Qualitative Research Methods in Computer Science

Edwin Blake
edwin@cs.uct.ac.za

Department of Computer Science
University of Cape Town

Overview
1. What is research and qualitative research about?
2. Examples of Qualitative Research
   1. Case studies
   2. Contextual Inquiry
   3. Ethnography
   4. Conversation Analysis
   5. Grounded Theory
3. Pragmatist Epistemology
4. Quality
5. Concluding Case Study

Qualitative Research
Research: an activity that contributes to our understanding
Research methods are the means by which a discipline
acquires and constructs knowledge.
Different philosophical assumptions about what constitutes
relevant knowledge
→ results in different strategies of enquiry and methods
→ qualitative research,
→ quantitative research and
→ combinations (mixed methods research)

Warning to the Innocent
◆ This stuff is controversial!
   ◆ At least in Computer Science (much more accepted in
     Information Systems)
   ◆ The terms are loaded.
     ◆ The opposition can be very prejudiced
     ◆ The practitioners are often puritanical
   ◆ If this is for a thesis then choose your examiners well.

Ontology, Epistemology and Methodology I
Ontological beliefs: beliefs regarding reality. For example:
   ◆ nature is an objective reality that exists regardless of
     human perception , or
   ◆ there is only a subjective reality, created in our minds.
Epistemological assumptions: assumptions regarding how
we come to know about the world
Methodological choices are the means we choose in
attempting to achieve desired ends.
Particular ontological beliefs → particular epistemological
assumptions.
Particular epistemological assumptions → certain
methodologies

Ontology, Epistemology and Methodology II
Your knowledge claims informs your strategies of inquiry
and your choice of methods:
   ◆ What is the researcher’s underlying ontology
     (fundamental worldview) and epistemology (theory of
     knowledge)?
   ◆ What strategies of inquiry governs our choice and use of
     methods?
   ◆ What methods of data collection and analysis do we
     propose to use?
Four fundamental approaches I

1. Positivist research
   - There is a real objective world that imposes itself on our minds via the senses
   - A search for truth, statements can be verified
   - (Post) Positivism
     - is generally quantitative in nature
     - uses hypothesis testing
     - makes claims of replicability, reliability and validity
     - tries to uncover "laws" of nature
   - Many different epistemologies can lead to a positivist method

Four fundamental approaches II

2. Critical research
   - Focuses on a critical understanding of the situation or practice in order to plan for transformative action. Emphasizes social change.
   - Originated in Hegelian and Marxian traditions.

3. Design (Science) research
   - Help designers to investigate people, form, and process
   - or the IS term for Experimental Computer Science ...
   - Confusing term for CS since all research must lead to an artefact

4. Interpretivist research — coming next
   - Many features in common with other qualitative approaches

Interpretivist Research — Metaphysical Assumptions

The Observer’s Perspective is a Factor:
- in the selection and formulation of Theory
- in the formulation of Hypotheses
- in choices made in the Research Design process
- in the selectiveness of observation
- in the process of observation

Interpretivist Research — Data Assumptions

Objectivity, in the sense in which it is used in Scientific Research, is meaningless, because:
- it presumes the existence of a unitary Truth
- it presumes that Truth to be accessible by humans
- it overlooks the fact that entities within the domain think they can exercise free will

An Alternative Interpretation:
- Try to identify Researcher Biases
- Try to avoid or allow for Researcher Biases
- Enable evaluators to assess Researcher Biases

Criticisms

Positivism
- Assumes methods are value neutral and ahistorical
- Treats people as objects of inquiry
- actually they are subjects and themselves initiators of action
- is itself a product of our minds, and so we cannot exclude ourselves from the process of creating knowledge.

Qualitative Research
- Data is flawed due to subjectivity
- Small samples so no replicability, reliability nor validity

Types of Qualitative Research

1. Case studies
2. Contextual Inquiry
3. Ethnography & Ethnomethodology
4. Conversation Analysis
5. Grounded Theory
6. Action Research
**Case Studies**

Focuses on the characteristics, circumstances, and complexity of a small number of cases
- Often uses multiple methods.
- Not really a specific method, but a class of studies.
Findings can raise awareness of general issues, but the aim is not to generalise the findings to other cases.
Case studies primarily use qualitative research techniques, but can exploit quantitative methods.

**Case Studies**

Studies a phenomenon in its real-life context (as opposed to experiments, simulations, or surveys or historical analyses)
- Can be positivist, interpretive or critical.
- Various types, e.g.
  - single case,
  - multiple cases,
  - critical case,
  - exemplary case.
- Exploratory (develop propositions for further use) versus descriptive (study incidence and prevalence).

**Contextual Inquiry/Design**

Not a research method as such
A design-oriented approach aimed at getting a grip on ‘context’, what it is, how it interferes.
- Practical way to gather information relevant for design, used in HCI, CSCW,
Apprentice / Master relationship is fundamental for the investigation
- No explicit teaching, just watching the work, detecting what matters, seeing details.
- Requires humility, inquisitiveness, attention.
- Ask questions.

**Principles of Contextual Inquiry:**

**context**

Go to where the work is; Summaries versus ongoing experience
Abstract versus concrete data

Cultural probes consisted of:
1. Disposable camera
2. CD ROM
3. Morning task
4. Pencil, pen and felt tips
5. Easter eggs
6. Workbooks
7. Diary
8. Images for collages
9. Stickers
10. Images, scissors, glue
11. Information sheet

**Principles of Contextual Inquiry:**

**partnership**

Help users articulate their work experience, alternate between watching and probing.
Teach users how to see work by probing work structure.
Avoid relationship models other than Apprentice / Master.
Not:
- Interviewer/interviewee: you are not there to get a list of questions answered.
- Expert/novice: you aren't there to answer questions either.
- Guest/host: it is a goal to be nosy.

**Principles of Contextual Inquiry:**

**interpretation**

Design ideas are the end product of a chain of reasoning.
Sharing interpretations with users won't bias the data, but teaches them to see structure in work, and let them fine-tune interpretations.

Materials for generative session:
1. Play dough
2. Skewers
3. Liquorice
4. Sticky tape
5. Stickers
6. Post-it notes
7. Pipe cleaners
8. Balloons
9. Various tinkering materials
10. Scissors
11. Felt tips
12. Glue (not shown)
Principles of Contextual Inquiry: focus

Clear focus steers the conversation, focus reveal detail, but conceals the unexpected (look for surprises and contradictions). Commit to challenging your assumptions and validating them.

Ethnography

From social and cultural anthropology.
- Rich descriptions based on extended fieldwork of people in their natural environment.
- Aim: understanding how people perceive and organise their world.
- Cultural and conceptual phenomena
- Behavioural patterns and material conditions.

Important principle: Immersion — researcher should spend a significant amount of time in the field. Participant observation is the basic resource.

Popular in HCI (especially CSCW)
- aim to inform design.
- You cannot do ethnography without much training (years)
- Settle for ethnographically inspired — or some such term.

Ethnomethodology

Ethnomethodology = the study of people’s methods.
Study people’s everyday ways to produce orderly social interaction:
- How do people give sense to and accomplish their daily actions (communicating, making decisions, reasoning)?
- Skills and practices that people use understand each other and social situations.

Focus on common-sense practices.
- Observable and reportable (speech and face-to-face behaviour).

Technique: disrupt what is taken for granted.
Answers how-questions rather than what-questions.

Conversation Analysis

A central method for ethnomethodologists.
Coherent communication is produced according to rules, the aim:
- to discover these rules, and
- describe the conversational structures they generate.

goes beyond grammatical analysis of statements.
Relies on detailed transcripts of conversation (naturally occurring or interviews).

Grounded Theory

Barney Glaser and Anselm Strauss (1967) criticised “the overemphasis in current sociology on the verification of theory and a resulting de-emphasis on the prior step of discovering what concepts and hypotheses are relevant for the area one wishes to research”.

Argued that any theory that is developed should be grounded in data, not be imposed from above.

Aim of Grounded Theory

to understand the phenomena in its own way.
to generate theory from data not the other way round.
(Inductive approach where no pre-conceived theoretical models are applied)
Grounded theory

Grounded theory as theory is:
"inductively derived from the phenomenon it represents. That is, it is discovered, developed and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore data collection, analysis and theory stand in reciprocal relationship with each other. One does not begin with a theory, then prove it. Rather one begins with an area of study and what is relevant to that areas is allowed to emerge." (Strauss and Corbin, 1990)

Theory should 'fit': the categories must be readily (not forcibly) applicable to the data
Theory should 'work': be meaningfully relevant and have explanatory power

Have come to believe that creating knowledge is inextricably intertwined with effective action.
Knowledge that does not lead to effective action is not really knowledge
A failure to create effective systems is equivalent to a failure of understanding.
Compatible with Action Research ...

PRACTICE — A PRAGMATIST

EPISTEMOLOGICAL VIEW

Action Research: Overview

Originated in social sciences after World War 2
("a therapy for social illnesses")

Aims:
- contributing to practical concerns (e.g., an organisation in need of change) and to
- generate new knowledge simultaneously

Active involvement and interventions,
- the researchers have a change agenda, a vision of what can be done.
- participants have a view of what they want

Phased and iterative (cyclic):
Diagnosing, planning intervention, conducting intervention, evaluating, new diagnosis, etc.

Action Research Cycle

Facilitating change in community through facilitating action
Cyclical software development process: participatory design + prototype evaluation.

Diagnosing → planning → implementing plan → observing results → reflecting on the results

Action Research

Motivations
- To make academic research relevant, researchers should try out their theories with practitioners in real situations and real organizations
- The emphasis is more on what practitioners do than on what they say they do

Key Assumptions
- Social settings cannot be reduced for study, and
- Actions brings understanding

Action Research II

Action research has been typified as a way to build

- theory, knowledge, and practical action
  - by engagement with the world in the context of practice itself
**Action Research**

A research approach with the dual aims of action and research

- action to bring about change in some community or organisation or program;
- research to increase understanding on the part of the researcher or the client, or both

This joint collaboration has to be within a mutually acceptable ethical framework

---

**Features of Action Research**

- the researcher is immersed in the community
- the work unfolds in response to the situation and not to the researcher’s requirements
- situated in the local context and all the questions, problems, and issues arise from that context
- descriptions and theories are built up by iteration within the context and are tested within the situation
- there is close democratic collaboration between researchers and the participants

---

**Phases of Action Research: Diagram**

- **Specifying**
  - Identifying general findings
- **Diagnosing**
  - Identifying or defining a problem
- **Common Context**
  - Ethical agreement that constitutes the research environment
- **Action Planning**
  - Considering alternative courses of action
- **Action Taking**
  - Implementing a course of action
- **Evaluating**
  - Studying the outcomes of an action

---

**Carrying out Action and Research**

- Organize the actions into small units which can be completed in short time
- Take field notes on every action
  - Actions includes: fieldwork entrance letters, fixing computers items, meetings and workshops
  - Anything that consumes our time in the field is part of the action
- Use some known data analysis techniques
  - Align our field notes empirical material in those techniques
- Think and make sense of the actions and results
  - Some time is needed away from the field

---

**Field Notes**

Field notes should be written as soon as possible after leaving the field site, immediately if possible

Plan to leave a block of time for writing just after leaving the research context

---

**Data Collection Methods**

- Semi-structured interviews
  - Participant observations
  - Analysis of documents
  - Use of checklists: data registers, analysis tools, and health workers
  - Software prototyping process
  - Group discussions and Training workshops
  - Video/still pictures
  - Analysis of press media reports
Data Analysis and Presentation

Interviews, observations, questionnaires, and system documents work together to support the research claims.
- Must be written up with the usual rigour demanded of scientific writing

Empirical materials are presented in:
- Descriptive statistics (quantitative data)
  - E.g., measurement instrument for evaluating user satisfaction
- Qualitative excerpts of encoded user reactions
- Software evaluation via criteria such as reliability and usability
- Log files of actual use of system
- Screen shots of programs

Secondary Sources of Data
- Documents from the field
- Photos and videos

What About Quality?

How can Qualitative Research be Good?
- What is good research?
  - Trustworthy?
  - Replicability?
  - Validity
  - Reliability
- Can Qualitative Research be Replicable?

Qualitative Quality

Triangulation
- Different and complementary views of reality from different methods
- Iteration can also be seen as a form of triangulation

Respondent Validation
- In the case of software this amounts to: check with your users!
- Acid test: do they use the software?
- Does it make a difference?


Recoverability

- Recoverability: research process is recoverable by outside researchers (Checkland & Holwell)
- Transparency and Documentation
  - process and methodology must be declared in advance
  - careful and documented data collection and analysis,
  
Action Research >> Agile Software Engineering

- The cyclical nature of action research, where questioning and reflection are tied to intervention, neatly solves the need of users to learn about ICT while the engineers learn about the community within which they are working.
- Agile & Iterative SE methods still lay too much emphasis on the programming team and on the client knowing what they want.
- Note Well: This comment is aimed at Computer Scientists and Geeks
Communication Tools for Deaf People: Community-Based Co-Design

Deaf participants working with generative tools
Output produced with generative tools


Some Web Resources

Not a lot on qualitative research in CS, but there is plenty for IS. Lots of activity in Australia and New Zealand.

Qualitative Research in Information Systems: Michael D. Myers. www.qual.auckland.ac.nz
Information Systems and Qualitative Research. www.people.vcu.edu/~aslee/ifipwg82.pdf
Action research: Communications of the ACM 42, 1 94–97 (Jan 1999). doi.acm.org/10.1145/291469.291479


Conceptualisation of a series of Deaf telephony bridges. Laboratory tests.

Telgo prototypes

Telgo123
- Deaf telephone with TTS
- Tactile and voice generators in laboratory only

TelgoSIP
- SIP-based
- Works with Metasoft

Softbridge prototypes

Softbridge v1
- Generic modality adaptation
- PC-based CORBA approach

Softbridge v2
- Stalker style UI & voice
- Supports phone calls and text
- Interacts with clients via TTS
- Works with Metasoft

Softbridge SIP
- SIP-based

SIMBA prototypes

SIMBA v1
- Hotel environment with SIP
- Tightly coupled voice/text for TTS
- Deaf community tools

SIMBA v2 and NIMBA
- KSU prototype

SIMBA v3
- SMS interface added for deaf users
- Adding Android & Siemens

Deaf-to-Deaf prototypes

Deaf Chat
- Real-time text chat suitable for school
- Multiple clients with TTS
- Deaf users like it

Deaf Video Chat v1
- Real-time video
- User controls (camera and protocol)

Deaf Video Chat v2
- Mobile phone as interface
- Real-time interaction with processing on PC

Talking with a Doctor
- Mobile phone as interface
- Voice and video
- User controls (camera and protocol)

Some Web Resources

Not a lot on qualitative research in CS, but there is plenty for IS. Lots of activity in Australia and New Zealand.

Qualitative Research in Information Systems: Michael D. Myers. www.qual.auckland.ac.nz
Information Systems and Qualitative Research. www.people.vcu.edu/~aslee/ifipwg82.pdf
Action research: Communications of the ACM 42, 1 94–97 (Jan 1999). doi.acm.org/10.1145/291469.291479