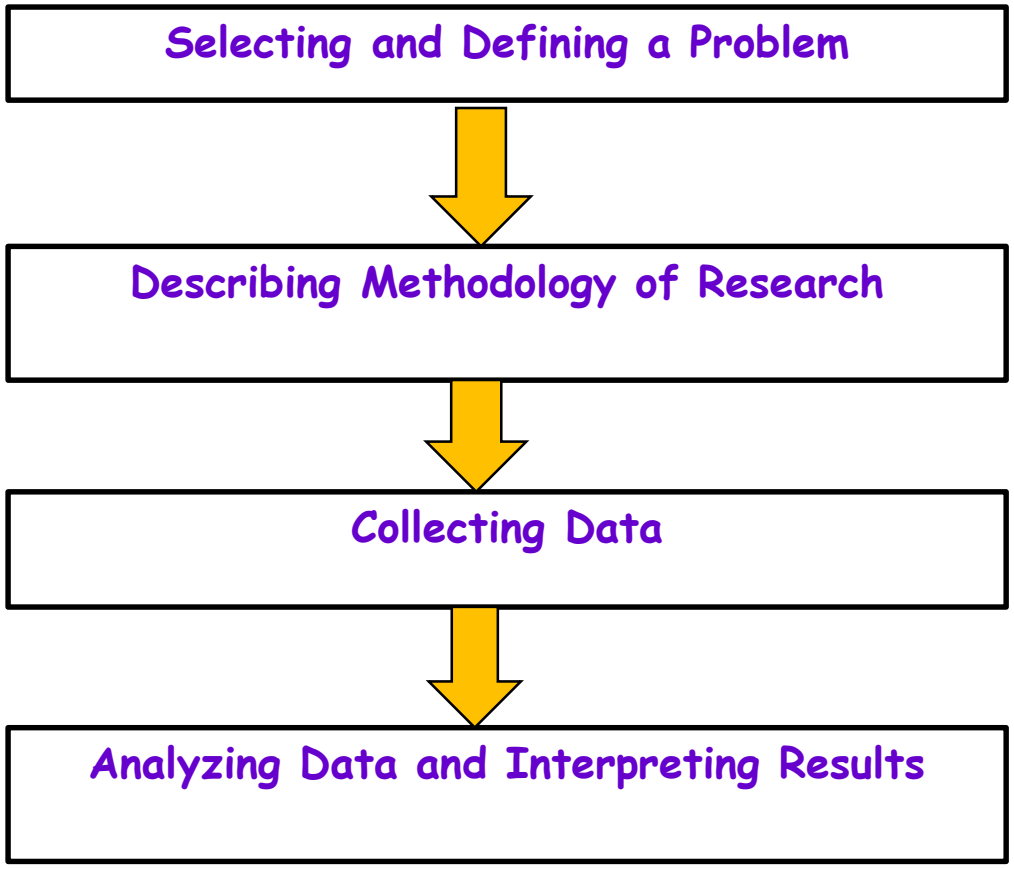
Types of Research

Differences between Research Activities in the Engineering Discipline and Others?

- Experiments can be done within a shorter period of time.
- Outputs in engineering research are more tangible such as a software, a new machine or component, or even mathematical equations, etc.
- Engineering research do not differ much in different regions of the world.

Steps in Conducting Research

Irrespective of the category of a research study, the steps followed in conducting it are the same.

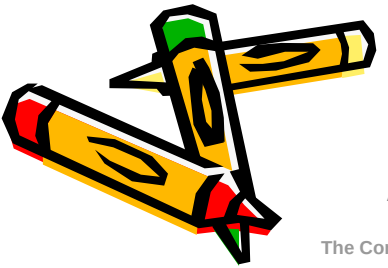


Steps in Conducting Research

1. Selecting and Defining a Problem

This marks the beginning of a research study and is the most difficult and important step. This involves :

- identifying and stating the problem in specific terms;
- identifying the variables and defining them adequately;
- generating tentative guesses (hypotheses) about the relation of the variables or in other words the solution of the problem, or writing explicitly the questions (research questions) for which answers are sought; and
- evaluating the problem for its research ability.



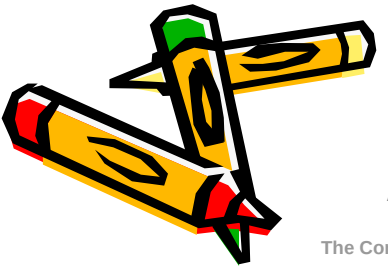
- All this is not done in a vacuum.
- To achieve this, you review the literature related to the problem to know what other researchers have done and discovered and to identify the possible methodology for conducting the research

Steps in Conducting Research

2. Describing Methodology of Research

You need to state the purpose of the study and to define the problem clearly. This guides you in deciding the methodology of research which involves :

- identifying the method of research;
- specifying the subjects of study (e.g. heat flow problem, etc.);
- selecting an adequate representative sample of subjects;
- selecting/constructing valid and reliable instruments for measuring the variables in the problem;
- selecting a research design and describing the procedure to be employed for conducting the research study.

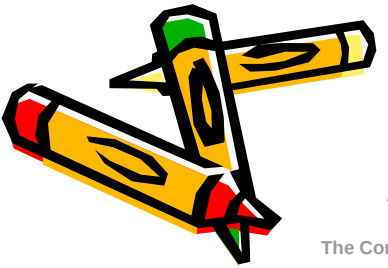


Steps in Conducting Research

3. Collecting Data

•This step involves conducting the study as per the designed procedure (manipulating the experimental variables in the case of an experimental method), administering instruments for measuring variables and/or gathering information through observation.

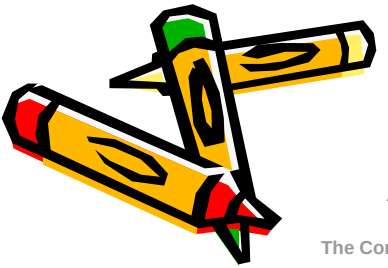
•It also involves tabulating the data thus collected for the purpose of analysis



Steps in Conducting Research

4. Analyzing and Interpreting Results

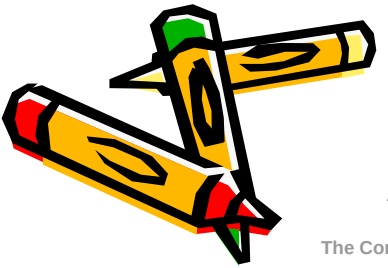
- The results of the study are generated at this stage.
- The data are summarized, in other words analyzed to provide information for testing the hypotheses.
- Appropriate statistical methods of analysis are used to test the hypotheses.
- You can perform the analysis manually, by using a hand calculator or a computer as per the demands of the problem, and the available facilities.
- After completing the analysis results are tied together or summarized.



Steps in Conducting Research

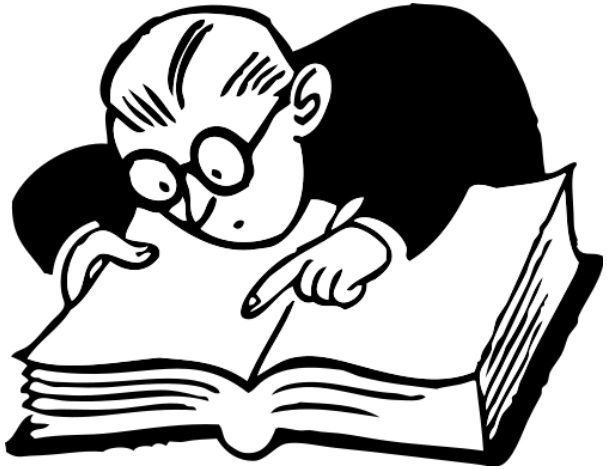
4. Analyzing and Interpreting Results

- The results interpreted in the light of the hypotheses and/or the research problem
- These are then discussed in relation to : the existing body of knowledge, consistencies and inconsistencies with the results of other research studies, and then the conclusions are drawn.
- This is followed by writing the research report.



Where to do Research?

Magazines

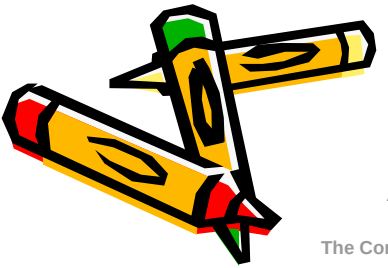


Books, Theses and Dissertations

The Internet

Where to do Research?

For a university student, it is very important to do research carefully, since unfortunately, it will not always be very easy with too much information and too many ways to find it.



Where to do Research?

Main ways of finding information:

Research in the library

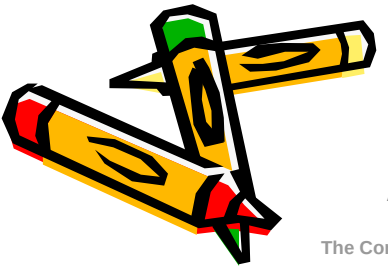
Research on the Internet

Field Research

Where to do Research?

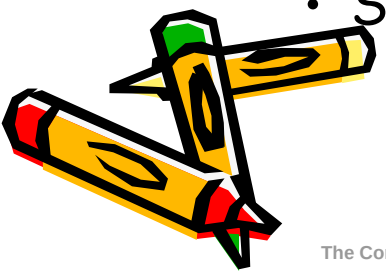
Research in the Library

- What is the benefit of learning how to use the library?
  - You will be able to use your time on productive study and research rather than aimless wandering about in the hope of finding random bits of information.



Where to do Research?

- Libraries have three kinds of holdings
  - A general collection of books
    - Most of the books that are available for general circulation.
  - A collection of reference works
    - Encyclopedias, dictionaries, indexes, directories, handbooks, yearbooks, atlases, and guides.
  - A collection of periodicals, bulletins, and pamphlets.
    - Scholarly journals and magazines are pediodicals.



Where to do Research?

- Research on the Internet

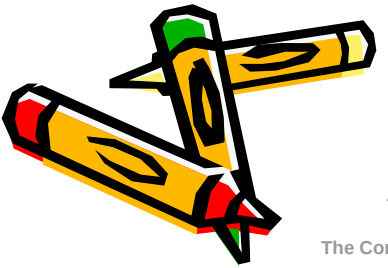
Some information is high quality, highly reliable and relevant to the research problem. Yet, some information is low quality, is irrelevant and may even be described as junk.

Where to do Research?

- Research on the Internet

Misconception

It is a source of free information about everything

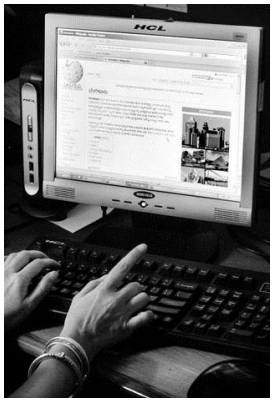


Where to do Research?

Before you begin researching on the Internet.....

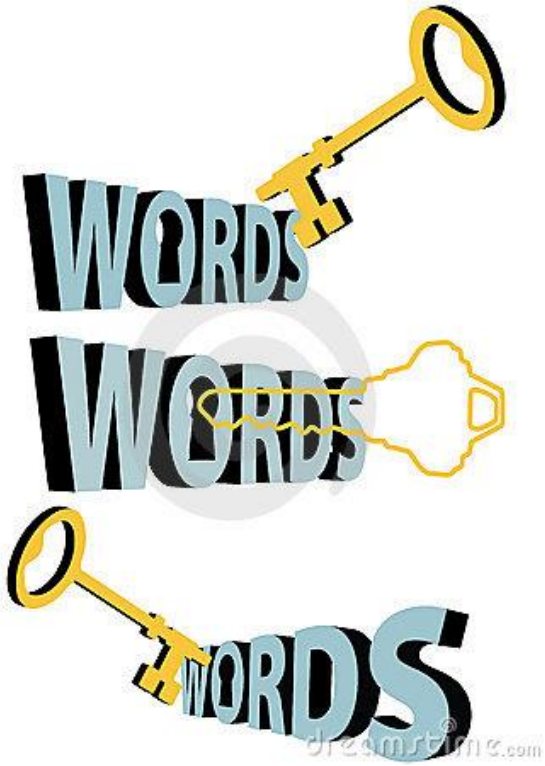
•Think about the topic you are researching. Is it likely to find reliable information for free?

•Decide whether a printed or an electronic source would be quicker or more appropriate.



Where to do Research?

Find different keywords that would best describe your subject. Try to be as precise as possible.



Where to do Research?

Library vs. The Internet

	Library	The Internet
Advantage	Uses universal cataloging systems that classify and organize all sources.	Online sources can be accessed 24 hours a day, 7 days a week
Disadvantage	Sources can be checked out by other people and, therefore, may not always be available.	Has no system that catalogs and organizes all sources.

Where to do Research?

Evaluation of Sources on the Internet

Reliability of the Information

1. Who wrote/published the information on the site?
2. What information and resources does the site provide?
3. When was the site created/last updated?
4. Where does the site "live"?
5. Why should I use the site?

Where to do Research?

On the whole, the webpage is of value to your research, if....

Accuracy: Your page lists authors and institution that published the page and provides a way of contacting him/her.

Authority: Your page lists author's credentials and its domain (.edu, .gov, .mil etc.)

Objectivity: Your page provides accurate information with limited advertising and it is objective in presenting the information.

Up-to-date: Your page is current and updated regularly and the links are also up-to-date.

Coverage: You can view information properly –not limited to fees, browser technology, or software requirement.

Where to do Research?

Field Research

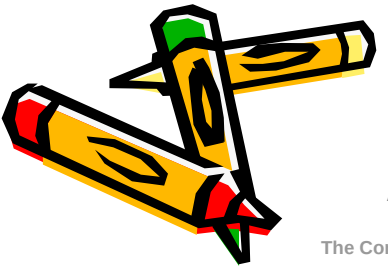
- To collect first hand data
  - Interviews
  - Questionnaires
  - Observations

Where to do Research?

While conducting a research...

•writers rely on articles from scholarly journals rather than popular magazines.

•There are differences between them.



Where to do Research?

- Appearance
  - Is sober and serious
  - May contain graphs and charts
  - Does not have glossy pages or photographs.
- Authors/Audience
  - Scholars and Students
- Documentation
  - Sources cited in footnotes and/or bibliography
- Purpose
  - Reports the results of original research or experimentation
- Article Acceptance Procedure
  - Many scholarly journals are "refereed journals" – they undergo a process called "peer-review" where other scholars in the field examine the articles before they are published

- Appearance
  - Has an attractive appearance
  - Has advertisements
  - Is heavily illustrated
  - Has glossy paper
- Authors/Audience
  - General Audience
- Documentation
  - Sources not cited or cited informally
- purpose
  - Provides general information
- Article Acceptance Procedure
  - Written by hired reporters, edited by magazine editors, and published.

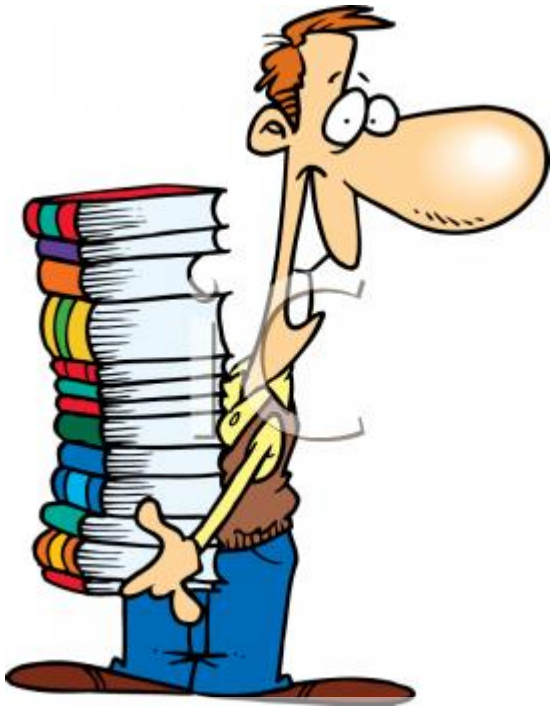
What is a RESEARCH PAPER?

- A research paper is a presentation of the results of your investigation on a selected topic.

- Based on your own thoughts and the facts and ideas you have gathered from a variety of sources, a research paper is a creation that is *uniquely yours*.

What is a RESEARCH PAPER?

- The experience of gathering, interpreting, and documenting information, developing and organizing ideas and conclusions, and communicating them clearly will prove to be an important and satisfying part of your education.



Research at the University

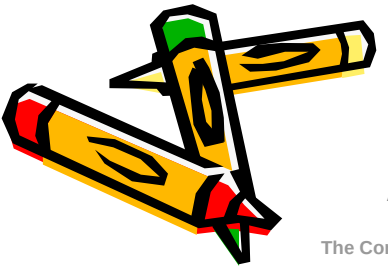
- Undergraduate Research
- Postgraduate Research (MSc, MEng, PhD – Time frame differs)

Postgraduate Research

- Time (longer)
- More algorithmic/mathematical
- Applications should be novel
- More detailed analysis

Undergraduate Research

- Time (shorter)
- Emphasis is not on developing of new algorithms
- Applications not necessarily novel
- Analysis need not necessarily be substantial



Research at the University

- PhD: More algorithmic, development of new techniques, extension of existing new techniques, and/or novel applications.
- Masters by Research: Mainly novel applications, applications of relatively new techniques or algorithms, comparisons of techniques.
- Masters by Instruction (Course): Case studies, mostly similar to Bachelor projects with more analysis.
- Bachelors: Application of existing techniques, case studies, software or circuit design to implement existing techniques.