Research Methods in Human-Computer Interaction

Kerstin Severinson Eklundh
Ann Lantz
HCI group, CSC-KTH
The purpose of the course

- To analyze and discuss HCI as a science
- To review different research perspectives and methods, and how they are used in HCI
- To teach how to plan and perform a scientific investigation in HCI at a basic level

- Point of departure: your own research areas and questions!
HCI and other disciplines

- HCI is a young discipline (about 30 years)
- Has developed from computer science, with influences from cognitive psychology
- Other influences: sociology, anthropology, communication, design, ergonomics
- Related area: Interaction design
Content of the course

• The nature of HCI as a science
• Overview of research perspectives
  – Basic assumptions about user, context etc.
  – Research approaches and methods
  – Their limitations in application
• Methodological exercises
• The course attempts to provide a broad picture of research approaches in HCI
HCI as a "user science"

- All HCI research includes studies of the use of technology
  - Empirical study methods are essential
- But HCI is also closely related to the design and development of technology
- Important to discuss the relationship between research and development
Is HCI inter- or multidisciplinary?

• One discipline = one research community
  – Shared values, methods and concepts
  – Criteria for "good" and "bad" research

• Disciplines may have difficulties understanding each other (e.g. due to cultural differences)

• HCI demands cooperation among researchers

• How does real interdisciplinarity arise?
Inter- and multidisciplinary research

- Interdisciplinary research transcends the borders between knowledge areas and organisations ... The goal is an integration, gradually developing into a science of its own
- Multidisciplinary research has a clear division of labour among the sciences involved
  - Wallén: Vetenskapsteori och forskningsmetodik
Research approaches and perspectives

- Experimental psychology
- Cognitive modelling, task analysis
- Situated and distributed cognition
- Ethnography
- Conversation analysis
- Activity theory
- Organisational approaches

  – See Monk & Gilbert for an overview
HCI heritage from Computer Science

• Computer science was itself interdisciplinary
  – Mathematics + engineering
• A model for all kinds of engineering:
  – 1. Identify requirements
  – 2. Specify a design
  – 3. Build an implementation
• Waterfall model (top-down)
• More realistic: Iterative model!
HCI heritage from psychology

• Research object in cognitive psychology: mental processes (memory, thinking, learning)

• Approach:
  – modelling mental processes
  – influences from information processing in computers
  – Oriented towards experimental methods and controlled data management
  – Testing of hypotheses

• Limitations for HCI:
  – Great individual variations; many variables interact
  – De-contextualization
  – Strong focus on causal relations
HCI heritage from psychology, cont.

• Work psychology: originates from ergonomics
• Task analysis
  – 1. Informal description of tasks (e.g. as a scenario)
  – 2. Systems for formal description of work tasks
• Purpose: to match the system design to users’ tasks
  – Problem: many tasks are open-ended and cannot be described in a simple way with rules or tree structures
• Situated action: more recent approach
  – Socially oriented psychological theory
  – Individuals’ cognitive processes interacting with a social context
  – Method: interpretative, more field studies
Perspectives of HCI

• Other perspectives discussed in the course: activity theory, distributed cognition, conversation analysis

• Seminar next time (22 February): discussion of some influential perspectives and their implications
  – Read two articles and prepare three questions each
  – Kammersgaard: Four perspectives of HCI
Course requirements

• Active participation in seminars
• Methodological assignments
  – Research scenario (Feb, 27, March 1)
  – Questionnaire (March 8)
  – Interview (March 15)
  – Experimental methods (turn in before May 12)
  – Research plan (May 3 or May 17)
• Home examination
What is science? What is research?

• Scientific knowledge is different from everyday knowledge in that the conditions, methods and reliability of the knowledge are reviewed systematically (Wallèn)

• What is NOT science?
• Knowledge acquired through intuition, or skills (?)

• Is an enquiry a kind of science?
• Is construction of computer systems a science?
What is good research?

• Research is a systematic and methodical search for new knowledge and new ideas
  – (OECD)

• Two aspects of quality in research:
  – 1. Sociology of science, investigates how researchers actually carry out their work
What is good research? Cont.

• Research (especially in social science) is heavily influenced by the researcher’s perspective of humans
• The human as an object - or the human as a thinking and acting creature
• Paradigm: influential research traditions
Scientific traditions

• Positivism
  – Empirically verifiable knowledge
  – Measurement and measurement methods
  – Replicating results by repeated experiments
  – Explanations by cause and effect
  – Looking for general facts
  – The researcher should be objective
Critique of positivism

• The human is viewed as an object
• Ignoring culturally defined phenomena
• Interpretation cannot be avoided when investigating human and social affairs!
Systems theory

- Study of flows of information among interrelated objects
- How does a change in one part of the system affect other parts?
- How do processes develop over time?
- This perspective can be applied to several areas, with different assumptions
- E.g. Computer science, medicine, biology
Hermeneutics

- Interpretation of meaning in text, actions, symbols
- The interpreter has a pre-understanding through her linguistic and cultural knowledge
- Switching between perspectives of a whole and its parts
- An alternative or complement to positivism
- E.g. in psychology and health
Hermeneutics (Wikipedia)

- Hermeneutics may be described as the theory of interpretation and understanding of a text through empirical means. It should not be confused with the concrete practice of interpretation called exegesis. Exegesis extracts the meaning of a passage of text and enlarges upon it and explicates it with explanatory glosses; hermeneutics addresses the ways in which a reader may come to the broadest understanding of the creator of text and his relation to his audiences, both local and over time, within the constraints of culture and history. Thus it is a branch of philosophy concerned with human understanding and the interpretation of texts. Recently the concept of texts has been extended beyond written documents to include, for example, speech, performances, works of art, and even events.
Phenomenology

- A philosophical tradition about how humans perceive the world around them
- Opposite to positivism: no search for objective knowledge, rather the subjective experience of the individual
- Different research traditions do not exclude each other - but their assumptions may do so
- To what extent can they be combined?
Theories and models

• Theory
  – A conceptual description of a phenomenon; its essential features
  – Basic concepts and their internal structure

• Model
  – A simplified description of how different entities are related
  – Example: Norman’s model of the interaction process
  – What is covered by the model? What is missing?
Measurement

• How can variations in a phenomenon be measured?
• Subjective measures
  – Ratings, question-answer studies
• Objective measures
  – Direct observation
  – E.g. Time measurements, or process logs
• Validity: do you measure what you intended to measure?
• Reliability: do different measurements give the same result?
Different kinds of scientific studies

• Explorative study
  – May initiate new research in a field
  – Contributes to discovery and understanding of problems
  – Identify typical cases and relevant variables

• Descriptive study
  – Characterisation of a research object and its properties
  – Can be rather free from theoretical assumptions

• Explanatory study
  – Causal connections are looked for
  – Identifying the basic mechanisms behind a certain effect
Induction and deduction

• Induction: going from collected data, trying to reach general conclusions
  – E.g. In Grounded theory: collection of data, analysis and classification, conceptual analysis

• Deduction: empirical testing of a hypothesis, generated from a theory

• Usually in experimental study
  – Different factors (variables) are varied systematically and the effects are measured
System development as a scientific activity (?)

- Systematic study of users in relevant tasks
- Construction of a prototype ("hypothesis")
- Evaluation with users ("testing the hypothesis")

Usually an iterative process!

- Is this science? Depends on the systematic character of the process
Perspectives of the user

• A consciousness of the user perspective is important!
• Relationship with social environment
• Example 1: design of a car
  – How many doors?
  – How big should the baggage trunk be? (how far should one go?)
  – Placement of controls (who will be driving?)
Perspective of the user, cont.

• **Example 2: designing a bridge**
  – Which vehicles can pass beneath the bridge?

• **Example 3: a computer system**
  – Which metaphors and analogies are applied?
  – Whose knowledge do these metaphors represent?
Methodological principles

• Choice of problem
  – Could depart from some user need, or the lack of adequately designed technologies
  – The need for increased understanding of a domain

• Delimitation
  – Specifying the problem
  – What is the research question?
  – What will NOT be included in the study?
  – Sometimes initial explorative study is needed
Methodological principles, cont.

• Conceptual framework
  – Is there an established model of the processes included in the study?

• Choice of method of investigation
  – Should be adapted to the problem and the conceptual framework
  – Motivate your choice - discuss alternatives!
  – Triangulation (combination of methods) may be a good idea
Methodological principles, cont.

• Procedure for data collection and analysis
  – Consider validity and reliability
  – Will the procedure answer the correct question? Will it do so in a reliable way?

• Systematic way of collecting information
  – Always be consistent; the same level of detail everywhere
  – Document the procedure systematically

• Identify and avoid error sources!
Methodological principles, cont.

• In the presentation of results: explain clearly on what basis the conclusions are drawn
• Other researchers should be able to repeat the process you have followed
• Discuss problems with the chosen methods, and potential alternative approaches
  – What happens if I assume the opposite?
  – What limitations does my study have?
  – Which relevant question have I ignored?