

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](#)

27/6/12

Qualitative Research in CS

2

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)

27/6/12

Qualitative Research in CS

3

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.

27/6/12

Qualitative Research in CS

4

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

27/6/12

Qualitative Research in CS

5

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?

27/6/12

Qualitative Research in CS

6

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
 - Popper: a scientific statement must be falsifiable
 - (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

27/6/12

Qualitative Research in CS

7

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

27/6/12

Qualitative Research in CS

8

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

27/6/12

Qualitative Research in CS

9

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

27/6/12

Qualitative Research in CS

10

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

27/6/12

Qualitative Research in CS

11

Types of Qualitative Research

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

27/6/12

Qualitative Research in CS

12

Case Studies I

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.

27/6/12

Qualitative Research in CS

13

Case Studies II

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).

27/6/12

Qualitative Research in CS

14

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.

27/6/12

Qualitative Research in CS

15

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

16

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.

27/6/12

Qualitative Research in CS

17

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.

27/6/12

Qualitative Research in CS

20

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.

27/6/12

Qualitative Research in CS

21

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).

27/6/12

Qualitative Research in CS

22

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.

27/6/12

Qualitative Research in CS

23

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)

27/6/12

Qualitative Research in CS

24

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

27/6/12

Qualitative Research in CS

25

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

27/6/12

Qualitative Research in CS

26

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.

27/6/12

Qualitative Research in CS

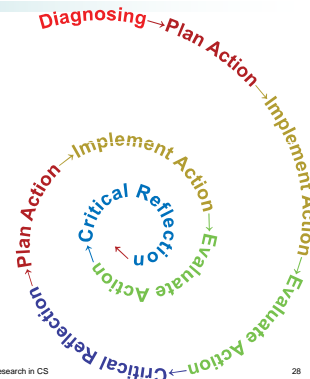
27

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



27/6/12

Qualitative Research in CS

28

Action Research I

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

27/6/12

Qualitative Research in CS

29

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

27/6/12

Qualitative Research in CS

30

Action Research

III

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

27/6/12

Qualitative Research in CS

31

Features of Action Research

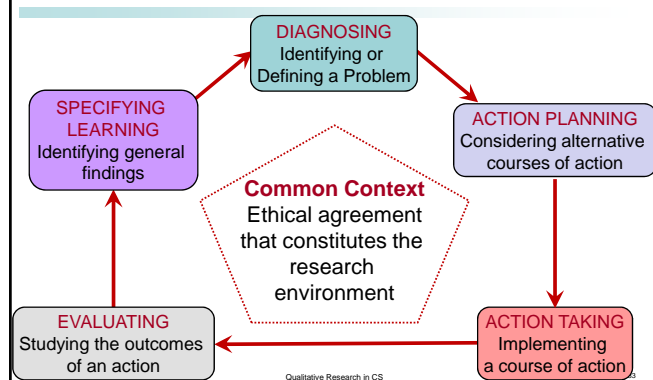
- ◆ the researcher is immersed in the community
- ◆ the work unfolds in response to the situation and not to the researcher's requirements
- ◆ situated in the local context and all the questions, problems, and issues arise from that context
- ◆ descriptions and theories are built up by iteration within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

27/6/12

Qualitative Research in CS

32

Phases of Action Research: Diagram



Qualitative Research in CS

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

27/6/12

Qualitative Research in CS

34

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

27/6/12

Qualitative Research in CS

35

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

27/6/12

Qualitative Research in CS

36

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

27/6/12

Qualitative Research in CS

37

What About Quality?

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

27/6/12

Qualitative Research in CS

38

Qualitative Quality

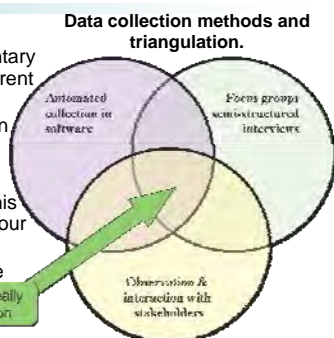
Triangulation

- 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?

What's really going on?



From: Tucker "Softbridge: a socially aware framework for communication bridges over digital divides" PhD Thesis 2009

27/6/12

Qualitative Research in CS

40

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,
- Checkland, P. B., and Holwell, S. E. .Action Research: Its Nature and Validity,. Systemic Practice and Action Research (11:1) 1998, 9-21. dx.doi.org/10.1023/A:1022908820784
- Holwell, S. Themes, iteration and recoverability in action research. In: Kaplan et al. eds. Information Systems Research: Relevant Theory and Informed Practice. Kluwer. 2004. oro.open.ac.uk/159/1/IFIP_8_2_AR.pdf

27/6/12

Qualitative Research in CS

40

Concluding:

Use Action Research ... if you're clueless

- Action research applies an engineering paradigm for dealing with complex design situations in order to achieve democratic social development.
- Designers do not initially understand local issues and culture while at the same time
- Local communities cannot appreciate the potential of ICT to address their development needs.
- Cyclical approach to action and reflective learning has been used for development for a long time.
- Known as emerging action research when there is a wide degree of openness
 - research questions may change from cycle to cycle.

27/6/12

Qualitative Research in CS

41

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


27/6/12

Qualitative Research in CS


42

Communication Tools for Deaf People: Community-Based Co-Design


Deaf participants working with generative tools



Output produced with generative tools



E Blake, W Tucker, M Glaser & A Freudenthal. Case study 11.1: Deaf telephony: Community-based co-design. In Rogers, Sharp, Preece, *Interaction Design: Beyond Human-Computer Interaction*, 2011. www.id-book.com/casestudy_11-1.php



“Baby” in SASL
Sign Language Education and Development (SLED) www.sled.org.za

27/6/12 Qualitative Research in CS 44

Building a technology base (2001-2003)	Community based action research (2004-2007)	Action Research and Industrial Design (from 2008)
<p>Conceptualisation of a series of Deaf telephony bridges. Laboratory tests.</p> <p>Telgo prototypes</p> <p>Telgo323</p> <ul style="list-style-type: none"> Deaf text to voice with TTS Teldem to PSTN H.323 gateway in laboratory only <p>TelgoSIP</p> <ul style="list-style-type: none"> Ported to SIP Still only one way and in lab <p>Softbridge prototypes</p> <p>Softbridge v1</p> <ul style="list-style-type: none"> Generic modality adaptation PC-based CORBA approach <p>Softbridge v2</p> <ul style="list-style-type: none"> Jabber async text & voice Web service media adapters Mixed media clients with .NET 1st Deaf user trial in lab 	<p>User empowerment via ICT training and PC literacy courses started. Community involvement</p> <p>SIMBA prototypes</p> <p>SIMBA v1</p> <ul style="list-style-type: none"> NGN redesign with SIP Tightly coupled web services for TTS Human relay operator Deaf community trials <p>SIMBA v2 and NIMBA</p> <ul style="list-style-type: none"> Audio is Typing Guaranteed delivery <p>SIMBA v3</p> <ul style="list-style-type: none"> SMS interface added for Deaf user Added Asterisk & Digium <p>Deaf-to-Deaf prototypes</p> <p>Deaf Chat</p> <ul style="list-style-type: none"> Real-time text chat similar to Teldem, but multi-user and PC-based Deaf users like it & use it Standalone and web clients with SIP <p>Deaf Video Chat v1</p> <ul style="list-style-type: none"> Semi-synchronous video Real-time video User trials of codecs and protocols 	<p>Deaf users more confident in expressing requirements. Exposure to off-the-shelf communication tools. Extensive co-design begun. Researchers learn SASL</p> <p>Mobile Video prototypes</p> <p>Mobile Gestures</p> <ul style="list-style-type: none"> Async video Deaf-to-Deaf Mobile phone as interface Gesture recognition interface with processing on PC <p>Talking with a Doctor</p> <ul style="list-style-type: none"> Deaf semi-literate communication with hearing Canned video on mobile device <p>Deaf Video Chat v2</p> <ul style="list-style-type: none"> Semi-synchronous video User trials of ROI codecs <p>Work with Deaf as equal partners</p>

27/6/12 Qualitative Research in CS 46

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 Resources. www.scu.edu.au/schools/qcm/ar/arhome.html

Action research: Communications of the ACM **42**, 1 94–97 (Jan 1999). doi.acm.org/10.1145/291469.291479

Action Research: Its Nature and Validity. Checkland and Howell. *Systemic Practice and Action Research*, Vol. 11, No. 1, 1998. dx.doi.org/10.1023/A:1022908820784

Holwell, Themes, iteration and recoverability in action research. In: Kaplan et al. eds. *Information Systems Research: Relevant Theory and Informed Practice*. Kluwer. 2004. oro.open.ac.uk/159/1/IFIP_8_2_AR.pdf

27/6/12 Qualitative Research in CS 46