



Kwame Nkrumah University of  
Science & Technology, Kumasi, Ghana

## **Workshop on Research Design and Implementation Course**



Kwame Nkrumah University of  
Science & Technology, Kumasi, Ghana

## **SESSION I: INTRODUCTORY LECTURE AND LEARNING OUTCOMES**

**Write your expectation for the course on the provided?**



*Complete this take in 2 minutes*

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## **Sample Expectations from Previous Years**

## Class Expectations – General

At the end of the course, students want to be able to:

- Well informed about the course and see its use in my career
- I don't want to gain knowledge; I want to gain skills as well
- Have a good understanding about the course and how to apply it
- Understand principles behind the course and ways to make it efficient and effective
- Apply or practice knowledge gained

## Class Expectations – General...

- Grasp the main concepts of the course and understand its relevance in my journey as a food scientist
- Find information that can be used to solve problems
- Gain knowledge and understanding about research design and implementation so as to apply it in my field of work
- Gain skills in research work concerning food science and how to implement them as a food scientist and develop new designs to meet ...
- Develop an interest for good research
- Use research effectively



## Class Expectations – Research

- Find the various means by which research is done worldwide
- Equip myself and place myself at a better position to effectively understand research
- Relate research work to the purpose and importance of the research
- Various methods used in research work and analysis
- Know how to do research



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## Class Expectations – Research ...

- Learn how to go about how to go about conducting researches and solving problems
- Learn how to go about research and implement it
- Broaden understanding and scope in research design and how to effectively implement it
- Understand fully the precepts of research design and implementation and be able to utilize the concept where needed
- I expect to know what it means when we say research, the full composition of research, the types of research and how to use research results to work



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## Class Expectations – Research ...

- Know how to implement ideas in the industry
- Know how to make a proper research and design for the market
- I want to learn how to research adequately and with the right tools.
- I want to learn how to research into new things
- Know the best ways to conduct research and present my findings

## Class Expectations – Design and Implement



- Do a standard research on any topic given at the end of this class
- Be able to undergo a study and plan well in solving a particular problem
- Get knowledge on how to get a research idea or topic
- Develop a quick method of identifying problems and solve them through research
- How to design a research work?
- How to plan in terms of resources and material

## Class Expectations – Design and Implement ...

- Do efficient and useful research
- Do an appropriate research
- Design, develop and implement a supervised research project
- How to conduct effective research on my own
- Be able to do research on my own without any help from someone



## Class Expectations – Design and Implement ...



- How to evaluate or get a sound result of the research
- Per my findings, be able to implement my findings well to make society a better place
- Learn how to make relevant and tentative researches, scrutinize the information obtained and to use the information acquired to solve problems
- Obtain more researching skills and be able to design a solution to my research findings and implement it into real life situations with the aim of solving them

## Class Expectations ...



### Data Analysis

- Critically analyse and present research data in a meaningful way

### Communicate

- Communicate in the scientific world
- How to present research information?
- Present research information in a publishable way
- How the information from the research is used to implement change in my field of study?

## Class Expectations ...

### Product Development

- Have the idea on how to improve the market value of products
- Know how to develop products
- Be creative in product development
- Equipped with skills and ideas to innovate products in different forms

## Class Expectations ...

### Product Development ...

- Gain enough knowledge on how to design a product through research and learn how to improve or implement it when the need be
- Learn the principles in the research design of a food product or something and ways by means it can be implemented efficiently and effectively
- Know how to gather accurate information needed to help formulate new products that will fit consumer preference and help the food market as a whole

## Class Expectations ...

### Others

- I want this course to make me a better food scientist
- Broaden my scope of knowledge in food science
- Gain skills on how to research and bring about new concepts in the field
- Help move the food industry to another direction
- Come out as a whole outright student and personality that can fit the market
- How the course will make an impact in my life?
- Good grade

Begin with the end in mind

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## Course Learning Outcomes

*Learning Objectives*



At the end of this course, students would be able to:

- ✓ Understand the concept and characteristics of research, explain the rationale for conducting research
- ✓ Distinguish the types and approaches to research associated with solving a contemporary food science and technology problem

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## Course Learning Outcomes



Learning Objectives

- ✓ Demonstrate the steps in conducting scientific research
  - ✓ Identify a research problem
  - ✓ Critically examine the problem
  - ✓ Generate research objectives
  - ✓ Design research in alignment with the objectives
  - ✓ Conduct research study either by survey or experiment
  - ✓ Collect, manage, analyze and interpret data

## Course Learning Outcomes



Learning Objectives

- ✓ Communicate scientific research effectively in a professional environment through different forms
- ✓ Critique scientific publications
- ✓ Discuss ethical issues encountered in conducting research and understand the art of patenting an invention

## Course Learning Outcomes



- ✓ Restate the concept and importance of proposal writing and develop a research proposal
- ✓ Know the importance of referencing, the different referencing styles and how to use at least one referencing style and software
  - ✓ format used in KNUST (College of Science)

## Norms for this class (Open Discussion)

Please think of the best training you have attended

- What made it successful?
- What guidelines or norms will help us this semester?
- Select a time keeper for the course

## Requirements for the Course

- **Attendance**



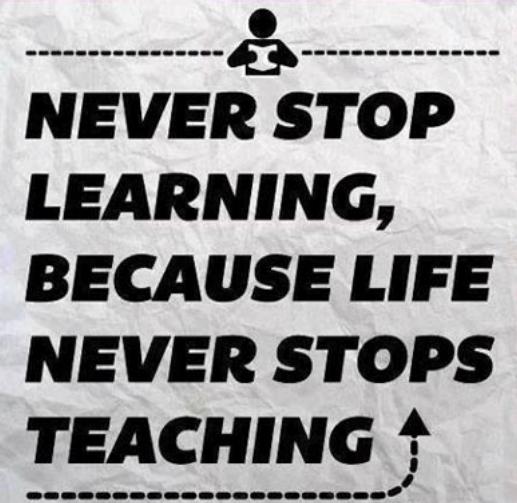
- will be taken at each lesson
- Absenteeism is **NOT** an acceptable excuse for incomplete assignments

Interactive and interesting class  
NO ONE is permitted to be 'laid-back'

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- **Assessments**

- Group/ Individual Assignments & Presentations
- Unannounced quizzes
- One project/term paper
- Journal Club

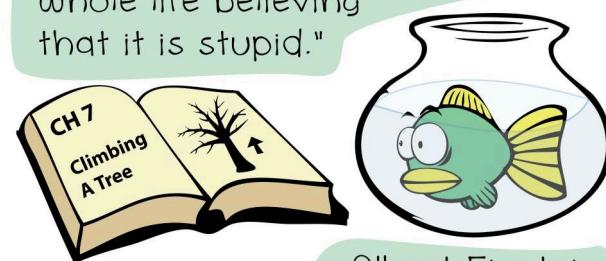


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## Education and Schooling

- What are some of the similarities between education and schooling?
- What are some of the differences between education and schooling?
- What are some of the moral lessons from the Animal School?
- Why do you think education is more important than schooling?

"Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid."

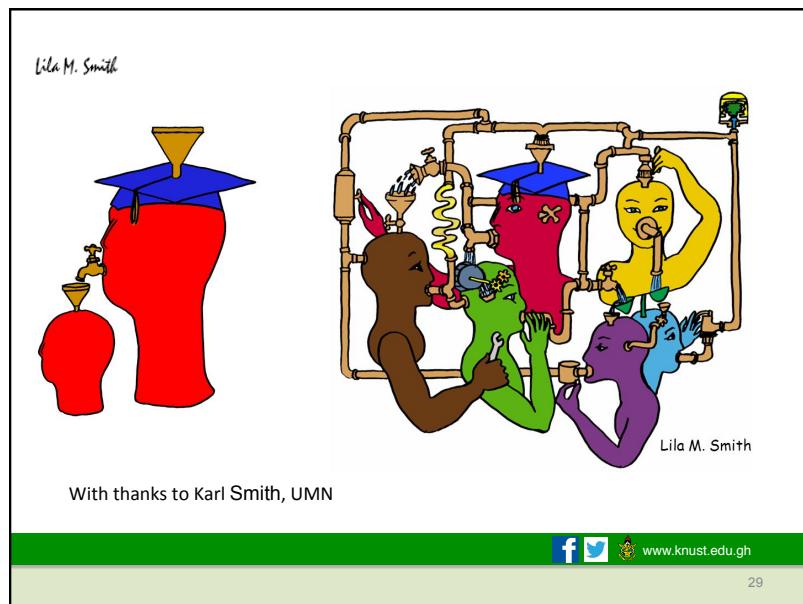


- Albert Einstein



## Teaching and Learning Philosophy

*“When you **hear** you **forget**,  
when you **see** you **remember**,  
when you **discover** you **own it for life”***  
Anonymous

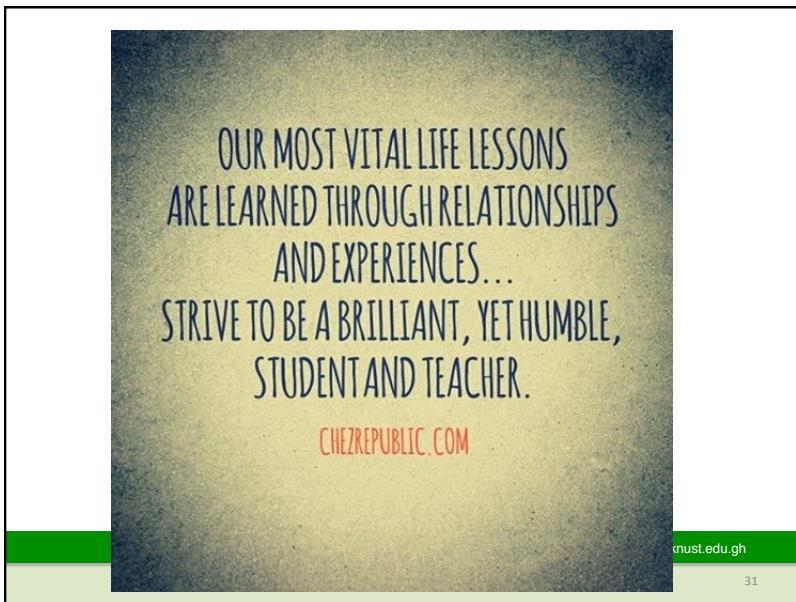


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“We are all students and teachers. ...  
What did I come here to learn, and  
what did I come to teach?”

Anonymous

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## Group Activity

1. What is Research?
2. What is Design?
3. What is Implementation?
4. What is Research Design and Implementation?

PROCESS

- Identify facilitator / someone to take notes
- Agree who will report out
- Take 10 minutes to discuss
- Be prepared to make a 2 minute report

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## Activity

- Identify members in the group who had internship during the long vacation
- Share with your group members
  - Where you had your internship
  - Did you observe any avenues for research during this period
  - How differently would you have seen things if you had knowledge on Research Design and Implementation



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## SESSION II: CONCEPT AND CHARACTERISTICS OF RESEARCH



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### Intended Learning Outcomes

By the end of this session, students will be able to:

- Understand the concept of research
- Understand the rationale for conducting research
- Explain the characteristics research

## Defining research

- ... is a search for knowledge in any branch of knowledge

“Research is [creating new knowledge.](#)”

... Neil Armstrong

- ... is a process of investigation or inquiry



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## The Concept of Research

- It's not just a trip to the library
  - to pick up a stack of materials, or
  - picking the first five hits from a computer search
- It is a journey from the known to unknown

**Research is a hunt for the truth !**



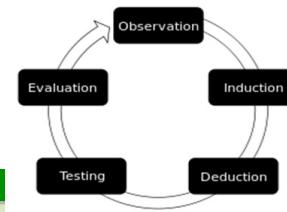
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*“Good, sound research projects begin with straightforward, uncomplicated thoughts that are easy to read and understand.”*

John W. Creswell

## Definition of Research

systematic and objective analysis and recording of controlled observations that may lead to the development of generalizations, principles, or theories, resulting in prediction and possibly ultimate control of event

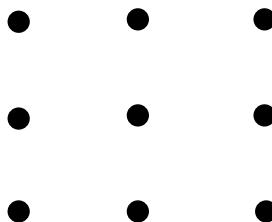


## A Thinking Outside of the Box Activity

### The Nine Dots Challenge

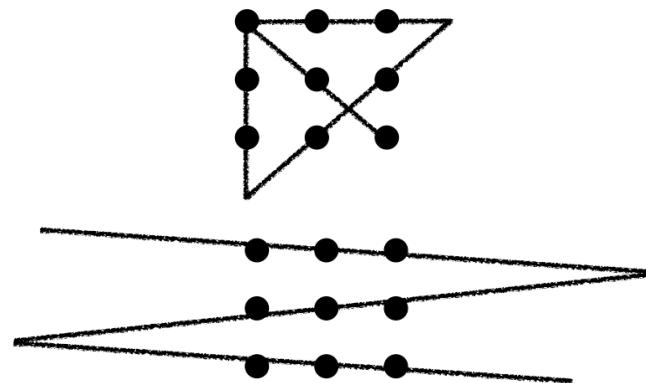
#### Instruction

Link all 9 dots using four straight lines or fewer, without lifting the pen and without tracing the same line more than once



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### A Thinking Outside of the Box Activity



### Group Activity

1. Why is research important?
2. What are the characteristics of research?

#### PROCESS

- Identify facilitator / someone to take notes
- Agree who will report out
- Take 10 minutes to discuss
- Be prepared to make a 2 minute report

## Why is research important?

"We have to arm ourselves with data, research, design patterns, and a clear understanding of our users and our content so our decisions are not made out of fear but out of real, actionable information. Although our clients may not have articulated reasons for why they want what they want, it is our responsibility to have an ironclad rationale to support our design decisions."

- Debra Levin Gelman

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## Why is research important?

- Students
  - Enhances knowledge
  - Clarifies confusion
  - Have proper understanding of a subject
  - Learn about methods and issues
  - Understand published work
  - Understand the rationale and origin of study
  - Know area of interest
  - Create a balance between the collaborative and individual work

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## Why is research important?

- Mankind
  - Helps understand society and culture
  - Know the truth (a way to prove lies and to support truths)
  - Increased awareness
  - An aid to business success
  - Means to find, gauge and seize opportunities
  - Up to date technology
  - Make right choices for a career

## Why is research important?

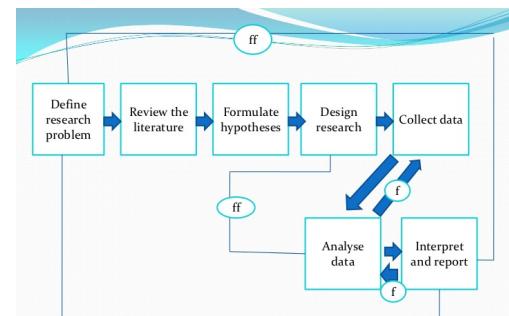
- Education
  - Leads to great observations
  - Results in predictions, theories and many principles
  - Improving practices
  - Develops new understanding related to learning, teaching etc.
  - Helps in initiating action and decision making
  - Brings consistency and motivates others
  - A seed to love reading, writing, analyzing and sharing valuable information
  - Nourishment and exercise for the mind

## Characteristics of Research

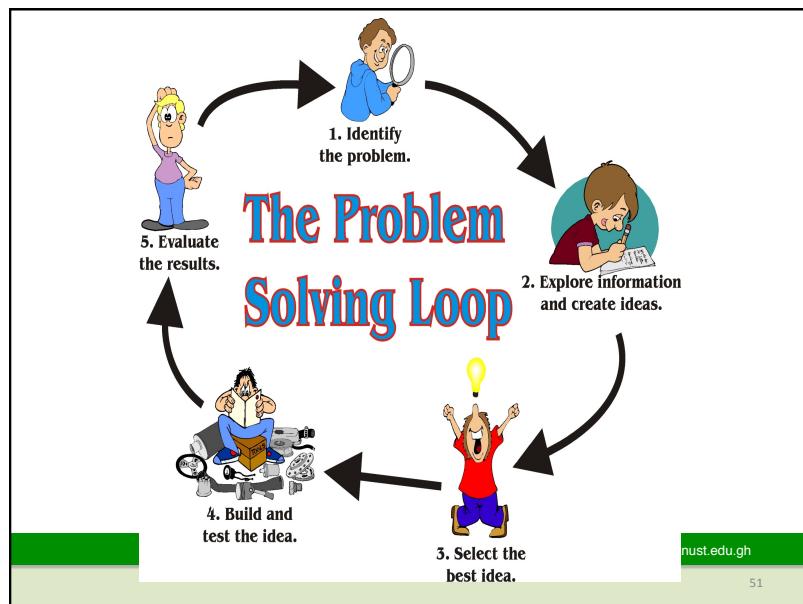
- originates with an **observation, question or problem**
- usually divides the principal problem into more **manageable sub problems**
- requires a clear articulation of the objective
- is guided by the specific research problem, question, or hypothesis
- requires a specific plan of procedure
- requires the collection and interpretation of data in attempting to **resolve the problem** that initiated the research

## Characteristics of Research ...

- Research is, by its nature, **cyclical**; or **more exactly, helical**



Where  
f = feed back(helps in controlling the sub system)  
ff= feed forward(serves the vital function of providing criteria for evaluation)



## Research in Science

- It is an original contribution to the existing stock of knowledge making for its advancement
- It is the pursuit of truth with the help of
  - Study
  - Observation
  - Comparison
  - Experiment

## Scientific Research

- It is the systematic method consisting of
  - enunciating the problem
  - formulating a hypothesis
  - collecting the facts or data
  - analyzing and interpreting of facts
  - reaching certain conclusions

## Conducting research as a Student

- is one of the most interesting and often required feature of any degree course
  - Offers you a measure of control and autonomy over what you learn
  - Gives you an opportunity to confirm, clarify, pursue or discover new aspects of a subject or topic
  - Trains you as a **junior scientist**

## Characteristics of a Researcher

A good scientist is one who is

- Curious about his world
- Thinks outside the box
- Open-minded and unbiased
- Skilled
- Observant
- Prudent
- Honest

Thus; a research scientist

- Develops the ability to **critically analyze problems**
- **Finds solutions** and **raise other questions**

## The objectives of Research

- The purpose of research is to discover answers to questions through the application of scientific procedures
- Each research study has its own specific purpose



## The objectives of Research

- There are **4 general** objectives for a research
  - To explore a phenomenon or gain new insight into it (explorative / formulative research)
  - To accurately portray the characteristics of a particular situation or a group (descriptive research)
  - To determine the frequency with which something occurs (diagnostic research)
  - To test a hypothesis and/or establish a relationship

## General objectives of research

1. To explore a phenomenon or gain new insight into it (explorative / formulative research)
  - Review or synthesize existing knowledge
  - Explain new phenomenon
  - Generate new knowledge
  - Construct or create new procedures or systems

## General objectives of research...

2. To accurately portray the characteristics of a particular individual, situation or a group (descriptive research)
  - Investigate existing situations or problems
3. To determine the frequency with which something occurs (diagnostic research)
  - Explore and analyze more general issues
4. To test a hypothesis and/or establish a relationship

## General objectives of research...



A research objective could be a combination of any of the above!

Ultimately, a research objective must provide solutions to problems

## Opportunities from Research

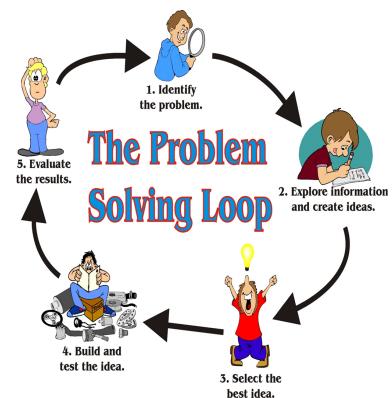
The outcome of innovative research is an **intellectual property**

- Because your product, process or technology can be
  - Patented
  - Commercialised

**Business incubation exist to nurture your ideas**

## Facts about Research

- Is an academic activity
- A scientific approach guided by
  - a research problem, question or hypothesis
- Originates with a question
- It involves a specific plan and procedure



## In summary

### Research encompasses the following

- ✓ Defining and redefining problems
- ✓ Formulating hypothesis or suggested solution
- ✓ Collecting, organizing, evaluating and interpreting data
- ✓ Making deductions and Reaching conclusions
- ✓ Lastly, carefully testing the conclusions

## Wrap-up

- Empirical
  - (Direct observation and experience)
- Clear and concise
- Logical
  - (Valid procedures and principles in line with objectives)
- Analytical/Standardized
- Collection and Interpretation of data
- Systematic/Methodical
- Dynamic and Flexible
- Replicable (Validity)
- Helical



**Remember: Research must be relevant**

*"There are in fact two things,  
science and opinion;  
the former produces knowledge,  
the latter ignorance."*

- Hippocrates



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## Quiz on Session 2

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**Test on Concept and Characteristics of Research**

1. Which statement is true
  - A. A testable hypotheses is turned into a research question
  - B. A research question is transformed into a testable hypotheses
2. Which of these best describes the process of research
  - A. It is corkscrew
  - B. It is cyclical
  - C. It iterates
  - D. It is ellipsoid
3. Your research findings could be negative or positive depending on \_\_\_\_\_
  - A. The objective
  - B. The question
  - C. The norm
  - D. The method

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**Test on Concept and Characteristics of Research**

4. A researcher should have the following characteristics except
  - A. Liberal
  - B. Brilliant
  - C. Sceptical
  - D. Creative
5. All research must be beneficial to society
  - A. True
  - B. False
6. The validity and reliability of the data should be checked occasionally
  - A. True
  - B. False

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**Test on Concept and Characteristics of Research**

7. Which of the following is not an assumption of scientific research?
- A. There are reoccurring patterns in the world
  - B. Events happen because of preceding cause
  - C. We can discover solutions to problem of interest
  - D. Theoretical explanation must agree with common sense
8. Research must always conform to the norm
- A. True
  - B. False
9. Scientific discoveries can be patented
- A. True
  - B. False

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**Test on Concept and Characteristics of Research**

10. The purpose of \_\_\_\_\_ research is to help in the process of developing a clear and precise statement of the problem rather than providing a definite answer.
- A. Diagnostic
  - B. Extrapolative
  - C. Formative
  - D. Descriptive
11. It is important that others know what you assume with respect to your project
- A. True
  - B. False
12. Research is carried out to create wealth
- A. True
  - B. False

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### Test on Concept and Characteristics of Research

13. Research is important to students mainly to
- A. Know area of interest
  - B. Bring consistency and motivate others
  - C. Increase awareness
  - D. Know the truth
14. Without a valid assumption research cannot proceed
- A. True
  - B. False
15. The term research should be used in a technical sense
- A. True
  - B. False

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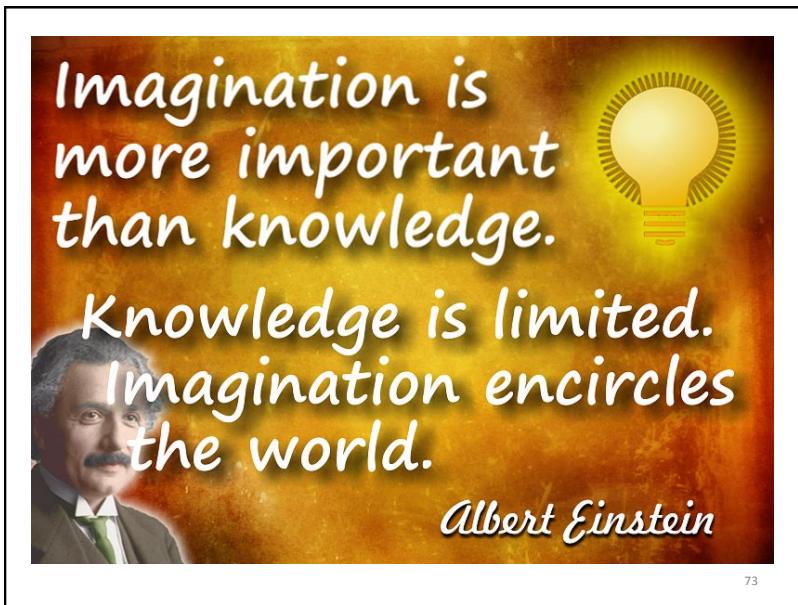
### Session 2: Concept and Characteristics of Research

## RECAP

Kudos to the class on the quality of slides and presentation skills on Tuesday!!



- What have you learnt in this session?
- Any pending issues/questions regarding this session?



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## Semester Project

As a consultancy firm, you have been hired by a top investor to market a named product for him. Using research, design and implementation, develop means and strategies for marketing the named product.

DURATION: **6 Weeks**



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## Market Research

- Involves gathering, analysing and interpreting information about a market, a product or service to be offered for sale in that market, the past, the present and potential customers for the product or service; characteristics, spending habits, location, needs of the target market and competitors

## Semester Project

### Major Areas

- Product
  - Composition (ingredients, nutrients), Features, Production, Packaging
- Consumer
  - Market niche identification, demographics, preferences
- Channels
  - Distribution, Packaging, Advertisement, Delivery
- Feasibility Studies
- Business Model

## Group Activity (Project Discussion)

In your discussion consider the following:

- Creating an identity for the Product
  - Composition, Features, Production, Packaging
- Consumer
  - Market niche identification, demographics, preferences
- Channels
  - Distribution, Packaging, Advertisement, Delivery
- Feasibility Studies
- Business Model



## Quote of the Day

Knowledge Is Like  
A Garden,

If it is Not Cultivated,  
It Cannot Be Harvested

Proverb

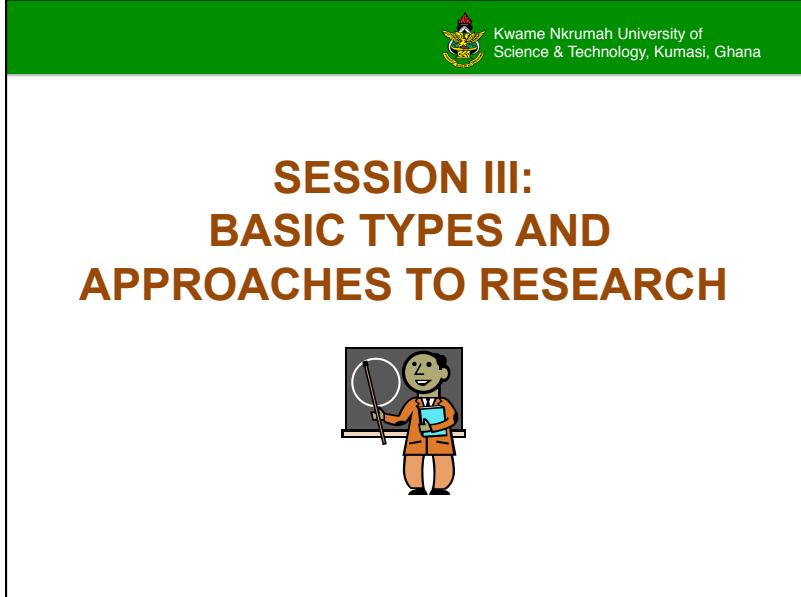


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**SESSION III:**  
**BASIC TYPES AND**  
**APPROACHES TO RESEARCH**



A small cartoon illustration of a teacher standing at a chalkboard, holding a pointer stick and a book.

## Quote

“Nothing in life is to be feared,  
It is only to be understood.  
Now is the time to understand  
more,  
So that we may fear less”

-Marie Curie(1867-1934)



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## Intended Learning Outcome

By the end of this session, students will be able to:

- ✓ Know the various types of research and understand their applications
- ✓ Distinguish between the various types of research
- ✓ Understand various approaches used in research worldwide
- ✓ Apply the types and approach of research to their research problem



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## Types of Research

Can be categorised based on;

- **Application/Immediate Purpose**

Basic vs. Applied Research

- **Objectives**

Exploratory, Descriptive, Analytical vs. Predictive

- **Methodology**

Qualitative vs. Quantitative Research

These overlap because **Research is both dynamic and flexible**

## Food for Thought

*"People cannot foresee the future well enough to predict what's going to develop from basic research. If we only did applied research, we would still be making better spears."*

-Dr. George Smoot

## Basic/Pure Research

- Driven by a scientist's *curiosity* or interest in a scientific question
- Conducted to **investigate issues** relevant in formulating or reformulating theories
- May not be concerned with their practical application (no obvious commercial value)
- Motivation is to expand man's knowledge, not to create or invent something

Example: What is the microstructure of cocoyam?

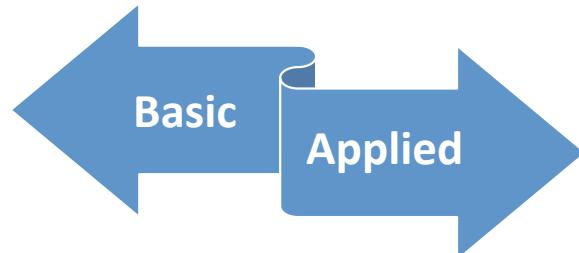
## Applied Research

- Designed to solve practical problems of the modern world
- Not focused on just acquiring knowledge
- Primary goal of the applied scientist is to generate information that can improve the human condition
- Often based on Basic/Pure research

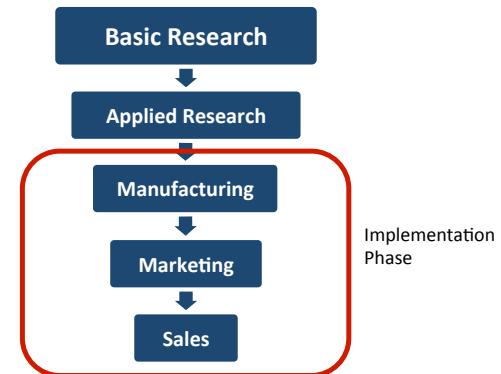
### Example

Develop complementary foods from cocoyam based on its microstructure

Research process ranges from basic to applied



#### Linear Model Research and Implementation



### Types of Research Based on Objectives



### Exploratory Research

- This is undertaken when few or no previous studies exist
- The aim is to look for patterns, hypotheses or ideas that can be tested and will form the basis for further research
- Typical research techniques would include
  - ✓case studies, observation and reviews of previous related studies and data

Example

Reviewing literature to find gaps in an area of research

## Descriptive Research

- This can be used to identify and classify the elements or characteristics of the subject

Examples

- ✓ Determine the level of consumer acceptance of a bread
- ✓ Describe the intensity of sourness or smoothness of sweetpotato yoghurt

- Quantitative techniques are most often used to collect, analyze and summarize data

## Analytical Research

- Extends the Descriptive approach
- Suggests or explains why or how something is happening

Examples

- Determine the effect of HQCF substitution on the consumer acceptance of bread
- Determine the effect of fermentation time and starter culture concentration on the pH of Sweetpotato yoghurt

- An important feature is in
  - ✓ locating and
  - ✓ identifying the different factors (variables) involved

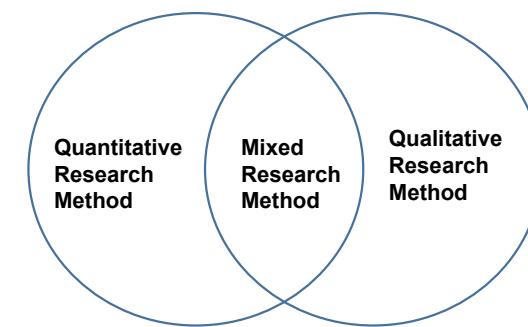
## Predictive Research

- The aim is to speculate intelligently on future possibilities
- Based on close analysis of available evidence of cause and effect

Example

- Model how increasing sweetpotato puree affect consumer acceptability of sweet yoghurt

## Approaches of Research



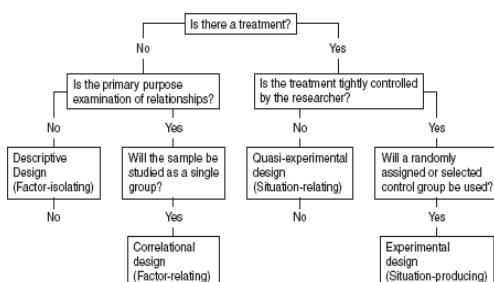
## Quantitative Research Method

- Often uses postpositive claims for developing knowledge
  - (cause and effect thinking, test hypotheses or theories and make predictions)
- Objectivity is critical
- Employs strategies of inquiry such as experiments and surveys
- Collects data on predetermined instruments that yield statistics data

## Types of Quantitative Method

- Descriptive
- Experimental
- Correlational
- Quasi-experimental

Figure 3-1 Decision tree matching research design to category of research question.



## Qualitative Research

- Seeks to understand and interpret social and personal interactions (individuals, cultural or social organizations)
- Study of the whole and not variables
- Subjectivity is expected
- Collects open-ended responses, interviews, observations, field notes and reflections
- Identifies patterns, themes and features

## Types of Qualitative Method

<b>Case Study</b> (also Quantitative)	Sheds light on a phenomena by studying in-depth a single case (individual, event, group or institution) example of the phenomena
<b>Grounded Theory</b>	Completely open minded without any preconceived ideas on the outcome of an event or situation (inductive)
<b>Phenomenology</b>	Describes the structures of experience through consciousness, without recourse to theory, deduction or assumptions from other disciplines
<b>Ethnography</b>	Identifying a culture-sharing group and studying how it developed shared patterns of behaviour over time
<b>Historical</b>	Systematic collection and objective evaluation of data related to past occurrences for testing hypotheses concerning causes, effects or trends of events that may explain present events and predict future events

### COMPARING QUALITATIVE & QUANTITATIVE RESEARCH

Qualitative Research	RESEARCH ASPECT	Quantitative Research
Discover Ideas, with General Research Objects	COMMON PURPOSE	Test Hypotheses or Specific Research Questions
Observe and Interpret	APPROACH	Measure and Test
Unstructured. Free Form	DATA COLLECTION APPROACH	Structured Response Categories Provided
Research is intimately involved. Results are subjective	RESEARCHER INDEPENDENCE	Researcher uninvolved Observer. Results are Objective
Small samples –Often in Natural setting	SAMPLES	Large samples to Produce Generalizable Results [Results that Apply to Other Situations]



## SESSION IV: SCIENTIFIC METHODS AND STEPS IN CONDUCTING RESEARCH



### Expectations of Students

By the end of this session, students want to:

- Develop methods to identify problems and solve them through research
- Scrutinize information and use the information obtained to solve problems
- Know the best ways to conduct research (adequately and with the right tools) and present findings
- Know how to make a proper research design for the market (industry)

## Expectations of Students

- Learn how to go about conducting research to solve problems and implement it
- Be able to undergo a study and plan well in solving a particular problem
- Conduct a good and effective research on any topic with little supervision
- Design a research work, develop and implement findings in the society



## Intended Learning Outcomes

By the end of this session, students should be able to:

- ❖ Demonstrate the steps in conducting scientific research
  - ✓ Identify a research problem
  - ✓ Critically examine the problem
  - ✓ Generate research objectives

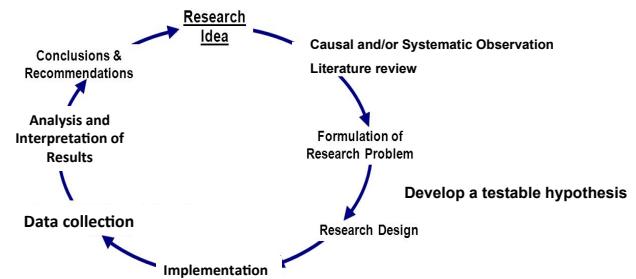
## Intended Learning Outcomes

By the end of this session, students will be able to:

- ✓ Design research in alignment with the objectives
- ✓ Conduct research study either by survey or experiment
- ✓ Collect, manage, analyze and interpret data

## Steps in Conducting Research Overview

- Research process is cyclical in nature



- Research process is **cyclical, but more exactly like a chain**
  - Begins with a question and ends with another question

## Steps in Conducting Research

- Generating Research Idea
  - ✓ Causal and/or Systematic Observation
  - ✓ Library research
  - ✓ Curiosity
  - ✓ Being inquisitive
  - ✓ Challenging the status quo
  - ✓ Being adventurous
  - ✓ Interactions with others

## Reviewing Literature

- Define the purpose of the literature review
- Provide an outline for the review including key words
- Search for relevant material (information)
- Synthesize ideas
- Provide references and sources of information

## Literature Review

- Sources of information includes;
  - ✓ Technical reports
  - ✓ Journal articles
  - ✓ Books
  - ✓ Monographs
  - ✓ Patent
  - ✓ Newspapers
  - ✓ Internet
  - ✓ Indigenous knowledge
  - ✓ Videos
  - ✓ Pictures
  - ✓ Conference proceedings

## Formulation of Research Problem

- Start by having the ideal situation in mind
  - Where are we?
  - Where should we be?
  - Why aren't we where we should be?

## Steps in Conducting Research

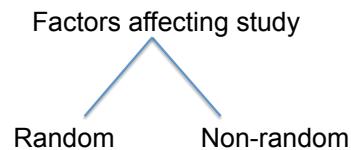
- Develop idea into a testable hypothesis
- Research hypothesis = Scientific hypothesis
  - Statement of an expected or predicted relationship between variables
  - What the experimenter believes will happen in the research study
  - Can be directional or non directional
- Statistical hypothesis = Null hypothesis
  - States that there is no relationship between the variables

## Research Design

- It is the plan or blue print
- Depends on;
  - Nature of research
  - Type of design method (data to analyse)
  - Subjects (consider sampling techniques, animal subjects, human participants, etc.)
  - Factors and levels
  - Respond variables
  - Exposure
  - Where experiment is being performed

## Experimental/Interventional Study

- Manipulation of variables
- Introduction of a factor and responses



## Observation Study

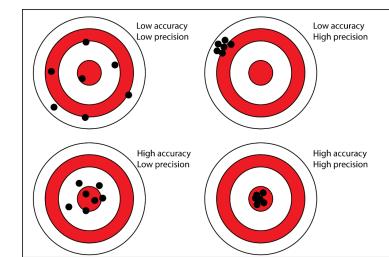
- Natural setting
  - No manipulation
- Analytical (Cohort study)
- Descriptive
- May require technical issues such as ethical clearance

## Implementation Phase

- Obtain all the relevant resources
  - Assemble all materials and equipment
  - Identify laboratories where analysis can be performed
  - Reagents
  - Samples
  - Feasible procedures and modifications where necessary
  - Obtain relevant skills to perform study
- Conduct study (Pretesting, Pilot work and Actual study)

## Data Collection

- Variables being measured
- Instruments
- Level of measurement
- Precision and Accuracy
- Ethics



## Analysis and Interpretation of Results

- Analyse data
  - (using descriptive and inferential statistics)
- State your findings
- Support with literature
  - May or may not conform or may even not exist
- Explain
- Defend

## Steps in conducting Research

- These steps and activities run throughout the entire research process;
- Literature review
  - Planning
  - Monitoring and evaluation
  - Record keeping
  - Asking questions

**“In every success story,  
you will find someone  
who has made a  
Courageous decision”**

-unknown



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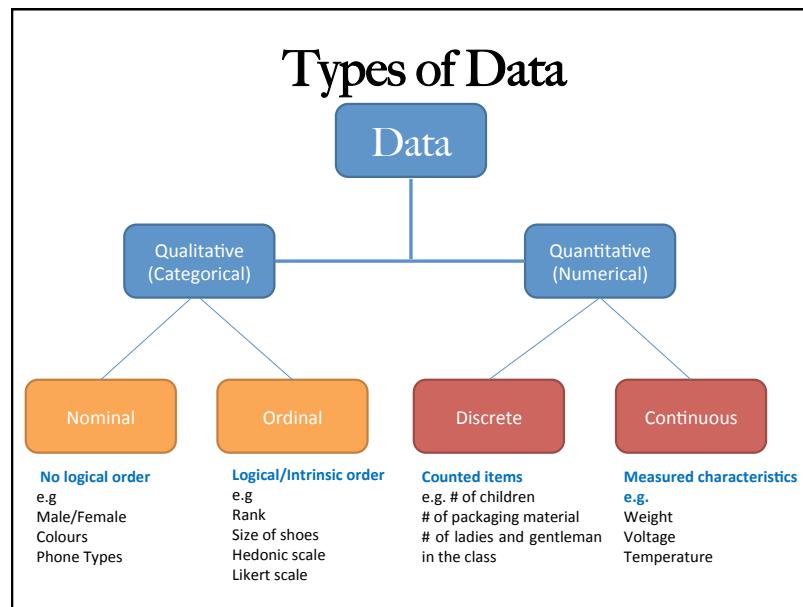


## SESSION V: DATA ANALYSIS & INTERPRETATIONS

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### Data Analysis and Interpretations

- Data analysis
  - An attempt by the researcher to summarize collected data.
- Data Interpretation
  - Attempt to find meaning
- How do these differ by research tradition?
  - Quantitative
  - Qualitative



## Exercise

No.		Nominal	Ordinal	Discrete	Continuous
1	A jug of milk holds one gallon				
2	The distance was 32.62 km				
3	Team C were 1 <sup>st</sup> while Team A and B took the 3 <sup>rd</sup> and 2 <sup>nd</sup> position.				
4	Capital Cities in Ghana				
5	The % fat was 94.5				
6	Number of weeks in a month				
7	Names of days in the week				
8	I went to the gym at 5.00am				
9	Brands of phone				
10	Official Class Register/List				

## Key components of a data analysis plan

- Purpose of the evaluation
- Questions
- What you hope to learn from the question
- Analysis technique
- How data will be presented

## What should be the approach?

- **Think about analysis EARLY**
- **Start with a plan**
- **Code, enter, clean**
- **Analyze**
- **Interpret**
- **Reflect**
  - What did we learn?
  - What conclusions can we draw?
  - What are our recommendations?
  - What are the limitations of our analysis?

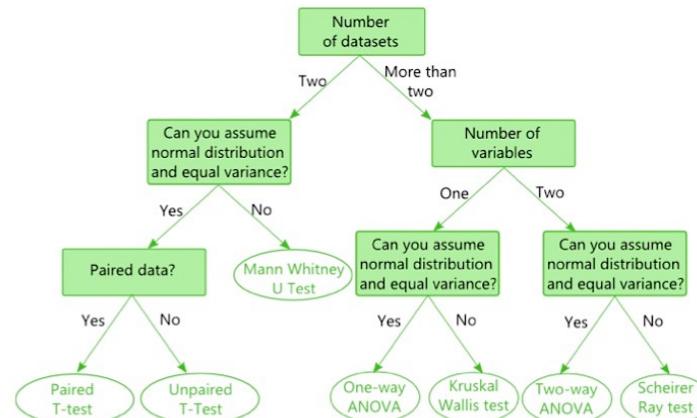
## Coding

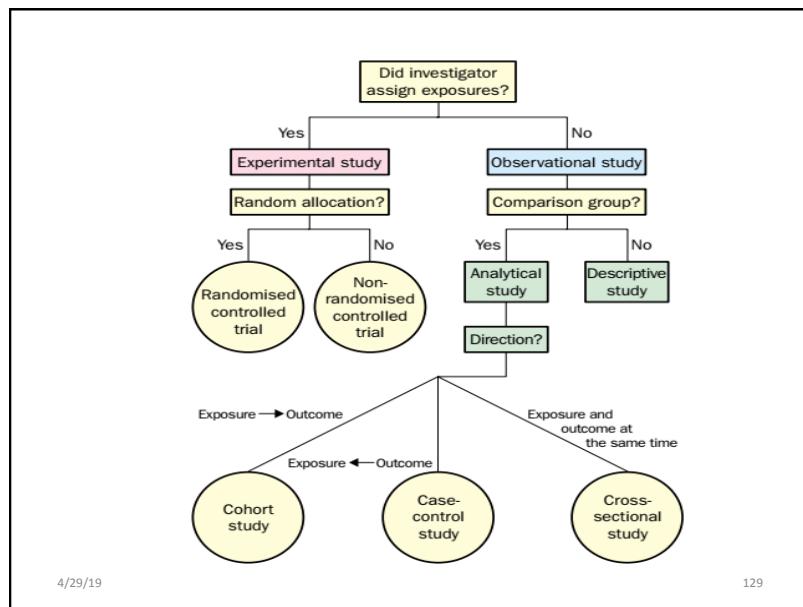
- Master sheet
  - Where all variables are named
- Dummy variables
- Coding facilitates data entry
- Requirement for many statistical softwares

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## SELECTING STATISTICAL TOOL





## Hypothesis and Hypothesis Testing

# Hypothesis

- “Hypothesis is perhaps the most powerful tool, man has invented to achieve dependable knowledge” – Fred Kerlinger
- Hypothesis is the testable answer to a scientific question
  - *is a test of a claim or an assumption*
- The general idea of hypothesis testing involves:
  1. Making an initial assumption
  2. Collecting evidence (data)
  3. Hypothesis Testing
    - *Deciding whether to reject or not reject the initial assumption*

# Hypothesis

1. **Making an initial assumption**
  - a. Based on two competing hypotheses
    - Null hypothesis ( $H_0$ )
    - Alternative hypothesis ( $H_1$  or  $H_A$ )
  - b. In statistics, we always **assume the null hypothesis** is true until proven otherwise empirically.

**That is, the null hypothesis is always our initial assumption**

Type	Null	Alternative
Right-tailed	$H_0: \mu_1 = \mu_2$	$H_a: \mu_1 > \mu_2$
Left-tailed	$H_0: \mu_1 = \mu_2$	$H_a: \mu_1 < \mu_2$
Two-tailed	$H_0: \mu_1 = \mu_2$	$H_a: \mu_1 \neq \mu_2$

**OR**

Type	Null	Alternative
Right-tailed	$H_0: \mu_1 \leq \mu_2$	$H_a: \mu_1 > \mu_2$
Left-tailed	$H_0: \mu_1 \geq \mu_2$	$H_a: \mu_1 < \mu_2$
Two-tailed	$H_0: \mu_1 = \mu_2$	$H_a: \mu_1 \neq \mu_2$

## **Exercise**

(Write the hypothesis for these claims/assumptions)

Q1. Based on the recent National Math and Science Quiz, an educationist is investigating if the IQ of SHS students in the Ashanti Region are different from the other 9 regions in Ghana.

Q2. After a testing over 10 brands of yoghurt, an investor is of the view that IcyCup is taste best as compared to the brands.

Q3. Samsung Note 7 is the worst phone produced and marketed by Samsung

## Hypothesis Testing (p-value approach)

- In statistics, we always make one of two decisions. We either "reject the null hypothesis" or we "fail to reject the null hypothesis."
- Testing is done at a level of significance, which is based on a probability.
- The P-value approach involves determining "likely" or "unlikely" by determining the probability — assuming the null hypothesis were true
- If the **P-value is less than (or equal to)  $\alpha$** , then the null hypothesis is rejected in favor of the alternative hypothesis. And, if the **P-value is greater than  $\alpha$** , then the null hypothesis is not rejected.

	Truth	
Jury Decision	Not Guilty	Guilty
Not Guilty	OK	<b>ERROR</b>
Guilty	<b>ERROR</b>	OK

	Truth	
Decision	Null Hypothesis	Alternative Hypothesis
Do not reject null	OK	<b>Type II ERROR</b>
Reject null	<b>Type I ERROR</b>	OK

**Type I error:** The null hypothesis is rejected when it is true.

**Type II error:** The null hypothesis is not rejected when it is false.

## Exercise

(Hypothesis testing Write the hypothesis for these claims/  
assumptions)

Q1. Based on the recent National Math and Science Quiz, an educationist is investigating if the IQ of SHS students in the Ashanti Region are different from the other 9 regions in Ghana.

- a. P value = 0.002,  $\alpha$  = 0.01
- b. P value = 0.05,  $\alpha$  = 0.05
- c. P value = 0.03,  $\alpha$  = 0.002

Q2. After a testing over 10 brands of yoghurt, an investor is of the view that IcyCup tastes best as compared to the other brands.

- a. P value = 0.04,  $\alpha$  = 0.05
- b. P value = 0.19,  $\alpha$  = 0.13
- c. P value = 0.09,  $\alpha$  = 0.08

Q3. Samsung Note 7 is the worst phone produced and marketed by Samsung

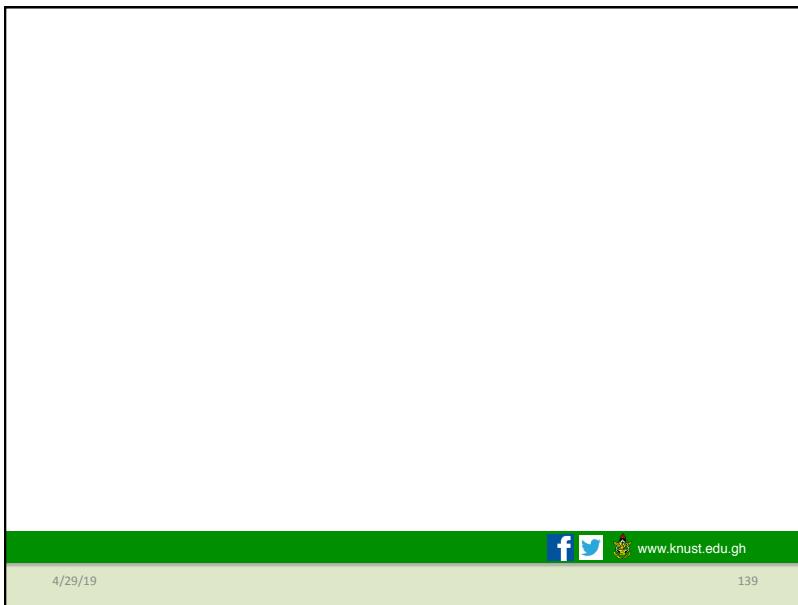
- a. P value = 0.15,  $\alpha$  = 0.04
- b. P value = 0.003,  $\alpha$  = 0.03
- c. P value = 0.06,  $\alpha$  = 0.002

## Quote of the Day

*“Take advantage of every opportunity to practice your communication skills so that when important occasions arise, you will have the gift, the style, the sharpness, the clarity, and the emotions to affect other people.”*

-Jim Rohn

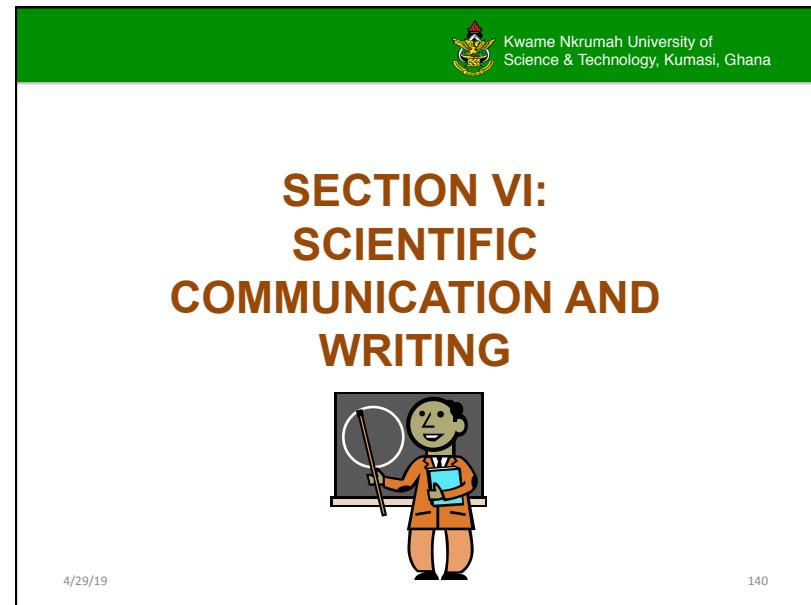




A blank slide template with a white background and a thin black border. It features a green header bar at the top and a light green footer bar at the bottom. The footer bar contains social media icons for Facebook and Twitter, and the website address [www.knust.edu.gh](http://www.knust.edu.gh).

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A slide titled "SECTION VI: SCIENTIFIC COMMUNICATION AND WRITING" in large, bold, brown capital letters. Above the title is the Kwame Nkrumah University of Science & Technology logo and name. Below the title is a cartoon illustration of a teacher standing next to a chalkboard, holding a book and a pointer.

Kwame Nkrumah University of  
Science & Technology, Kumasi, Ghana

SECTION VI:  
SCIENTIFIC  
COMMUNICATION AND  
WRITING

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## Intended Learning Objectives

By the end of this session, students will be able to:

- ✓ Understand the need for scientific communication
- ✓ Know how to effectively achieve the 3 P's of science
- ✓ Present research information in the scientific world
- ✓ Present research information in a publishable way
- ✓ Know the basics of scientific writing and some rules to follow
- ✓ Transfer research information to implement changes in field of study



## Recall...

- The aim of research is to contribute to knowledge
  - add new results to the previous state of knowledge
  - form a basis for new thinking and interpretation
- Research results do not contribute to knowledge and development
  - unless they are communicated effectively
- Effective communication of science is
  - very important component of research process

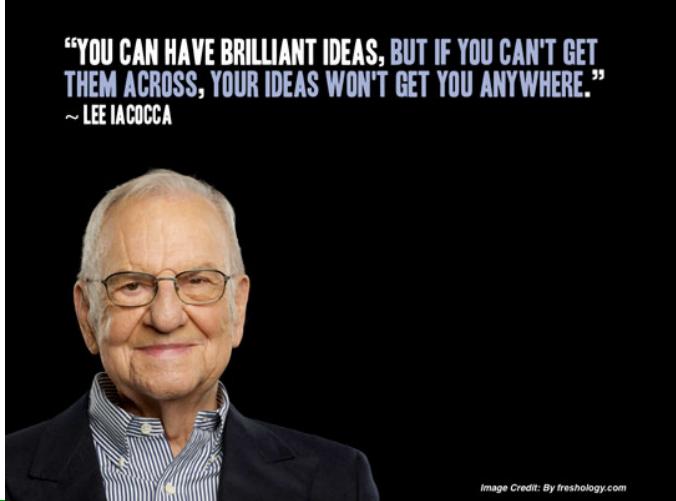


## Why Communication in Science?

- Important part of being a scientist because;
  - Promote
  - Publicize
  - Popularize

## Researchers and Conference Presentation

- Visibility
- Reputation development
- Powerful networking tools, for sharing knowledge and skills
- Clarify your thoughts
- Professional way to get ideas
- Puts your research into a more in-depth and wider context



**"YOU CAN HAVE BRILLIANT IDEAS, BUT IF YOU CAN'T GET THEM ACROSS, YOUR IDEAS WON'T GET YOU ANYWHERE."**

~LEE IACOCCA

*Image Credit: By freshology.com*

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## Oral Communication



We may not be experts at public speaking...

...But we are all experts at listening to talks



**"We rule the world by our words"**

-Napoleon Bonaparte

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## How to prepare, structure and deliver a good talk



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## Before you begin



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## Planning the Presentation

- An effective presentation begins with focused thinking
- You should think about the
  - Objective
  - Audience
  - Context



## Define your objective

- Your objective should drive the development of your presentation
- What is the purpose of this presentation?
- What do I want my audience to do as a result?

## Know your audience



- The better you **understand your listeners**, the more intentional you can **customize your presentation**
  - Is it controversial, familiar or new to this audience?
  - Who are they?
  - What do they need to know about the topic?

## Pertinent questions to ask

- **Who** are you addressing?
- **Why** is your message important?
- **What** are your main findings?
- **How** can you best deliver your message and satisfy the audience's needs?



## Understand your presentation's context

- Is it formal or informal?
  - Mannerism, Culture and Ethics
- Is the audience tired or alert?
- Who speaks before or after you?
- Time allocation

## Oral Communication

“When a man is asked to make a speech,  
the first thing he has to decide is what to  
say”

-Gerald R. Ford

- Once you have your objective, deciding what to say to your audience isn't always easy
  - To make it easier, divide the task into 3 stages

## Decide what to say

- Stage 1
  - Define the key message
  - What do you want people to remember?
  - What actions do you want them to take?
- Stage 2
  - Identify the arguments that support your message
  - Avoid excessive detail
- Stage 3
  - When is it important to get audience participation or reaction?

## How to Structure a Good talk

- Be smart and familiarize with your PowerPoint
- Introductions: start broad, then get specific
- Think of your talk as consisting of episodes
- Use a home slide to make transitions effectively
- Conclusions: start with specifics, end broadly

# Preparing for the presentation

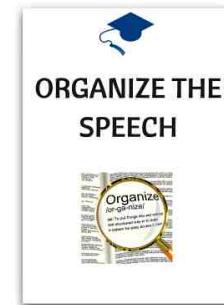
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## Organize your presentation

- An opening
- A need or problem statement
- A solution
- A call to action



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## The Opening

- Good organization begins with a compelling opening
- Use a hook to get the audience attention
  - Comment
  - Question
  - Relevant
  - Statement or Quote
  - Example

## The opening

- Outline the purpose of the presentation
- Describe the importance of the topic for the audience
- Preview the main points to be covered

## The Need or Problem Statement

- Make it clear why the audience should care about your message
- Develop a clear need or problem that you and your audience will solve together

## The Solution

- Help the audience visualize the benefits of the solution
- Phrase your solution in terms of the audience's need
- Make sure the urgency of your solution matches the need

## Call to action

- Reiterate the presentation's key message
- Integrate your opening points into your closing comments
- Recommend action



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## Rehearse

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“There are always three speeches, for every one you actually gave. The **one you practiced**, **the one you gave** and **the one you wish you gave**”

~ Dale Carnegie

## **Effective rehearsing**

- Rehearse with equipment and visuals
- Rehearse the entire presentation
- Rehearse in front of friends or colleagues
- Concentrate on the subject not your notes

“The person being coached is not lacking, they simply need someone to tap on their microphone and turn up the volume so they can hear their own sound”

- Suzette Hinton

## Visual Aids in Presentation



- Visual aids are an audio-visual communication process
- Examples; Short video clips, pictures, demonstrations, models and PowerPoints
  - a powerful tool to employ
  - Complement the presenter's voice or message

## How PowerPoint can enhance your presentation?

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### **Tips for creating PowerPoint slides**

- Keep it simple
- Limit bullet points and text
- Limit transitions and animations
- Have a visual theme but avoid using PowerPoint templates

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## **Tips for Effective PowerPoint**

- Use contrasting colour schemes (design templates)

These colours contrast

These colours contrast

These colours don't contrast

These colours don't contrast

These colours contrast (harder to read?)

These colours contrast (harder to read?)

## **Tips for creating PowerPoint slides**

- Use high quality images



# Some Final Words

## When Presenting

- Speak loudly and clearly
  - Learn how to pitch
- Direct your words to all aspects of the room
- Maintain eye contact with your audience
- Ask questions of your audience but not too many
  - (if applicable)
- Do not read the slides word-for-word, use them for reference



## When Presenting

- Show good mannerism
- Learn how to use the pointer
- Practice your presentation before a neutral audience
  - Ask for feedback
- Be particular about the time allotted for presentation
- Leave time for questions

## Remember

- Simplicity is the ultimate sophistication...

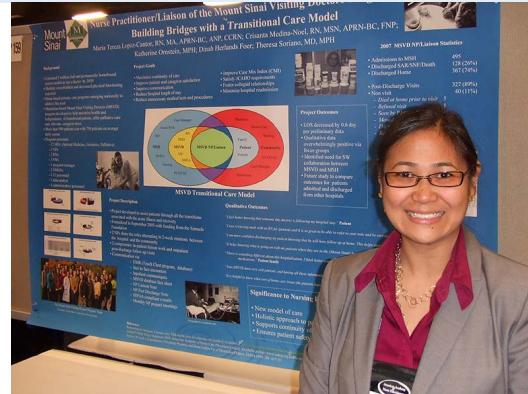
-Leonardo Da Vinci

## SESSION VII: POSTER PRESENTATION



Kwame Nkrumah University of  
Science & Technology, Kumasi, Ghana

### How to make an Effective Scientific Poster Presentation



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*“The more strikingly visual your presentation is, the more people will remember it. And more importantly, they will remember you.”*

-Paul Arden



### Scientific Poster

- They are a key component of communication in science
  - serve as an advertisement of your research
- Should be considered as a snapshot of work
  - an illustrated abstract
- Intended to
  - engage colleagues in a dialog about the work  
Or if you are absent
  - be a summary to encourage the reader to want to learn more



## Importance of Poster Presentation

- Advertisement of research
  - conferences, symposia, etc
- Practice public speaking
- Learn about most current results in field
- Deepens understanding of topic
- Opportunity for teaching and learning
- Share ideas and Create collaborations

## How do I get months and years of research onto my poster?

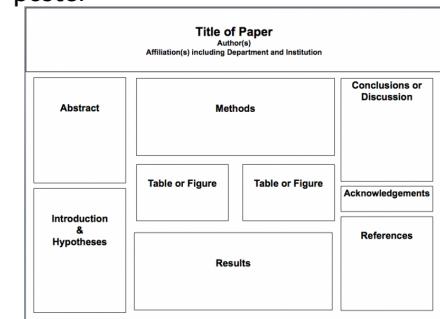
- Your poster is a short story
- Describe a few major points
- Arouse the reader's interest to read on
- Limit it to 250 words

## Know your Audience

- Researchers in your field
- Researchers in related fields easily persuaded to view
- Previously uninterested passers by can be attracted by a good poster
  - You want to attract these people!
- Don't vary content, vary explanation

## Preparing Your Poster

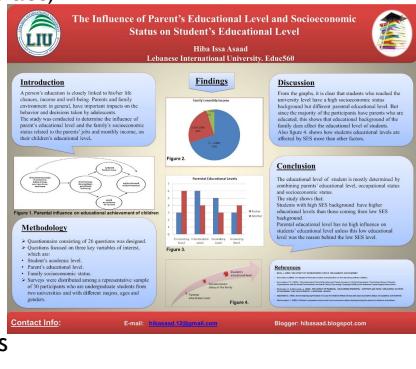
- Make rough plan of your poster
  - Size
  - Content
  - Layout
  - Have standards



Example of a layout

## Main Elements of a Poster

- Title (same as submitted abstract)
- Name and Campus
- Core Technical Content
  - Introduction
  - Materials and Methods
  - Results/Findings
  - Discussion
  - Conclusion
  - Literature cites/Resources
  - Acknowledgements

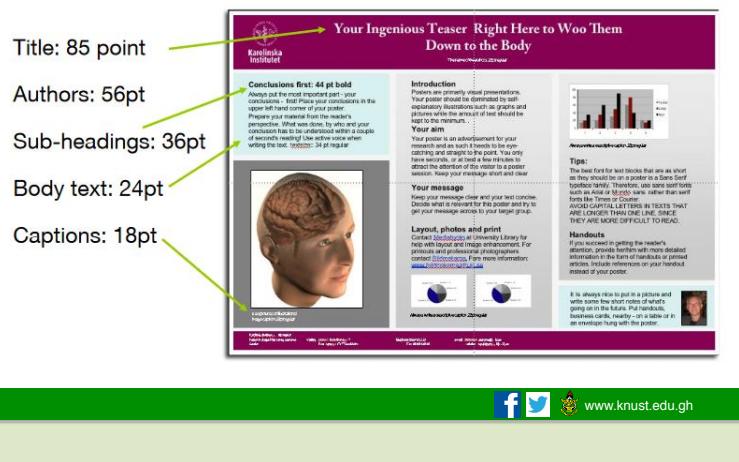


## Visuals

- Font should be legible fonts
  - Arial
  - Trebuchet MS
  - Tahoma
- Do not use illegible fonts
  - Brush Script
- Use the same font type throughout poster
- Use large text (at least 18-24 pt)
  - Headings (30-60 pt)
  - Title (> 72)



## Text sizes:



## Visuals

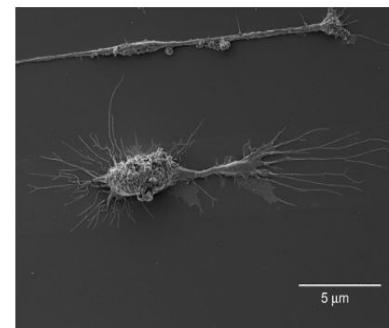
- Leave adequate white space
- Make it readable
- Use colour sparingly
  - Use 2 or 3 colours
- Dark type on light coloured background

Whoa! Where's my sunglasses?



This attracts attention but tires out the eye

## Label Images, Figures and Graphs



Your cool images mean nothing without a scale bar or description

## Final words

Print out a letter size draft

- Can you read the type?
- Are these the colours you really want?
- Does it look too busy
- Do they main points pop?

Remember to keep it simple!



## SECTION VIII: SCIENTIFIC COMMUNICATION AND WRITING



## The ABC of Science Communication

- It should be
  - ✓ **A**ccurate and **A
  - ✓ **B**rief
  - ✓ **C**lear**

## Modes of Scientific Communication

- **Written**
  - Journals
  - Short communication
  - Monographs
  - Training manuals
  - Technical reports
  - conference papers
  - Grants/proposals
  - Books
- **Oral**
  - oral presentations
  - poster presentation
  - Lecture
- **Visual**
  - Poster session
  - Lecture

## Ways of scientific communication

In what ways do these forms of communication differ?

What do they have in common?

## Important Notes

- Various forms of communication have a great deal in common
  - but they differ in purpose and audience address
- Science is international
  - many of those who read or listen to a scientific presentation will be doing so in a foreign language
- Science is universal

## Written communication

Writing should;

- be clear
- be logical
- be factual
- use correct grammar
- use correct sentence structure
- avoid (rampant) speculation

## Definitions

- **Scientific journal**- is a periodical publication intended to further the progress of science, by reporting new research findings specialized for different academic disciplines or sub-disciplines
- **Scientific book**- is a work of non-fiction written for a wider audience presumed to have a general education, thus authors sufficiently explain difficult topics to people who may be totally new to the subject
- **Short communication**- is for a concise, but independent and original report representing a significant contribution to science
- **Monograph**- an established body of work or writing pertaining to a specific subject. Usually written by qualified scholars having expertise in a particular subject for serious readers having interest in the same subject

## Definitions

- *Scientific paper*- is a written report describing original research results
- *Technical reports*- a document that records the procedure adopted and results obtained from a scientific or technical activity or investigation
- *Training manuals*- a book or booklet of instructions, designed to improve the quality of a performed task
- *Conference papers*- refer to articles that are written with the goal of being accepted to a conference, with the aim of presenting results to the community, usually as an oral presentation, a poster presentation, or a tabled discussion
  - typically published in collections called "proceedings"

## Writing Technical Papers



## Planning

Before writing a paper, PLAN!

How do I communicate my research to my target audience?

- Decide on short or more detailed paper
- Decide your readership
  - Based on the data you have
- Decide on the best mode of communication
- Obtain the authors guidelines and study carefully
- Assess whether work is ready for submission

## Planning

- Writing can start before research is even undertaken, due to structure of research papers
  - Enables timely publication
  - Task made easier now with WORD processing
- Consider both the practical research and the paper together (Sketch)
- Literature search save time in planning and avoids repetition
- Writing is part of the investigation, not an unwelcome task to be taken at end

## **Note!!**

- Keep records in notebook, not scraps of paper
- Every note must be dated and time of observation where relevant indicated
- Make duplicate copies of notes

## **Tips when doing Project Work**

- Write an account of observations and experiments as project proceeds
  - think of report as part of investigation
- Use writing and drawing as aids to observation and description
- Share write-ups with colleagues for advice (internal peer review process)

## Sections of a Scientific Paper

Standard format of a Technical Paper;

- Title
- Abstract
- Introduction
- Materials and Methods
- Results & Discussion
- Conclusion
- References

## Title

- It should be
  - attractive
  - informative
  - specific and concise
  - relevant to the content of the work
- Use technical terms which are familiar to most readers
- **Do not use abbreviations in title**

## Examples

- *Chemical Composition and Starch Digestibility of Different Gluten-free Breads*
  - (Segura and Rosell, 2010)
- *Assessing the Suitability of Locally Produced Gum Exudates in the Food Industry*
  - (Owusu *et al.*, 2016)
- *Breakfast Meal from Breadfruit and Soybean Composite*
  - (Oduro *et al.*, 2007)

## Abstract

- Brief summary of major points of the research in a clear and understandable form
  - objective
  - approach
  - main results
  - few sentences to emphasize important conclusions
- Normally written in the past tense,
  - but sometimes the present tense is used
- At the end of the abstract,
  - list **key words** that best describe your research (optional)

## Example

➤ *Viscosity Studies of Cashew Gum*  
     • (Owusu *et al.*, 2005)

➤ *Abstract*

Gum exudates from the cashew tree had similar viscosity characteristics to gum arabic, and there were no significant effects of pH, temperature changes or storage time on the viscosity.

Keywords: exudate gums, cashew gum, viscosity.

## Example

➤ *The Quality Assessment of Gari Produced by Using Microwave Energy*

- (Oduro and Clarke, 1999)

➤ *Abstract*

A novel technique using microwave energy for roasting and drying or *garification* of fermented cassava mash is investigated. The quality of *gari* produced using this method compared favourably with the standards quoted in the literature and with those of commercial *gari* purchased from a London market, in terms of colour, swelling capacity, moisture, pH and total acidity.

➤ *Key words*

- Cassava, cooking, drying, gelatinization.

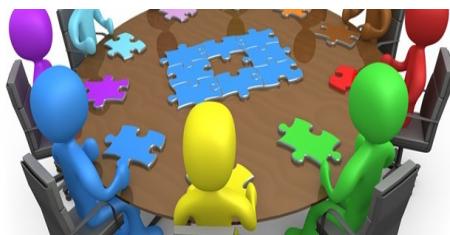
## Introduction

- It provides information on
  - the background of study
  - the rationale for the study
  - clear objective(s) and approach to the work
- Should persuade the reader to know
  - the importance of the topic
  - the objective of the research
- Should orient the reader by summarizing briefly the relevant literature (background)

## Material and Methods

- Provides a clear and complete description for all
  - experimental
  - analytical
  - statistical procedures
- Should be logical or chronological
  - **use specific, informative language**
- Must contain enough information
  - to enable repetition of procedures in order to obtain similar results

## Results and Discussion



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## Results

- This section should contain
  - only results and a summary of your research findings
  - not a comparison of literature
- Prepare your results first in the form of tables or figures
  - Select the most important/ representative tables or figures
- Explain or elaborate on your findings
  - by logically summarizing and illustrating relevant data
- Sufficient data should be presented to allow readers interpret results

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## Writing Technical Papers



### **Characteristics of *Xanthosoma sagittifolium* roots during cooking, using physicochemical analysis, uniaxial compression, multispectral imaging and low field NMR spectroscopy** (Boakye et al., 2017)

**Abstract:** To effectively promote the industrial utilization of cocoyam (*Xanthosoma sagittifolium*) roots for enhanced food sustainability and security, there is a need to study their molecular, mechanical and physicochemical properties in detail. The physicochemical and textural characteristics of the red and white varieties of cocoyam roots were thus analysed by low field nuclear magnetic resonance relaxometry, multispectral imaging, uniaxial compression testing, and relevant physicochemical analysis in the current study. Both varieties had similar dry matter content, as well as physical and mechanical properties. However, up to four fast-interacting water populations were observed in the roots, dependent on the root variety and their degree of gelatinization during cooking. Changes in the relaxation parameters indicated weak gelatinization of starch at approximately 80°C in both varieties. However, shorter relaxation times and a higher proportion of restricted water in the white variety indicated that this variety was slightly more sensitive towards gelatinization. A strong negative correlation existed between dry matter and all multispectral wavelengths >800 nm, suggesting the potential use of that spectral region for rapid analysis of dry matter and water content of the roots. The small, but significant differences in the structural and gelatinization characteristics of the two varieties indicated that they may not be equally suited for further processing, e.g. to flours or starches. Processors thus need to choose their raw materials wisely dependent on the aimed product characteristics. However, the spectroscopic methods applied in the study were shown to be effective in assessing important quality attributes during cooking of the roots.

- **Keywords:** Cocoyam (*Xanthosoma sagittifolium*) Physicochemical properties Texture Multispectral imaging Low field nuclear magnetic resonance (LF-NMR) Cooking Gelatinization

## Consumer Perception of Traditional Foods in Ghana A Case-study in Kumasi and Sekondi (Laryea et al., 2016)

### Abstract

**Purpose** – The purpose of this study is to identify the various traditional foods available in two towns in Ghana and to assess consumer perception about these traditional foods. Traditional foods provide nutritional and health benefits, but their consumption keeps declining, such that some are becoming extinct.

**Design/methodology/approach** – The level of knowledge of consumers and their attitude toward the consumption of traditional foods were determined. A cross-sectional survey was conducted in Sekondi and four areas in Kumasi, with a sample size of 200 in each of the two towns. The data obtained were analyzed using Pearson correlation and Chi-square test for independence.

**Findings** – While consumers had very good general knowledge of the traditional foods, most of them had little knowledge on nutrient compositions of the foods. About 95.5 per cent of respondents in Sekondi consumed traditional foods relative to those in Kumasi (62.5 per cent). There was no linear relationship existing between respondents' knowledge, attitude and consumption of traditional foods ( $r < 0.50$ ). More so, respondents' attitude, knowledge and consumption of traditional foods, mostly, did not depend on the demographic factors (age and education). Other factors such as convenience, economic status of respondents and safety of traditional foods may be contributory factors to the low patronage and consumption of traditional foods.

**Originality/value** – Most researches on traditional foods in Ghana have mostly focused on food ingredients; therefore, there is little or no available information on consumer perception of prepared traditional foods. Because consumer opinions change over time, there is a need to consistently gather data to help food industries and food service operators meet consumer needs and expectations.

**Keywords** Consumption, Consumer attitudes, Ghana, Survey, Perception, Traditional food, Consumer choice

**Paper type** Research paper

## Discussion

- Should interpret the results
  - clearly
  - concisely
  - logically
- Describe how your results relate to achieving objectives
- Cite evidence from literature that supports or contradicts your results and explain

## Discussion

- Indicate clearly whether you are reporting your own results or results from literature
- Use past tense to refer to results of your own research
  - but for generally accepted results present tense may be used

**NOTE: Results and discussion can be combined**

–Usually a good way to avoid repetition

## Conclusions or Implications

- Summarizes the main results of the research
  - Describes what they mean
- Should be based on your objectives

**NOTE: This is not the place to mention new results for the first time**

## References

Citations of published literatures should follow the instructions set by the journal (institution) where the write-up is to be published

## Appendix

- Provides readers with supplementary material
  - may not be essential to the understanding of the paper but may be helpful
- Such materials may include
  - numerical examples
  - questionnaires
  - extensive details of analytical procedures
  - novel computer programs

## Visuals

- Are used to
  - find relationships
  - emphasize material
  - present material more compactly and with less repetition
- Tables and figures
  - help make numbers meaningful and
  - convey information to the reader
- The number of tables, charts or graphs depends on
  - the amount of information you have
  - the purpose of presenting that information

## Selecting the form to display

- Table
  - when exact values are important
- Graph
  - when trends or relationships more meaningful than exact values
- Distribution map
  - essential when location of data points is more important than actual values

## Selecting the form to display

- Flow chart
  - when processes
  - sequences
  - systems need to be presented in an organized fashion

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## Tables

- Generally used when exact values are important
- To allow the reader to focus on specific numbers
- The title of the table should be descriptive enough to stand alone
- Tables must be legible
- Do not ‘crowd’ it with too much information

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## Example

Table 1. Proximate Composition of Diets

Treatment feeds	Moisture (%)	Ash (%)	Crude protein (%)	Crude fat (%)	Crude fibre (%)
C	9.73 (0.17)	8.52 (0.49)	17.4 (0.15)	3.66 (0.02)	3.61 (0.01)
Ca	9.76 (0.19)	8.66 (0.89)	16.6 (0.93)	3.67 (0.05)	3.60 (0.01)
R1	9.53 (0.10)	9.02 (0.96)	17.4 (1.39)	3.65 (0.04)	3.61 (0.01)
R2	9.36 (0.26)	8.57 (0.36)	16.9 (0.00)	3.67 (0.01)	3.63 (0.01)
R3	9.22 (0.17)	8.58 (0.28)	17.4 (0.15)	3.67 (0.02)	3.63 (0.01)
R4	9.41 (0.19)	9.08 (0.92)	17.3 (0.00)	3.67 (0.00)	3.63 (0.00)

## Example

Table 1. Proximate Analysis results on Sorghum Samples

Parameters	Raw Sorghum	Malted Sorghum
Moisture (%)	10.80 (0.18)	9.70 (0.21)
Ash (%)	1.30 (0.15)	1.60 (0.00)
Crude fat (%)	3.00 (0.03)	3.70 (0.01)
Crude fibre (%)	2.00 (0.04)	12.50 (0.01)
Crude protein (%)	10.72 (0.14)	12.50 (0.00)
Carbohydrate (%)	72.10 (0.01)	60.00 (0.02)

*"The preliminary examination of most data  
is facilitated by the use of diagrams.  
Diagrams prove nothing,  
but outstanding features to the eye;  
they are therefore no substitute for such  
critical tests  
as may be applied to data,  
but are valuable in suggesting such tests,  
and in explaining conclusions founded upon  
them."*

---R A Fisher (*Stat Methods for Research Workers*)



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## Figures

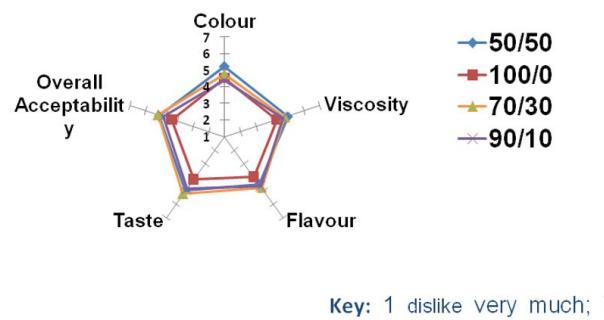
- Focus on relationships among numbers or illustrate trend
- Understood independently
  - examples are pie charts, bar charts, line graphs, scatter diagrams
- When comparing one item with another,
  - use a bar chart or a line graph
  - bar charts help to compare one item with another



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## Example



**Figure 1:** Preference sensory evaluation of four different cassava-sweetpotato drink formulations.

## General Principles for displaying data

### ➤ Accuracy

- no table, graph or map, however carefully designed can redeem poor or inaccurate data
- values depend on integrity and care must be taken to collect data

### ➤ Avoid redundancy

- data should be presented once
- not as table, graph, map, etc. at the same time

### ➤ Selectivity

- limit displays to as few as possible

### ➤ Consistency

- similar data should be displayed in similar form
- alternating between graphs, maps, and tables for variety is distracting

## General Principles for displaying data

➤ **Focus**

- figure or table must make a point
- should be apparent from the design of the display

➤ **Clarity and simplicity**

- enhances understanding
- do not impress by making a simple message complex!

➤ **Visual effectiveness**

- keep words minimum for graphs and maps to be visually effective

## General Principles for displaying data

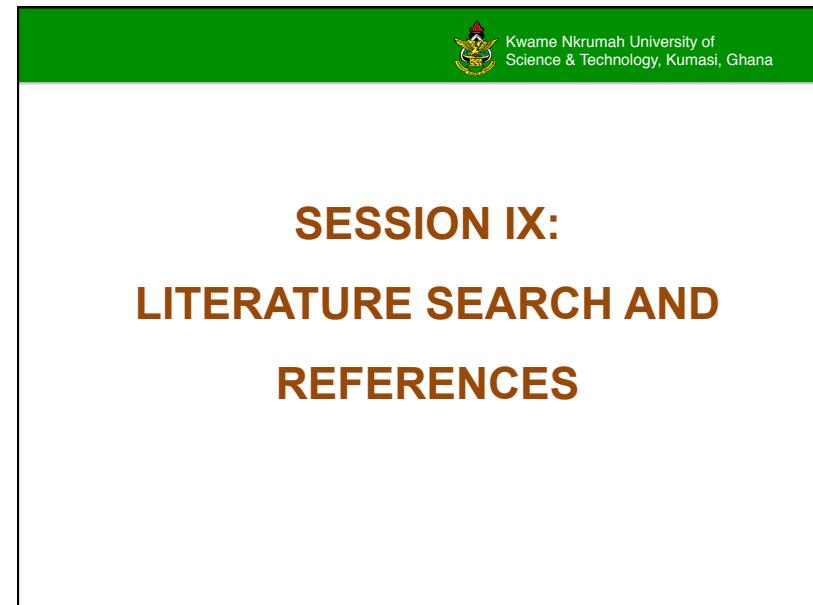
➤ **Convincing figures**

- graphs should be usually convincing
- if the point of a graph is that a variable increased, this increase should be apparent

➤ **Independence**

- tables with title and footnotes,
- graph with legend

**should be understandable without reference to text**



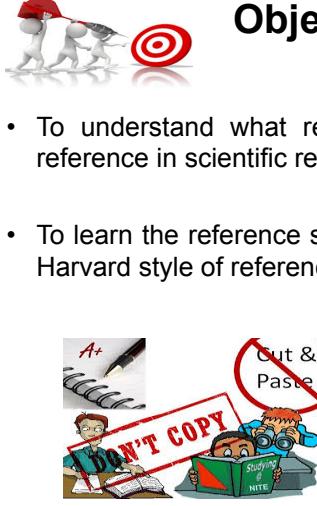
 Kwame Nkrumah University of  
Science & Technology, Kumasi, Ghana

## Referencing Literature: Reference Styles

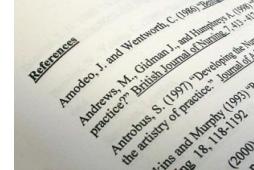


De Montfort University, Leicester  
University of Auckland

## Objectives of the Lecture



- To understand what references are and the need to reference in scientific reports
- To learn the reference styles with particular focus on the Harvard style of referencing



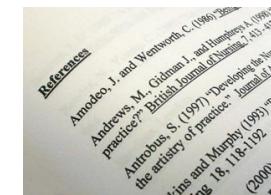
References
Anodeo, J., and Wensworth, C. (1996) 'Developing the New Practice?' British Journal of Nursing, 15, 40-43.
Andrews, M., Gidman, J., and Humphrey, J. (1997) 'Developing the New Practice?' British Journal of Nursing, 15, 40-43.
Antrobus, S. (1997) 'Developing the New Practice?' British Journal of Nursing, 18, 118-119.
Brown, S., and Murphy, J. (1993) 'Developing the New Practice?' British Journal of Nursing, 18, 118-119.
Cole, D. (1997) 'Developing the New Practice?' British Journal of Nursing, 15, 40-43.

## What is a reference?

- “Give credit where credit is due”
- It is important to give credit to authors whose ideas, words, etc are used in scientific write-ups or reports
- A **reference** is a detailed **bibliographic** description of the item from which you gained your information
- **References** are briefly cited within the text, and then given in full at the end of your work in a **reference list**

## In cases of no in-text referencing

- Any other items read for background information but not referred to in the text should be given in full at the end of your work in a **bibliography**



## Why does one need to reference?

- Enable the reader to locate the sources you have used
- Help support your arguments and provide your work with credibility
- Show the scope and breadth of your research
- Acknowledge the source of an argument or idea
  - Failure to do so could result in a charge of **plagiarism**

## What is Plagiarism

- Also known as “academic theft”
- It is using someone’s words and/or ideas without due credit to holders of such ideas, thus presenting it as one’s own



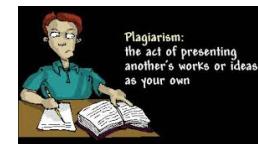
## What is Plagiarism

- Copying and pasting verbatim from a source (internet, textbook, journal etc.)
- Incorporating a direct phrase or sentence that sounds nice into your work without citation and/or quotation marks



## Forms of Plagiarism

- Direct lifting without citation (Common type: Copy and Paste)



- Direct lifting/quote with citation but no quotation marks (Common among those who think they are not plagiarizing)

### Forms of Plagiarism...

- Superficial rewording with citation (Copy, paste, edit)
- Complete paraphrase without citation
- Bunch of quotes pooled together or in sequence

*All are unacceptable and represents scientific misconduct*

### Less obvious plagiarism

- When you take a sentence directly from a paper, without quotation marks, even if there is a citation, it's plagiarism
- If you take multiple sentences from different sources with only minor changes (or none), it's still plagiarism, even with referencing
- You must read and SYNTHESIZE the material and write it all in your own words

## Paraphrasing

- It's not just simple rewording
- It involves complete change of
  - phrases, clauses,
  - sentence structure,
  - order of reasoning
  - only ideas are retained
- Sometimes summary of a text will do
  - You should still provide reference

However for highly technical language especially those from primary sources, paraphrasing sometimes become burdensome

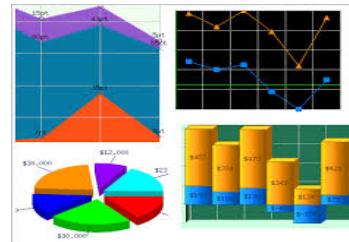
DIRECT QUOTING IS YOUR BEST OPTION

## Quoting

- Quote only
  - For highly technical language
  - When the writer's choice of words or sentence clearly express an idea in a unique way
  - Can be phrases, clauses, or whole sentences
- After quoting, explain the significance of quotations
- Too much quoting is not acceptable
- Use brackets to show added phrases and ellipsis (.....) for omitted texts
- REMEMBER to use quotation marks (" ") and
- Don't forget your citation

## These also warrant Citation

- Results of others' research
- Look up tables
- Charts
- Pictures
- Diagrams



## Where is Citation Unnecessary?

- Common Knowledge (contextual). It's common knowledge when
  - The information is assumed to be known by your reader and/or majority of people in the field
  - Common knowledge from the original text, when paraphrased could be left without citation
- Your own reasoning, ideas, deduction, re-analysis, or inference from others' ideas
- Your own writing in other sources, although you may want to quote yourself to establish priority. Caveat: Copyrights!!!

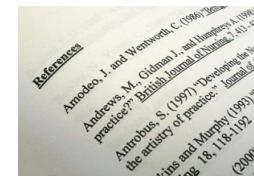
## Avoiding Plagiarism: An Effective Note-Taking Process

- Think through the material as you read along before hurrying to write it down
- Write main ideas and make linkages
- Index cards or jotters may be helpful
- Write full citations during the note-taking period or use EndNote/Mendeley/Refworks, etc
- Make it a habit to paraphrase every relevant sentence you write down from a source



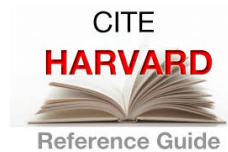
## Objectives of the Lecture

- To understand what references are and the need to reference in scientific reports
- To learn the reference styles with particular focus on the Harvard style of referencing



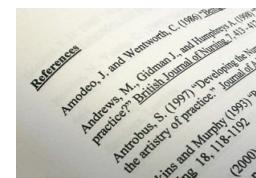
## Reference Styles

- Literally hundreds of different referencing styles
- Differs with academic discipline and publishing houses
  - Emerald, Taylor and Francis, Elsevier, etc
- Whichever system you use, it is important that you are consistent in its application



## Some discipline specific reference styles

- Arts
  - Harvard, Chicago, MLA, APA, University of Auckland Style
- Business and Economics
  - APA
- Creative Arts and Industries
  - APA, Chicago, Harvard, MLA
- Engineering
  - Harvard, Chicago, etc
- Medical and Health Sciences
  - Vancouver, APA



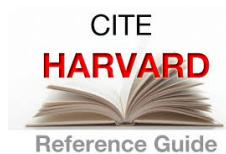
## Some discipline specific reference styles in the Sciences

Department	Style
Biological Sciences	APA
Chemistry	ACS
Computer Science	Not prescribed, although APA and IEEE styles may be used
Environmental Science	Not prescribed
Food Science	Harvard
Forensic Science	APA
Geology	Harvard
Marine Science	APA
Mathematics	Not prescribed
Physics	Harvard

The University of Auckland, 2013

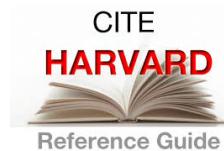
## The Harvard Style

- **Harvard** came originally from "The Bluebook: A Uniform System of Citation" published by the Harvard Law Review Association
- The Harvard style and its many variations are used in law, natural sciences, social and behavioural sciences, and medicine



### The Harvard Style: Citation in the text

- Generally, in internal references the surname of the author and year of publication are cited
- If author name is James Robert Jones and year of publication is 2012
  - (Jones, 2012)



### The Harvard Style: Citation in the text...

- If author's name is part of a statement put only the year in brackets
  - Jones (2012) has provided evidence to support this statement
- For two authors
  - (Bellamy and Taylor, 1998)
  - Bellamy and Taylor (1998)



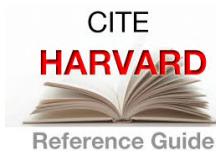
### The Harvard Style: Citation in the text...

- If there are more than 3 authors cite only the first followed by “*et al.*” (which means “and others”)
  - “The kernel meal of the cashew is rich in essential amino acids that are normally lacking in some plants; lysine and methionine (Ekpeyong *et al.*, 1997)...”
- If used in statement
  - Ekpeyong *et al.* (1997)



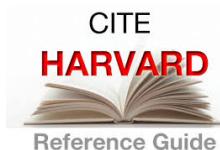
### The Harvard Style: Citation in the text...

- If an author has published more documents in the same year, distinguish them by adding lower-case letters
  - Smith (2014a, 2014b, 2014c)...



## The Harvard style: Secondary referencing

- When an author quotes or cites another author and you wish to cite the original author **you should first try to trace the original item**
- If it is not possible, then acknowledge both sources in the text, but only include the item you actually read in your reference list



## The Harvard style: Secondary referencing

- Example:
- If Jones discusses the work of Smith you could use:
  - Smith (2012) as cited by Jones (2013)
  - Smith's 2012 study (cited in Jones, 2013) shows that...
- Then cite Jones in full in your reference list

## How about information found in more than one source?

- If you find information in more than one source, you may want to include all references to strengthen your argument
  - Place them in order of publication date (earliest first)
  - Separate the references using semi-colon (;)
- Several writers (Jones, 2011; Owiredu, 2013; Smith, 2014) have reported that...



## The reference list/Bibliography

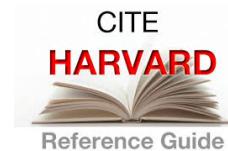
- Full references of sources used should be listed as a reference list at the end of your work
- This list of references is arranged alphabetically usually by author
- You may also be required to include a **bibliography** which should list not only all items used within the text but also any other sources you have read as part of your research

## Examples of a Reference list

- MAIMON, D. and BROWNING, C.R. (2012) Adolescents' violent victimization in the neighbourhood: situational and contextual determinants. *British journal of criminology*, 52 (4), pp. 808-833.
- Borget, J.L., Briggs, G.M. and Galloway, D.H. (1994), "Nutrition and Physical fitness", *International Journal of Food Science and Nutrition*, Vol. 45, pp. 223-230.
- Olaofe, O.F., Adeyemi, O. and Adediran, G.O. (1994). Amino acid and mineral composition and functional properties of some oil seeds, *Journal of Agriculture Food Chemistry*, Vol. 42, pp. 867-884.

## What I have talked about so far

- Myriad number of referencing styles
  - But be consistent in whichever system you use
- Some referencing styles are discipline specific
  - APA is the most commonly used
  - Harvard style is what is used in Food Science
- Citation in text
  - Secondary referencing
- Reference list

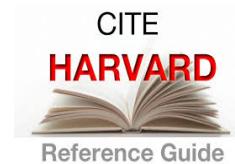


## How to reference books

- Author(s) (Year) Title. Edition – if not the 1<sup>st</sup>. Place of publication: Publisher.
  - CLARKE, S. (2011) *Textile design*. London: Laurence King.
  - SEIDMAN, S. (2012) *Contested knowledge*. 5th ed. Hoboken, New Jersey: Wiley-Blackwell.
- Note: It is required/very important to include the page numbers where references were taken
  - Nieman, D.C., Butter, W. and Nieman, C.N. (1992), *Nutrition*: Wm, C. Brown publishers, Dubugme, pp. 9, 540.

## Books with more than two authors

- Light, G., Cox, R. and Calkin, S. (2009). *Learning and teaching in higher education: the reflective professional*. 2nd ed. London: Sage.
- List all the names of authors once in the reference section



## Chapters in books

- AUTHOR(S) (Year) Title of chapter. In: AUTHOR(S)/EDITOR(S), (ed./eds.) *Book title*. *Edition*. Place of publication: Publisher, Pages, use p. or pp.
- TUCKMAN, A. (1999) Labour, skills and training. In: LEVITT, R. et al. (eds.) *The reorganised National Health Service*. 6th ed. Cheltenham: Stanley Thornes, pp. 135-155.
- Note: Electronic books should be cited exactly the same as print, following the rules above

## References from journal articles

- AUTHOR(S) (Year) Title of article. *Title of journal*, Vol. no. (Part no./Issue/Month), Pages, use p. or pp.
  - MAIMON, D. and BROWNING, C.R. (2012) Adolescents' violent victimization in the neighbourhood: situational and contextual determinants. *British journal of criminology*, 52 (4), pp. 808-833.
  - Maimon, D. and Browning, C.R. (2012). Adolescents' violent victimization in the neighbourhood: situational and contextual determinants. *British journal of criminology*. 52 (4): 808-833.
  - Maimon, D. and Browning, C.R. (2012), Adolescents' violent victimization in the neighbourhood: situational and contextual determinants, *British journal of criminology*, 52 (4): 808-833.

## References from journal articles

- When journal is taken from internet or a database, it should be cited as print using the rules earlier discussed
- Only include the web address or database name if there are no page numbers and just use the main web address, not the unique address of the individual article
  - Stamm, M.C. (2013). Information forensics: an overview of the first decade. *IEEE Access*, 1. Available from <http://www.ieee.org/IEEETweet>.

## Referencing Newspaper articles

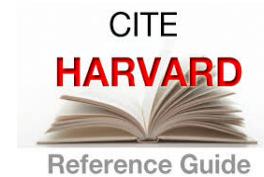
- AUTHOR(S) (Year) Article title. *Newspaper title*, Day and Month (abbreviated). Pages, use p. or pp.
  - Aldrick, P. (2014). It's not just academic: universities could make a difference to Britain's exports. *The Times*, 9th Jan. p. 45.
- Where there is no page number e.g. for an online newspaper use the source, and add the date accessed
  - Goodley, S. (2012) Bank of England cuts UK growth forecasts. *Guardian*, 8th Aug. Available from: <http://www.guardian.co.uk> [Accessed 20/10/13].

## Papers in conferences

- AUTHOR(S) (Year) Title. In: *Title of conference proceedings. Place and date of conference* (unless included in title). Place of publication: Publisher, Pages, use p. or pp.
- Chan, T.M. (2011). Three problems about dynamic convex hulls. In: *Proceedings of the 27<sup>th</sup> Annual Symposium on Computational Geometry, Paris, June 2011*. New York: ACM, pp. 27-37.

## Publications from a corporate body (e.g. Government publications)

- NAME OF ISSUING BODY (Year) *Title*. Place of publication: Publisher, Report no. (where relevant).
  - FAO (1990). Report on malnutrition. Elsevier. London: HMSO, Cm 413.



## Still on references...

- **Acts of Parliament**

- *Title of the Act and year* (chapter number of the act; abbreviated to 'c.'). Place of publication: Publisher.
- *Environment Act 2005* (c. 25). London: The Stationery Office.

- **Market research reports**

- NAME OF ISSUING BODY (Year) *Title, date (if available)*. Edition (if available). Place of publication: Publisher, Report no. (if relevant)
- MINTEL (2012) *Coffee: Mintel marketing report, April 2012*. London: Mintel International.

## Still on references...

- **Standards (GSA, ISO, etc.)**

- NAME OF AUTHORISING ORGANISATION (Year of publication) *Number and title of standard*. Place of publication: Publisher.
- BRITISH STANDARDS INSTITUTE (2008) *BS ISO 8178-2: Reciprocating internal combustion engines – exhaust emission measurement*. London: British Standards Institute.

- **Theses and dissertations**

- AUTHOR (Year) *Title*. Designation (Level, e.g. MSc, PhD.), Institution.
- FENG, W. (2010) *Remote service provision for connected homes*. Unpublished thesis (PhD.), De Montfort University.

## Referencing webpages (Electronic referencing)

- Electronic references should contain the following elements
  - AUTHOR(S) (Year) *Title of document*. [Type of resource] Organisation responsible (optional). Available from: web address [Accessed date].
  - NHS (2012) *Mobile phone safety*. [Online] NHS. Available from: <http://www.nhs.co.uk/conditions/Mobile-phone-safety/Pages/Introduction.aspx> [Accessed 08/08/12].
- If you are referencing an electronic journal article, newspaper article or book, use the standard referencing format for that item.

## How to reference a Software

- Individual authors are rarely acknowledged
- If you cannot find a named author of an electronic source then use the organisation or title in place of the author
- AUTHOR(S) or ORIGINATOR(S) (Year) *Title*. [Software] Version/series etc. Place of publication: Publisher.
  - SPSS (2004) *SPSS for Windows*. [Software] Version 12.0.1. Chicago: SPSS.

## **Introduction to Mendeley (A reference tool)**

Kwame Nkrumah University of  
Science & Technology, Kumasi, Ghana

## SECTION X: INTELLECTUAL PROPERTY RIGHTS



Quote

*“An original writer is not one who imitates nobody, but one whom nobody can imitate.”*

-Francois-Rene de Chateaubriand

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## Intended Learning Outcomes

By the end of this session, students will be able to:

- ✓ Know what intellectual property rights (IPRs) entail
- ✓ Distinguish between the various types of IPRs
- ✓ Know the importance of IPRs
- ✓ Understand the art of patenting an invention a scientific invention
- ✓ Know the importance of patenting
- ✓ Know the overview of the KNUST IPR policy

## Intellectual Property Rights (IPRs)

- IPRs or ownership protection rights are the legal rights granted to protect the creations of the intellect
- Different types of IPRs
  - Copyright
  - Trademark
  - Patent
  - Trade secret
- Protect valuable proprietary information

## Copyright

- A copyright protects original works that fall under;
  - literature
  - drama
  - musical
  - artistic
  - intellectual writings
- Exclusive rights to reproduce work in any medium



## Copyright...

- |                   |                                     |
|-------------------|-------------------------------------|
| ➤ literary work   | ➤ sound recording                   |
| ➤ artistic work   | ➤ audio-visual work                 |
| ➤ musical work    | ➤ choreographic work                |
| ➤ Published works | ➤ derivative work computer programs |

**Note:** A copyright protects a form of expression, but not the subject matter of the work

## Trademark

- A word, name, symbol or device (or any combination) adopted by an organization to
  - Identify its goods or services and to distinguish them from the goods and services of others
- used to protect a word, symbol, device, or name that is used for the purpose of trading goods
- None other can use the mark/sign/ symbol



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## Functions of a Trademark

- Indicates the source of origin of goods or services
- Helps guarantee the quality of goods bearing the mark
- Creates and maintains a demand for the product
- Used as a marketing tool to build a brand
- Can have great money value to a company
- Eliminate confusion when people are buying certain products



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Examples

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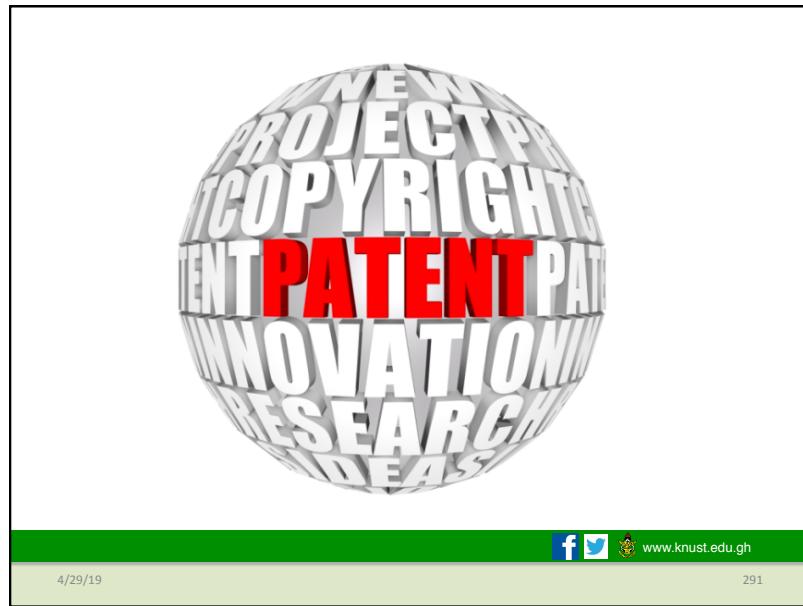
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Note!

A trademark does not prevent other people or businesses from producing the same product or services under a different mark



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### What is a Patent?

- Legal document – granted to the first person who invents a particular **invention** or **new product**
- Protects the idea or invention from being used by other parties
- Grants right to exclude others from making, using, offering for sale, selling or importing the invention
- Usually for a limited **period of twenty years** from the date patent application was first filed
- Invention falls into public domain afterwards

Below the list is a green footer bar with social media icons for Facebook and Twitter, and the website address 'www.knust.edu.gh'. At the bottom left is the date '4/29/19' and at the bottom right is the page number '292'.

## What is an invention?

- Invention means an idea of an inventor which permits in practice the solution to a specific problem in the field of technology
  - may be, or may relate to, a product or a process

## Some exceptions

- **The following are excluded from patent protection:**
  - (a) discoveries, scientific theories and mathematical methods
  - (b) schemes, rules or methods for doing business, performing purely mental acts or playing games
  - (c) methods for treatment of the human or animal body by surgery or therapy, as well as diagnostic methods practiced on the human or animal body

» Source: Ghana Patent Act 2003 (Act 657)

## Some exceptions...

(d) Inventions necessary to protect public order or morality, in the country of commercial exploitation which includes:

- (i) the protection of human, animal or plant life or health
- (ii) the avoidance of serious prejudice to the environment; if the exclusion is not made because the exploitation is prohibited

(e) Plants and animals other than micro-organisms;

(f) Biological processes for the protection of plants or animals other than non-biological and micro-biological processes

(g) Plant varieties

Source: Ghana Patent Act 2003 (Act 657)



## Patentable Inventions

- New inventions involves an inventive step and is industrially applicable
- any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof
- An invention is considered to involve an inventive step if;
  - the product or idea is non-obvious to a technical person in the field/ discipline
- An invention shall be considered industrially applicable if it can be made or used in any kind of industry



## Patentable Inventions

- An invention is new if it is not anticipated by a prior art
- Prior art consist of everything disclosed to the public
  - by publication in tangible form or by oral disclosure, by use or in any other way
  - prior to the filing or, where appropriate, the priority date, of the application claiming the invention

## Right to Patent

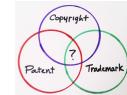
- The right to a patent belongs to the inventor
- Where two or more persons have jointly made an invention, the right to the patent belongs to them jointly
- Where two or more persons have made the same invention independently of each other, the person whose application has the earliest filing date shall have the right to the patent
- The right to a patent may be assigned, transferred or devolve by succession
- Where an invention is made in execution of an employment contract, the right to the patent belongs in the absence of any contractual provisions to the contrary, to the employer

## Categories of Patents

- Plant patent - plants created through asexual reproduction
- Utility patent - technology and inventions that have to do with mechanisms, piece of manufacture or machines which contribute to industrial and economical development
- Design patent - refers to designs and is given to anyone who creates a unique, useful, and new design for an article of manufacture

## Differences: Copyright, Patent & Trademark

- Copyright is automatic
  - Once you create a work, you have copyright protection
  - Registration is necessary in order to defend that protection
  - Registration does not create the copyright
- Trademarks and patents approval are not automatic
  - They come into being only when they are registered and the registration is approved



### Differences contd.

- Patents and copyrights expires, but trademarks do not
- A copyright will last for a lifetime, plus an additional seventy years
- A patent will last for twenty years after the application for the patent
- Once copyrights or patents expire, they cannot be revived
- Trademarks are issued for a finite period of time; but they can be renewed
  - In theory, a trademark could last forever

### Differences contd.

- Patent gives you the right to deny people to use, sell, or recreate your invention
- Patent rights holders are obliged to make their inventions public
- Both a trademark and a patent give their owners exclusive rights over subject matter whiles copyright does not

## Differences contd.

- A copyright protects the expression of a person's ideas. Must be original - a work that is not an exact copy of another work
- Patents protect inventions. Must be novel, useful, and non-obvious
- A trademark protects something that is used to identify where a product or a service comes from

## Trade Secret

- A knowledge or information or property which is not easily ascertainable
- Not found in public articles such as journals and books
- Can be for life if guarded properly
- Better to secure a TS for a product that will last for generations than patent
- For a product that is modified and not new, the trade secret is better since patent can not be given

## Patents vs Trade secrets

	<b>Patent</b>	<b>Trade Secret</b>
Duration	20 years	Forever
Subject matter	New Innovation	Not restricted
Requirement	Invention to be useful, novel and not obvious	No requirement apart from being secret and providing an economic advantage
Process of obtaining Protection	It involves invention in public domain via patent application	Maintaining secrecy and employing procedures for safe guarding secrecy
Protection against independent discover	Protect owners investment	Risks loss of invention by independent discovery of Trade secret by others

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## KNUST IPR Policy

- The purpose of KNUST's institutional policy on Intellectual Property is to
  - Create an environment that encourages and expedites the dissemination of discoveries, creations and new knowledge
  - generated by researchers for the greatest benefit of the public

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## KNUST IPR Policy

- According to the KNUST policy on IP
  - Ownership of IP created by faculty, staff, and students will reside with (or belong to) the inventor(s) unless:
  - The IP is developed in accordance with terms of a sponsored research or other agreement (ownership determined by terms of such agreement)

## KNUST IPR Policy

- The IP is created as a commissioned work prepared by an employee within the scope of his or her employment or as a specific assignment by KNUST (ownership resides with KNUST) or
- There is significant use of funds or facilities administered by KNUST in the development of the IP (ownership resides with KNUST)

*“No research without action, no action without research.”*

-Kurt Lewin

*“After all, the ultimate goal of research is not objectivity, but truth.”*

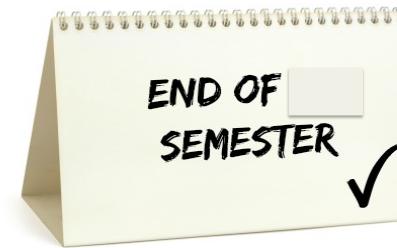
-Helene Deutsch

## Summary

What have you learnt throughout this course?

## Highlights

- ✓ Introduction to Research Design and Implementation
- ✓ Concept and Characteristics of Research
- ✓ Types and Approaches of Research
- ✓ Scientific Research and Steps in Conducting a Research
- ✓ Literature Search and Referencing
  - ✓ Referencing tool/Software (Mendeley)
- ✓ Data Analysis, Collection and Interpretation
  - ✓ Statistical software (SPSS)
- ✓ Communication
  - ✓ Oral, Written and Poster Presentation
- ✓ Intellectual Property



Remember that,  
*“An unexamined life is not  
 worth living.”*



-Socrates



## Students' Evaluation of Course

### Course Evaluation Form

1. Which of your expectation(s) have been met?
2. Which of your expectation(s) have not been met?
3. What were your most interesting experience in this course/lectures?
4. What did you not enjoy in this course/lectures?
5. Give suggestions (Ideas) that can help improve the course

## 1. Expectations that were Met

- Undertaking a good scientific research in an ethical manner
- What research entails and the practical nature of research
- Understanding the concept of Research, Design and implementation
- Practicality of the course
- Obtaining and interpreting a research data
- The use of SPSS in analyzing data
- Concept of patenting

## 1. Expectations That Were Met

- How to effectively make an oral presentation
- The importance of research
- Teamwork
- How to review literature
- Skills for a better presentation and PowerPoint preparation

## 2. Expectations that were not Met

- Practicality of the course(Example: an oral poster presentation)
- Understanding every single lecture very well
- The Practical use of the statistical tools
- How to write a proposal
- Using kahoot for other quizzes
- How to make presentations

## 3. Interesting experiences

- The opportunity to present before an audience
- Instances where students are allowed to bring out their own understanding of certain topics
- Presentations
- Kahoot
- Group works (Helps build friendship)
- The market research survey
- Numerous quizzes
- The Challenges to think about a product idea
- On spot critical thinking

### 3. Interesting experiences

- Learning new quotes
- Working with group members
- Discussions
- Market research presentation
- Combined professorship lectures
- Coco-challenge
- How lecturers interact with the class
- Different personnel in lecturing

### 3. Interesting experiences

- An interesting and interactive class involving dynamism
- Sharing of experiences, advice and encouragement from Lecturers
- Cooperation among lecturer when teaching
- All the lectures
- KNUST IPR policy lecture
- The lecture on Career

#### 4. Activities that were not Enjoyed

- Group Work (Some people are very difficult to work with)
- Tedious nature of assignment and so much pressure in submitting assignments
- The SPSS lecture was very confusing
- No review of the quizzes
- Duration of classes were sometimes longer than expected
- Work load especially in terms of Assignment
- Late notices
- Postponing of date for presentation

#### 4. Activities that were not Enjoyed

- There seemed to be some rushing through at certain points in the lectures
- The Library aspect was very complicated and not clear
- Some assignment given were not understandable
- Group work
- Got confused at some point in time
- Referencing and journal writing wasn't well understood

## 5. Suggestions for Improvement

- More time for Assignment to be done
- Proper explanation of assignments
- Maintain Problem based learning strategy since it helps students to think rather than just reading
- Task students and guide them to come out with a joint class publication by the end of the course
- Notices should be given early
- More Kahoot
- More group Assignments
- Sitting arrangement should continue since it makes interaction very easy

## 5. Suggestions for Improvement

- Individual presentations
- More presentation
- Inviting more resource persons to give presentations
- Reduce pressure on students
- Enough time for presentations
- The Library part should be revised effectively
- All the groups should present any assignment on the same day
- A trip to a research institute
- Facilitators should be maintained

## 5. Suggestions for Improvement

- Video should be added to the lecture
- various groups should be monitored and members should be allowed to assess each other
- Number of credit hour for course is small
- The number of group assignment should be reduced
- More interactive session
- TAs should be assigned to every group to help out in the presentations
- More group presentation

## 5. Suggestions for Improvement

- More presentations should be done as it makes practical the theories of the course
- The time of preparation for some presentations were short, students should be given 15-20 minutes for group discussion
- Format for end of semester should be given to students since the course entails a lot
- Video presentations
- Look out for students who have potentials but find it difficult to come out

## Skills Acquired by Some Students

- Improvement in Public speaking skills
- Boost in confidence
- Presentation skills
- Ability to work with a people