

## CONCEPT OF RESEARCH

1. Research is an *original* investigation undertaken to *gain knowledge* and understanding.

(1) Originality is doing something or producing something that has not been done before.

- *Inductive reasoning*: start with observations of the world and come to general conclusions about it, i.e., to build models and theories based on someone's interpretation of the world.
- *Deductive reasoning*: start with knowledge and understanding of the world, and predict likely observations within it, even though might not have encountered them before.

(2) Gain means that research should actually lead to contribution to knowledge, not simply new to someone.

(3) Different levels:

- *Data*: factual elements that represent the raw numbers and raw text gathered from investigation.
- *Information*: data that have been processed to provide some insight into their meanings.
- *Knowledge*: higher level understanding of things.
  - While information provides an idea of the 'what', knowledge represents understanding of the 'why'.
- *Wisdom*: ability to put knowledge into practice, i.e., to apply skills and experiences to create new knowledge and adapt to different situations.

- *Theory*: ideas, opinions, and suppositions based on observations of the world.
  - A theory is not necessarily true but, at the moment, it represents the best explanation for observations.
- *World knowledge*: world understanding, wisdom, and interpretation by everybody and everything that is recorded or documented somewhere and somehow.

2. *Intelligence-gathering* refers to the action of collecting data and information, but research must go beyond merely gathering data and need to describe what has been seen.

(1) It must make a contribution to *knowledge*.

(2) It looks for explanations, relationships, comparisons, predictions, generalizations, and theories.

3. Research Process:

(1) In a *sequential* process to perform a series of activities one after another as in a fixed, linear series of stages.

(a) review the field, i.e. perform a literature survey;

(b) build a theory based on the understanding and interpretations of the field;

(c) test the theory: does it work?

(d) reflect and integrate, i.e. update ideas based on 'tests' and contribute newly-found knowledge to others.

(2) The *generalized* research process identifies alternative routes that may be taken at different stages depending on the nature and outcomes of the research.

- It is identical to the sequential process in that activities are performed one after the other in a defined sequence.
  - It also recognizes that not all stages are applicable and some steps may require performing in different ways depending on the nature of the research.
- (3) The *circulatory* approach recognizes that any research that you perform is really part of a continuous cycle of discovery and investigation.
- Quite often research will uncover more questions than it answers and, hence, the research process can begin again by attempting to answer these new-found questions.

- Experiences of research might lead you to revisit or reinterpret earlier stages of your work.
  - The circulatory interpretation also permits the research process to be joined at any point and recognizes that the process is never ending.
- (4) The *evolutionary* concept takes the circulatory interpretation one stage further and recognizes that research must evolve and change over time.
- It does not necessarily following a defined circulatory pattern or repeating the same forms of analysis and interpretation that were performed before.
  - The outcomes of each evolution impact on later ones to a greater and lesser extent.

#### 4. Research classifications:

- (1) The *field* of research is little more than a labeling device that enables groups of researchers with similar interests to be identified.
- (2) *Approach* represents the research methods that are employed as part of the research process.
  - *Action research* involves working on a specific problem or project with a subject and evolving the results. This method is used to gain a greater understanding and improvement of practice *over a period of time*.
  - *Experiment* involves an investigation of causal relationships using tests controlled by yourself.

- *Case study* involves the investigation of a particular situation, problem, company, or group of companies for an in-depth exploration.
  - *Survey* is usually undertaken through the use of questionnaires or interviews.
- (3) The type of contribution that research makes to knowledge depends upon its *nature*.
    - *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. It might 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. These studies can start out by exploring particularly broad areas, concepts, and ideas before focusing in and narrowing down to specifics as the research progresses.
- *Explanatory studies*: explaining or clarifying something or some phenomena, and identify the relationships between things.
- *Causal studies*: assessing the effects that one or more variables have on another, e.g., 'Does the size of software product affect the difficulty of software maintenance?'

#### 5. Characteristics of good research:

- (1) *Open minds* — to work with an open system of thought. Conventional wisdom and accepted doctrine may turn out to be inadequate.
- (2) *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?
- (3) *Generalizations* — to generalize and to specify limits on the generalizations.

## RESEARCH STRATEGIES

1. *Literature searching* is a systematic gathering of published information relating to a subject.
  - (1) It is important to focus your literature search on relevant materials.
  - (2) The materials to trace should have been suitably refereed before publication. They have been assessed for academic worthiness by 'experts' and accepted as significant artifacts that contribute to the field.
2. Check information from different resources
  - (1) Textbooks contain stable, but sometimes out-of-date, information.

- They provide a good grounding and a good overview of a topic area.
  - As they are for different audiences, some details may not be available.
- (2) Survey papers in journals/conferences are concentrated
  - Journal papers discuss up-to-date issues. They represent the current limits and developments in your subject area.
  - General journal papers are quite specific, and sometime only part of an article is suited to your needs.
  - Conference papers contain more up-to-date ideas as they sometimes present preliminary results from research that has yet to mature.

- The majority of references of your literature review should be journal and conference papers as they represent the latest thinking in your field.
  - Keywords: *survey, roadmap, taxonomy, tutorial*
- (3) Person-to-person discussions in conferences or seminars provide the opportunity to obtain further information.
  - (4) Theses usually contain information of a subject, including list of references and researchers, in survey section. They are also a good source of implementation details.
  - (5) Technical reports may provide the most current, but usually unofficial, information of an area.
  - (6) Company reports and documentation can provide valuable information for case studies.

- (7) Manuals should be used when needing technical details for help, not as foundations for academic discussion.
  - (8) News groups carry interesting, but sometimes annoying, concepts.
  - (9) Other sources of information should be treated with more caution, including letters, memos, computing magazines, the Internet, company sales literature, and television programs.
- ### 3. Time management
- (1) assessing while gathering
    - Evaluate the source of information according to its credibility. IEEE, AAI, and ACM publish only 5-10% of received papers.

- A book: begin with the title, move on to the contents listing, and scan the index for keywords that are important to you.
  - 'Is the author well recognized?'
  - 'Is the book up-to-date?'
  - 'Is this the latest edition?'
- An article: read the abstract and keywords, look at the list of references at the back, move on to reading the introduction and the summary/conclusions.
  - 'Are the key works cited?'
  - 'Are there useful references you can use?'
  - 'Is it highly technical and readable?'
  - 'Is it a review, an introductory, or a discussion paper?'

- (2) make a proper schedule
4. Start with a general area, and then narrow down to specific topics
  - (1) Identify the active research topics
  - (2) Decide according to personal background and interest
  - (3) Pay attention to the legal and ethical issues
  - (4) Pursue with passion
  - (5) Know one's limits
5. Get help
  - (1) Efficient use of help
    - be prepared before going
    - know the problem

- understand and follow advises

## 6. Manage information

- (1) Categorize information according to the areas and sub-areas
- (2) Read online vs. photocopying
- (3) Make notes with highlighting
- (4) Write brief notes on the front pages
- (5) Record references of the materials in the right format
- (6) Using a consistent naming scheme, e.g., 'yuan2003'
- (7) Where to keep abstracts of papers?

## **RESEARCH TOOLS**

### 1. Tracing information:

- (1) libraries, inter-library loans
- (2) references at the back of papers
- (3) Internet sites: [www.acm.org](http://www.acm.org), [www.ieee.org](http://www.ieee.org), [www.citeseer.com](http://www.citeseer.com)
- (4) journals, conferences, seminars, and active research groups
- (5) Searching engines
  - the normal searching engines
  - [www.searchenginewatch.com](http://www.searchenginewatch.com) for new search engines

### 2. Bibliography management:

- (1) Databases
  - Scholar's Aid: [www.scholarsaid.com/downsafree.html](http://www.scholarsaid.com/downsafree.html)

- (2) Bibtex for LaTeX
3. File translation (from one language to another)
  - (1) Web page: [babelfish.altavista.digital.com/cgi-bin/tranlate?](http://babelfish.altavista.digital.com/cgi-bin/tranlate?)
4. Documentation
  - (1) LaTeX, Microsoft Office
  - (2) Acrobat
  - (3) Learn to write a good survey
  - (4) Create an outline of the survey early
5. Professional help
  - (1) The Academic Writing Center
  - (2) Native speakers

### **Forthcoming Conferences**

1. How to Find the conferences in your area:
  - (1) Check the homepages of well-known associations, societies, and organization for information about workshops, forums, and conferences they will hold in your research field.
    - [www.computer.org/conferences/calendar.htm](http://www.computer.org/conferences/calendar.htm)
    - [www.ieee.org/conferencesearch](http://www.ieee.org/conferencesearch) or [www.ieee.org/conferences/](http://www.ieee.org/conferences/)
    - [www.acm.org/events](http://www.acm.org/events)
    - [www.netlib.org/confdb/conf-list.html](http://www.netlib.org/confdb/conf-list.html)
    - [www.iso.org/en/commcentre/events/Eventsindex.html](http://www.iso.org/en/commcentre/events/Eventsindex.html)
    - [www.ietf.org/meetings/meetings.html](http://www.ietf.org/meetings/meetings.html)

- (2) Attend conferences/workshops to obtain information on future conferences
- (3) Check journals for upcoming conference information.
- (4) Register to mailing list of newsgroups.
- (5) Get help from professors and researchers.
- (6) Check the websites of big companies such as IBM, HP, and SUN for the technical conferences they often hold each year.
- (7) Use search engines to search over the Internet.

## 2. How to rank the conferences

- (1) use the reject rate to judge upon the quality of a conference

- (2) check the sponsors of conferences
  - the citation index tells about the sponsors: [www.isinet.com/isi](http://www.isinet.com/isi)

### Leading Researchers

1. Leading researchers are those researchers whose work influences the other researchers in the area.
2. How to Find the Leading Researchers (in your area):
  - (1) Those researchers whose articles are referred most
    - # of journal publications and the impact rating on the journals
    - # of conference publications and the rank of the conferences
    - # of patents received
    - # of journals on which serving/served as Editorial Board Member
    - # of journals on which serving/served as Reviewer

- # of conferences organized/chaired and their ranks
  - # of awards received and their reputations
  - # of books authored/co-authored/edited
- (2) Those who published milestone papers
  - (3) Those who gave panel speeches
  - (4) Those who lead important labs
  - (5) Those who are in different types of "Who is who"
    - Who's Who in America
    - Who was Who in America
    - Who's who in 20th Century America
    - Who's who in the World
    - Marquis Who's Who Regional Publications
    - Marquis Who's Who Professional Publications

### 3. How to make a request

- (1) What to request?
- (2) Formal or informal?
- (3) How much about yourself?

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### Literature Review

#### 1. *Critical reading* is:

- (1) one that goes beyond mere description by offering opinions, and making a personal response, to what has been written;
- (2) one that relates different writings to each other;
- (3) one that does not take what is written at face value;
- (4) one that views research writing as a contested terrain, leading to alternative views and positions

#### 2. Points to consider:

- (1) What kind of article is it — a review paper, a theory paper, a case study etc.?

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- (2) What can you gain from the article — ideas, techniques, useful quotations etc.?
- (3) Is the author well recognized in the field? Is he or she an authority in this area?
- (4) What contribution is being made by the article? What kind of contribution is it?
- (5) How important is the article in its field and your own? Does the paper classify and summarize its field in a clearer or more logical way than has been done before?
- (6) Do conclusions follow logically from the work that has been presented? Are the arguments logical?
- (7) Can you differentiate fact from unsubstantiated opinions? Are these opinions supported by logical argu-

ments or other authors?

- (8) Do you agree with statements that are made? Are there any counter arguments?
- (9) How does the article relate to other literature in the field?
- (10) Are references appropriate, relevant, up-to-date?
- (11) Are there limits to what the author is suggesting? Is the author's argument only applicable to certain cases?
- (12) Can you use the results from the article in your own work?

## SURVEY WRITING

1. A literature review should provide a coherent argument that leads to the description of a proposed study.
  - (1) The review needs to be developed through your critical evaluation and critical understanding of the relevant literature.
  - (2) It needs to reference to the past and current literature in your field(s) and will involve a discussion of current omissions and any biases you may have identified.
  - (3) It cannot be only a number of related articles and books that you has gathered or read.
    - It is not a report that lists all the papers and books you have read whether they are relevant or not. You

must be selective about that to which you refer.

- It must not dedicate a page or paragraph to each article in turn, merely reporting on their content.

## 2. Writing

- (1) A series of chapters
  - Abstract should be short and right to the points.
  - Introduction starts with the general problem, followed by the specific problem, and ends with a brief description of the survey structure.
  - Each chapter concentrates on a particular topic. It has a short introduction to the subject area, provides information about current research in the area, discusses relationships among research works, and iden-

tifies advantages, disadvantages, limits, further improvements.

- Conclusion provides some meaningful thoughts about your study.

(2) Professionally sound

- Correct English grammar and right writing styles
- Paraphrase only when absolutely necessary
- 20% or less passive voice
- Proofread before submitting
- Enthusiasm

(3) Professional look

- Proper page layout
- No missing pages