Computing Research Project

Research

Aims

- To introduce research in the context of computing projects

Learning objectives

- Discuss what research means
- Understand the research process
- Classify research and understand different research methods
- Understand issues surrounding interviews, questionnaires, and observational studies

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WHAT IS RESEARCH?

What is research?

- *The good researcher is not 'one who knows the right answers' but 'one who is struggling to find out the right questions might be'.* Phillips and Pugh (2005: 48)

A definition

- Research is defined by the Higher Education Funding Council for England (HECFE) as '***original*** investigation undertaken in order to ***gain knowledge*** and ***understanding***' (RAE, 2008)

Originality

- Doing something that has not been done before
  - Original in the ways you do things (using different technique or approach)
  - Original by producing or developing something new
- In term of originality in the ways you do things, there are several ways
  - Tools, techniques, procedures and methods
  - Exploring the unknown
  - Exploring the unanticipated
  - The use of data

Gain/contribution

- Rese ourself but c

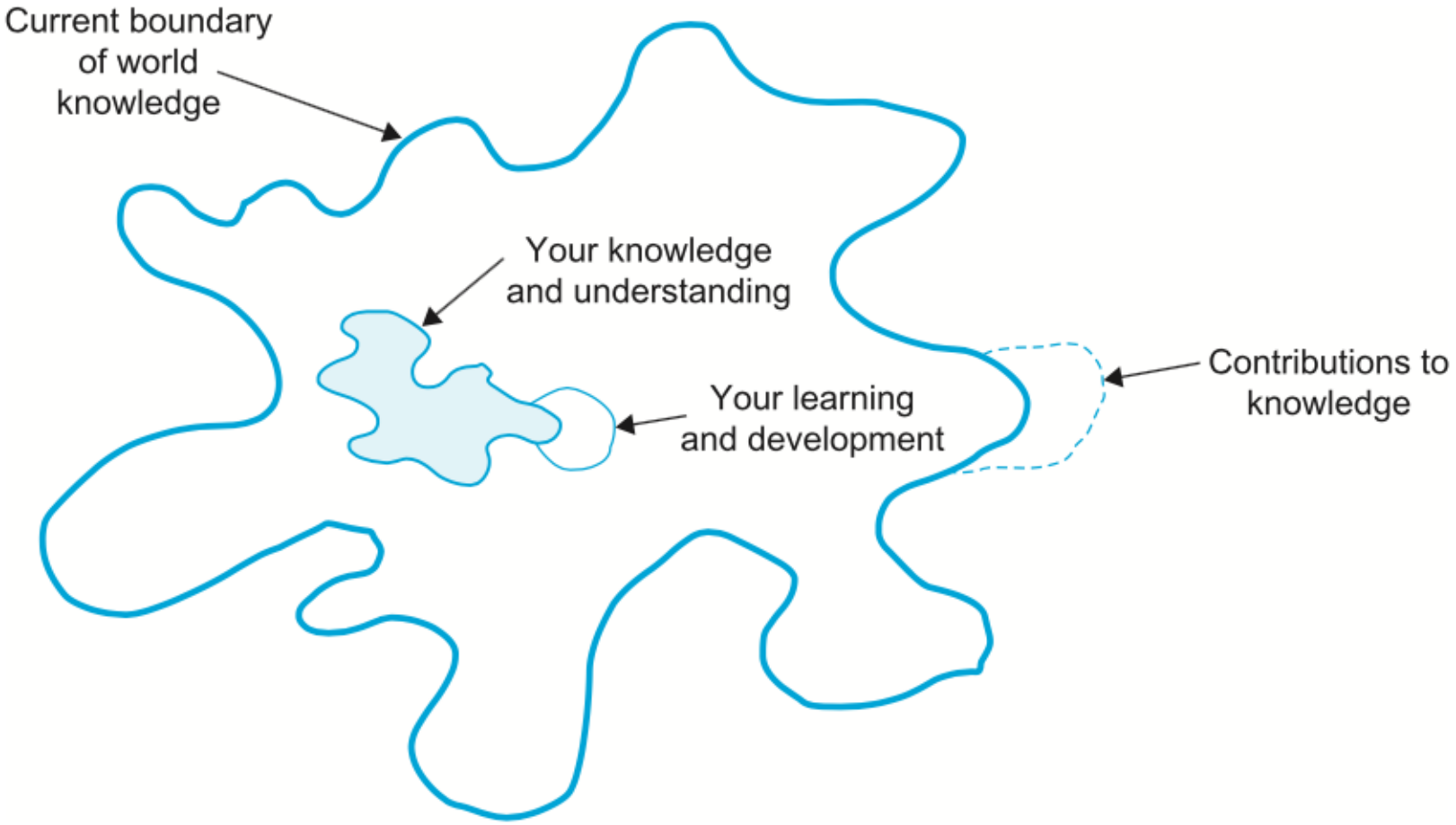

Figure 2.1 Contributions to knowledge

Knowledge and understanding

- There is a hierarchy: data, information, knowledge and wisdom
- Data
  - Factual elements that describe events
  - E.g., collecting data for your program's peer feedback
- Information
  - Represents data that have been processed in order to provide meaning
  - E.g., summaries of the results of your program's peer feedback
- Knowledge
  - Your high-level understanding of things (instead of 'what', this is about 'why')
  - E.g., explanation about the results of your peer feedback
- Wisdom
  - Ability about putting your knowledge into practice (create new knowledge and adapt to different situations)

Theory

- Data, information, knowledge, and wisdom represent “form” understanding
- Theory
  - Represents ideas, opinions, suppositions based on observations
  - Not necessarily true, at time, but is best explanation of the what observed

Collecting data and research

- Collecting data and information
  - Is termed “intelligence-gathering”
  - Used to answer “what” questions (what is happening, what don’t we know, what can we find out)
- Research
  - Must go beyond gathering data and describing what we see
  - Must make contribution to knowledge
  - Looks for “explanations, relationships, comparisons, predictions, generalizations and theories”
  - Addresses “why” questions (why do things happen the way they do? etc)

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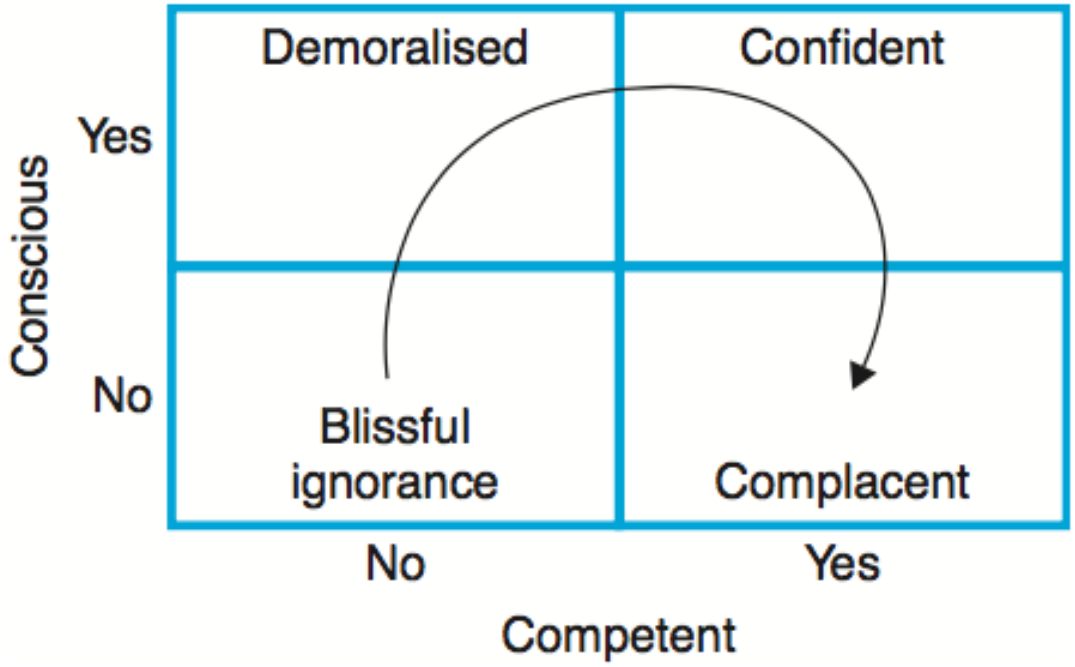
Self-awareness of a research field



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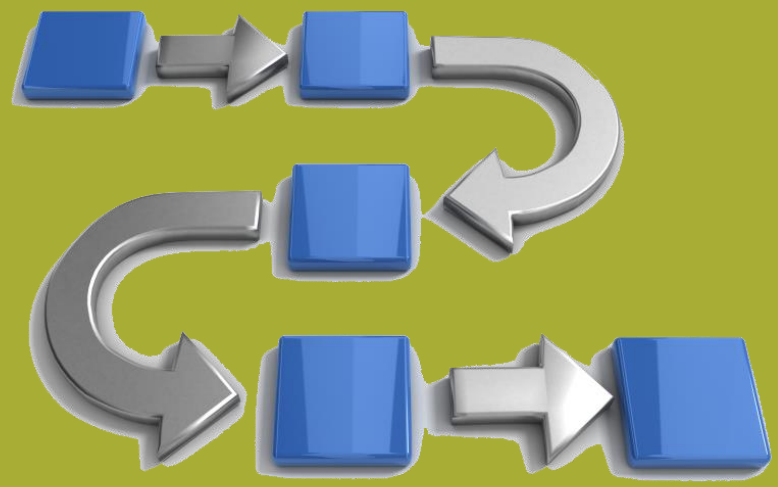
THE RESEARCH PROCESS

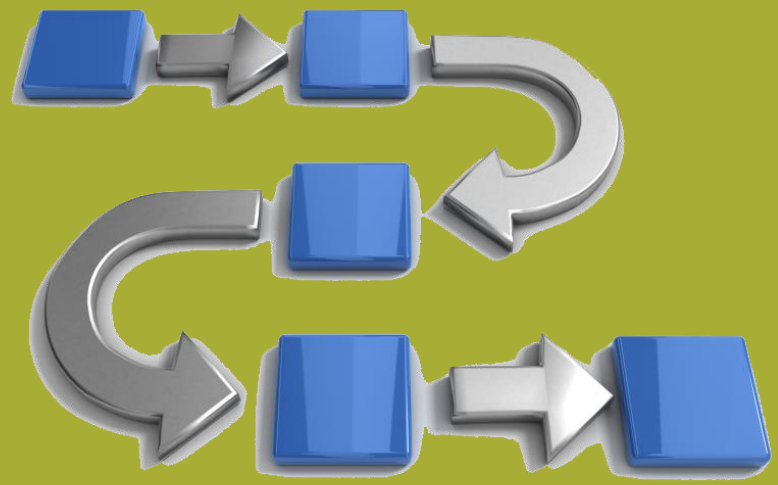
Overview

- Research should follow a recognized process
- Common views of research process:
  - Sequential
  - Generalized
  - Circulatory
  - Evolutionary



Sequential

- Series of activities are performed as a “fixed, linear series of stages”
- E.g., steps
  - Identify the broad area of study
  - Select a research topic
  - Decide on an approach
  - Plan how you will perform the research
  - Gather data and information
  - Analyze and interpret data
  - Present the results and findings



Generalized

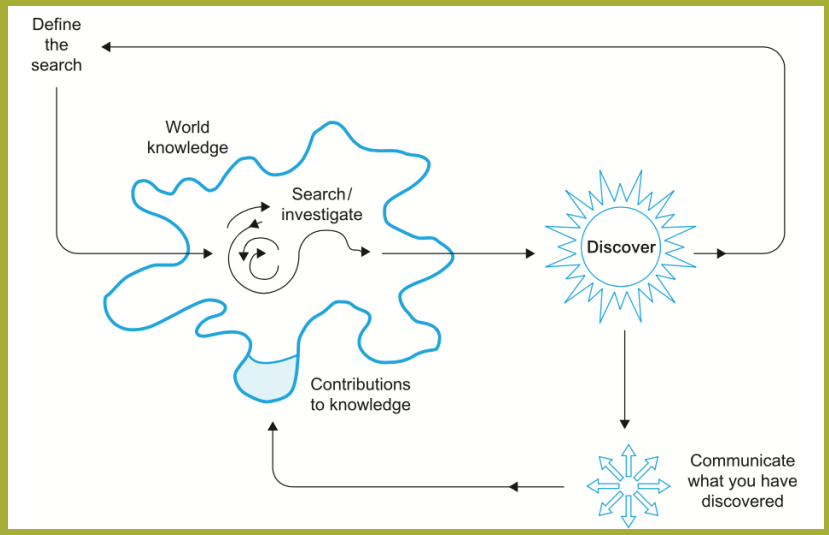
- Also define a sequence of activities to performed after one another
- However, not all stages are applicable and some steps may require performing in different ways depending on the nature of the research
  - I.e., identify alternative routes that may be taken at different stages
  - E.g., Kane defined 11 distinct stages and number of alternative methods

Circulatory

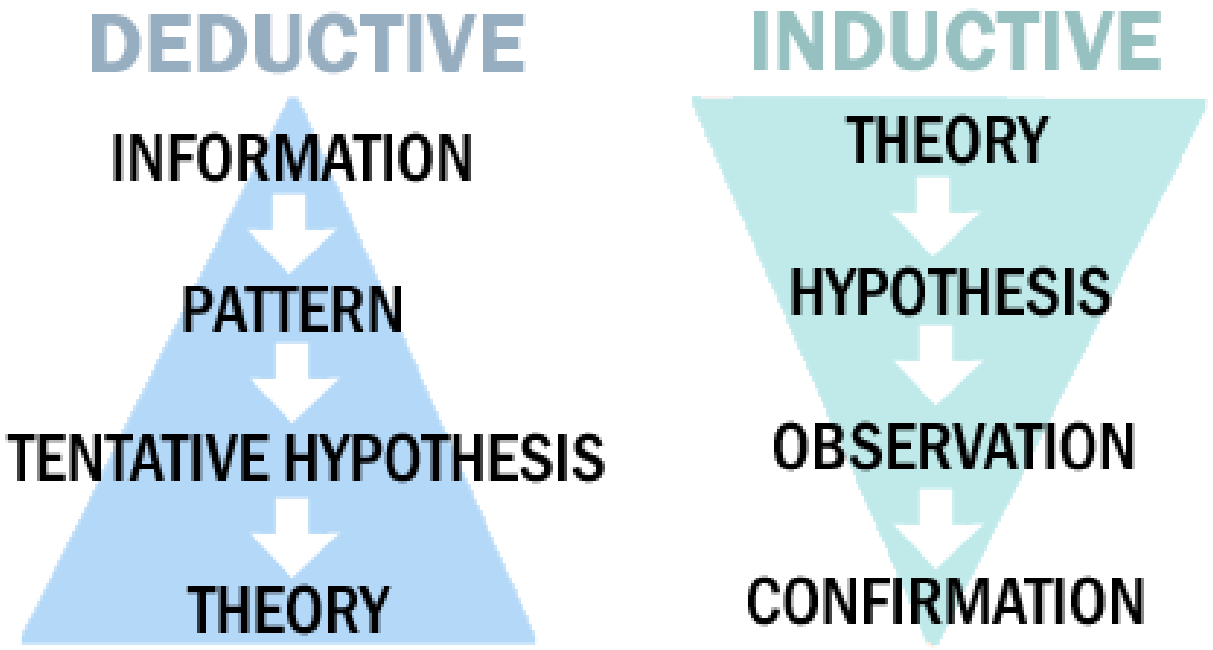
- It recognizes that any research is only part of a continuous cycle of discovery and investigation
- Research will uncover more questions than it answers and can begin again by attempting to answer these new found questions

Evolutionary

- It takes the circulatory interpretation one step further, it recognizes
  - That research must evolve and change over time
  - That research does not necessarily follow a defined circulatory pattern
  - That research does not necessarily repeat the same forms of analysis and interpretation that were performed before
- The outcomes of each evolution impact on later ones to a greater or lesser extent
- E.g., one that defined by Orna and Stevens (1995: 11)

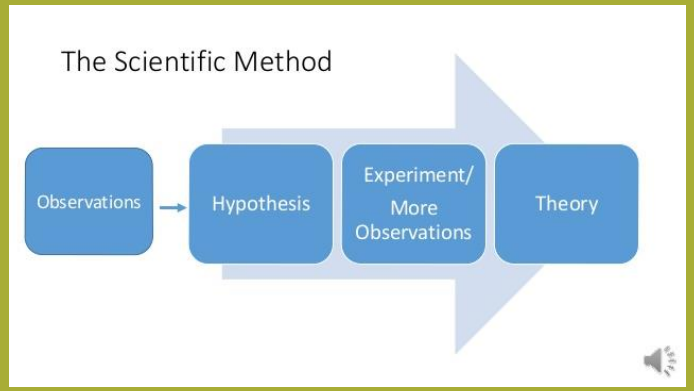


Intellectual discovery



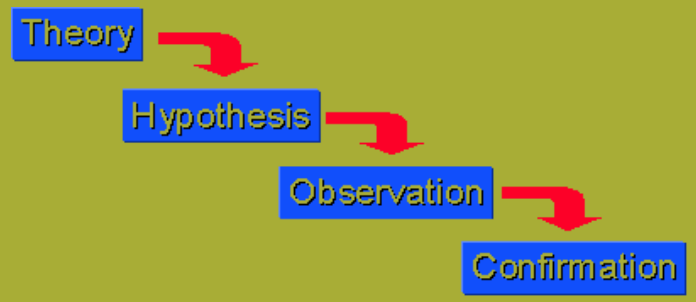
Inductive reasoning

- Start with the observations of the world then come to general conclusions about it
  - The knowledge obtained is referred to as epistemology
- *Positivism*
  - Draw general conclusions from what you observe and apply to other things
- *Anti-positivism*
  - Induce knowledge unique to yourself and the particular situation under study



Deductive reasoning

- Start with your knowledge, predict likely observations
- This is affected by your
  - Understanding of the world
  - Underlying assumptions
- This is referred to as *ontology*



Some other intellectual discovery techniques

- If you are having difficulty solving a problem you can
  - Assume the problem is solved and calculate the backward
  - Assume the problem is impossible and try to prove why
- Some other techniques
  - *Random guesses*: generating number of potential solutions at random (as brainstorming)
  - *Analogy*: Is this similar to something already has a solution or explanation?
  - *Inversion*: Look at things from opposite angle (e.g., what programming language to use to why shouldn't I use Java?)
  - *Partition*: Break into smaller and manageable parts

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CLASSIFYING RESEARCH

Classifying research

- Research can be classified from three different perspectives
  - Its field, its approach, its nature
- Field
  - In computing we may have: Information systems, artificial intelligence, software engineering and so on.
  - These may be further sub-divided into more specific topics for more specialist
- Approach
  - The research methods employed as part of the research process
  - E.g., case study, experiment, and survey
- Nature
  - Three categories of nature of research:
  - Category 1: Pure theoretical development
  - Category 2: Research that reviews and assesses pure theory and evaluates its potential for practical application
  - Category 3: Applied research that has some practical application or outcome˜

Nature of research: common classifications (1/2)

- Pure theory
  - Developing theories to explain things without necessarily linking them to practice
- Descriptive studies
  - Reviewing and evaluating existing theory and knowledge in a field or describing particular situations or events
  - This may include testing existing theories, describing the state of the art, or looking for limits in previous generalizations
- Exploratory studies
  - Exploring a situation or a problem
  - Useful to find out “what is happening; to seek new insights; to ask questions and to assess phenomena in a new light”
  - Can be performed through literature searches, open questionnaires and interviews

Nature of research: common classifications (2/2)

- Explanatory studies
  - Explaining or clarifying something or some phenomena and identifying the relationships between things
- Causal studies
  - Assessing the effects that one or more variables have on another
  - Manipulate independent variables & monitor changes to dependent variables
- Resolving a problem with novel solution and/or improving something in one way or another
- Developing or constructing something novel

What is good research?

- Open minds
  - Should work with “open system of thought”
  - Be open minded to the questions posed
- Critical analysis
  - Examine data critically
  - Are these figures correct?
  - Have they been affected in some way?
  - What do these data really mean?
  - Are alternative data available?
  - Can these data be interpreted differently?
- Generalization
  - Generalize and specify limits on the generalizations
  - Generalize to apply to wide variety of situations
  - Knowing the limitations to know when not to apply these

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RESEARCH METHODS

Main classes of research methods

- Quantitative
  - Associated with measuring things on numeric scales
  - Concerned with understanding “how something is constructed/built/works”
- Qualitative
  - Primarily concerned with increasing understanding of a substantive area, rather than producing an explanation for it
  - More common within the field of information science and involve methods such as case studies and surveys.

Main research methods

- Action research
  - Involves working on a specific problem or project
  - Note: shouldn't be too focusing with completing the action itself and neglect the real reason for doing it (i.e., evaluating it as part of your academic project)
- Experiment
  - Investigation of causal relationships using tests controlled by yourself.
- Case study
  - Is "an in-depth exploration of one situation"
  - Can be performed directly: interviews, observe, etc.
  - Can also be performed indirectly: studying reports or documentation
- Survey
  - Often use questionnaires and interviews

Research techniques

- There are three techniques appear again and again in both case study research and surveys are
  - Interviews
  - Questionnaires
  - Observations

References

Dawson, C. W. (2009). *Projects in Computing and Information Systems A Student's Guide* (2nd Edition ed.). Pearson Education.