Qualitative Studies in Software Engineering

Fabio Q. B. da Silva
Centre for Informatics
Federal University of Pernambuco
E-mail: fabio@cin.ufpe.br
www.haseresearch.com

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Bogotá, Colombia.

I received my **PhD in Computer Science** from the Laboratory for Foundations of Computer Science (LFCS), University of Edinburgh, Scotland, in 1992. I am a **Professor** of Software Engineering at the Center of Informatics, of the Federal University of Pernambuco, **Brazil**, where I have been working since 1993. I was a co-founder of the Center of Advanced Studies and Systems at Recife (**C.E.S.A.R.**) in 1996, and of the **Porto Digital** Science Park, in Recife, Brazil, in 2001, of which I was the first President between 2001 and 2003. In the last 25 years, I have been involved in **teaching** entrepreneurship, enterprise creation, innovation management, empirical research methods, as well as project management and software engineering, **supervised** +60 master and 10 doctoral students, and **published** over **200** articles in journals and conference proceedings. I am **IFTF Certified Foresight Practitioner** and have applied future and scenario thinking in diverse industries such as **IT**, **Film and Animation**, **Music**, **Museum Design**, etc.

I come from …

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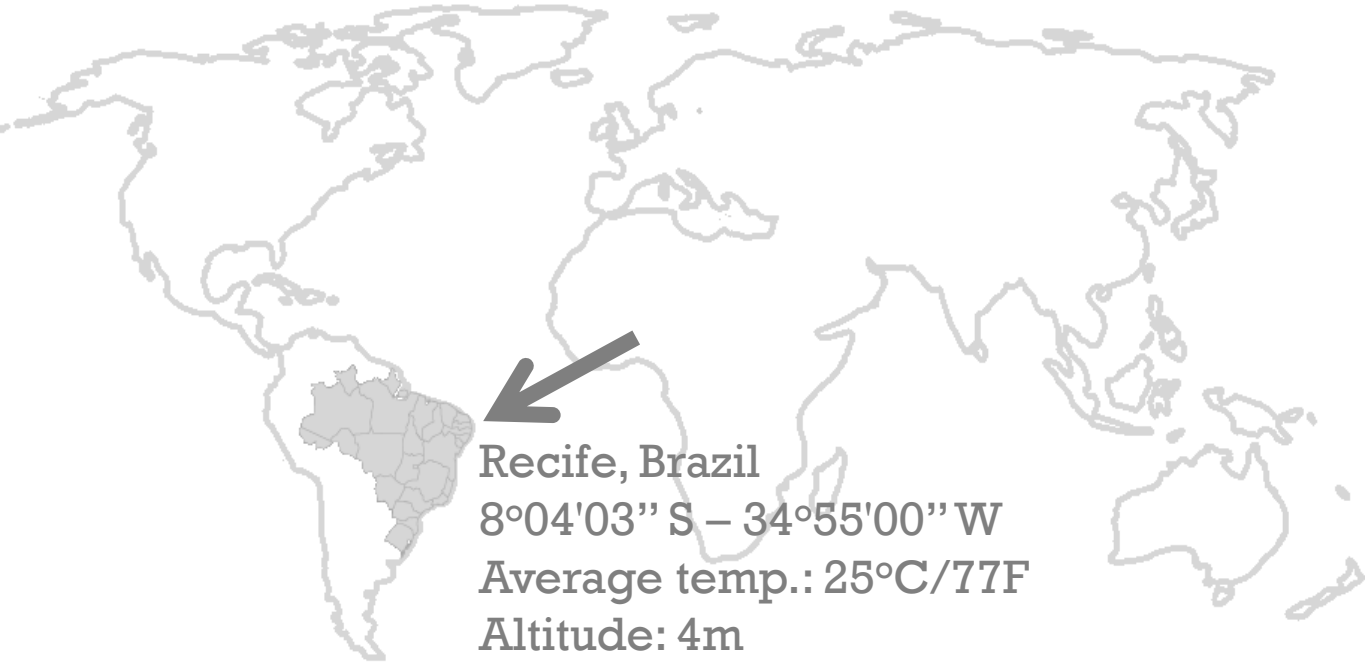
Average temp.: 25°C/77F
Altitude: 4m



Centre of Informatics – UFPE

+90 faculty members
3 undergraduate courses
+1,000 undergraduate students
+300 PhD students
+700 master students
Level 7 (excellence) postgraduate courses

2011 Most Innovative Research Institution in Brazil

A place with a nice view!

HASE – Human Aspects in Software Engineering

Research to improve software practice (Since 2006)

HASE Team

- 6 PhD researchers
- 9 doctoral students
- 5 master students

Results

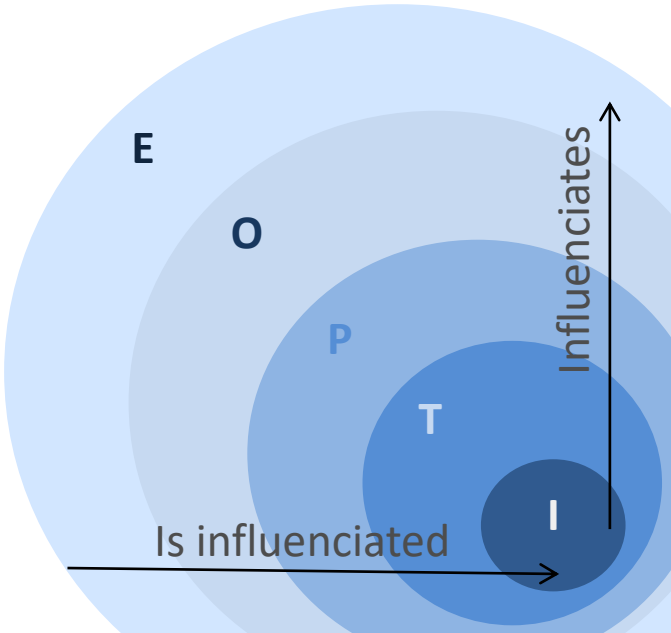
- 44 Master dissertations
- 8 PhD thesis
- +80 published articles
- Best paper awards (SBES'2009, ESEM'2011, EASE'2011, SBES'2012, EASE'2016)

Collaborations

- University of Bari – Italy
- University of Maryland Baltimore County – USA
- Western University – Canada
- The Open University – England

Areas of Interest

- Understanding human factors in software development
- The role of replication in empirical software engineering research
- The role of evidence based research in software engineering



Today's Agenda

- What is research?
- Research methods
- Qualitative Research Methods
- Field Work
- Validity Considerations
- Concluding Remarks

What is research?

"A systematic process by which we know more about something than we did before engaging in the process" (Merriam and Tiddel, 2015).

We do research because we wish

- to contribute to the knowledge base in some field (usually called pure research)
- to improve the practice of a particular discipline (usually called applied research)
- to assess the value of something (evaluation research)
- to address a particular (usually relevant and hard), localized problem (action research)

Philosophical perspetives of research

- What we accept as knowledge or …
- … what we believe about the nature of reality (ontology) and the nature of knowledge (epistemology)
- (at least) four distinct orientations:
  - Positivist
  - Interpretivism or constructivism
  - Critical
  - Poststructuralism or postmodernism

Four epistemological perspectives

	Positivist/ Postpositivist	*Interpretive/ Constructivist*	*Critical*	*Postmodern/ Poststructural*
Purpose	Predict, control, generalize	Describe, understand, interpret	Change, emancipate, empower	Deconstruct, problematize, question, interrupt
Types	Experimental, survey, quasi-experimental	Phenomenology, ethnography, hermeneutic, grounded theory, naturalistic/ qualitative	Neo-Marxist, feminist, participatory action research (PAR), critical race theory, critical ethnography	Postcolonial, poststructural, postmodern, queer theory
Reality	Objective, external, out there	Multiple realities, context-bound	Multiple realities, situated in political, social, cultural contexts (one reality is privileged)	Questions assumption that there is a place where reality resides; "Is there a there there?"

(Merriam, 2009)

Two paradigms + 1

- Quantitative research
  - Finding cause of events and predict similar events in the future
  - … or describing facts and characteristics of an event or relationships among them.
  - Focus on how much or how many, and results are numerical.
- Qualitative research
  - Uncovering the meaning of a phenomenon for those involved.
  - Focus on meaning and how people interpret their experiences.
  - Results have a variety of non-numerical forms, like texts, diagrams, etc.
- Mix-method research

Qualitative vs Quantitative

Point of Comparison	*Qualitative Research*	*Quantitative Research*
Focus of research	Quality (nature, essence)	Quantity (how much, how many)
Philosophical roots	Phenomenology, symbolic interactionism, constructivism	Positivism, logical empiricism, realism
Associated phrases	Fieldwork, ethnographic, naturalistic, grounded, constructivist	Experimental, empirical, statistical
Goal of investigation	Understanding, description, discovery, meaning, hypothesis generating	Prediction, control, description, confirmation, hypothesis testing
Design characteristics	Flexible, evolving, emergent	Predetermined, structured
Sample	Small, nonrandom, purposeful, theoretical	Large, random, representative
Data collection	Researcher as primary instrument, interviews, observations, documents	Inanimate instruments (scales, tests, surveys, questionnaires, computers)
Primary mode of analysis	Inductive, constant comparative method	Deductive, statistical
Findings	Comprehensive, holistic, expansive, richly descriptive	Precise, numerical

(Merriam, 2009)

Research methods

There are many research methods. The choice of method and corresponding study design should fit your research questions; you should also consider a method that is consistent with your philosophical orientation, your worldviews, personality, and, last but not least, your skills as a researcher.

What types of research are there?

- Exploratory
  - Used to build new theories where we don't have any yet
    - What are the experiences of students that used gamification in history class?
- Descriptive
  - Describes sequence of events and underlying mechanisms
    - How does serious games actually work in education?
- Causal
  - Determines whether there are causal relationship between phenomena
    - Does gamification increase performance in math courses?
- Explanatory
  - Adjudicates between competing explanations (theories)
    - Why does gamification increase engagement in classroom?

Based on Steve Easterbrook: **www.cs.toronto.edu/~sme/CSC2130.**

Many methods are available

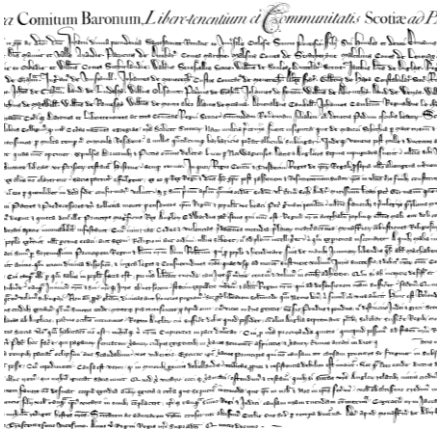
In the lab	In the wild
Controlled experiments	Quasi-experiments
Exemplars	Survey
Benchmarks	Case study
Simulations	Ethnography
	Action research

- Artefact/Archive analysis (mining)

Base on Steve Easterbrook, RE2007 Conference Tutorial T1.

Qualitative Research

The Qualitative Research paradigm focus on understanding the meaning people attribute to phenomena. Data is collect in form of words, drawings, pictures, video, and artefacts, not numbers. Results are presented as texts, narratives, diagrams, and other forms of non numerical presentation.



Definitions

- "The study of things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them" (Denzin and Lincoln, 2013).

- "An array of interpretive techniques which seek to describe, decode, translate, and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world" (Van Maanen, 1979).

(Merriam and Tiddel, 2015)

Key characteristics

- Focus on meaning and understanding
- Researcher as a primary instrument
- An inductive process
- Rich descriptions
- Flexible design, purposeful sampling, and long time spent in the natural setting

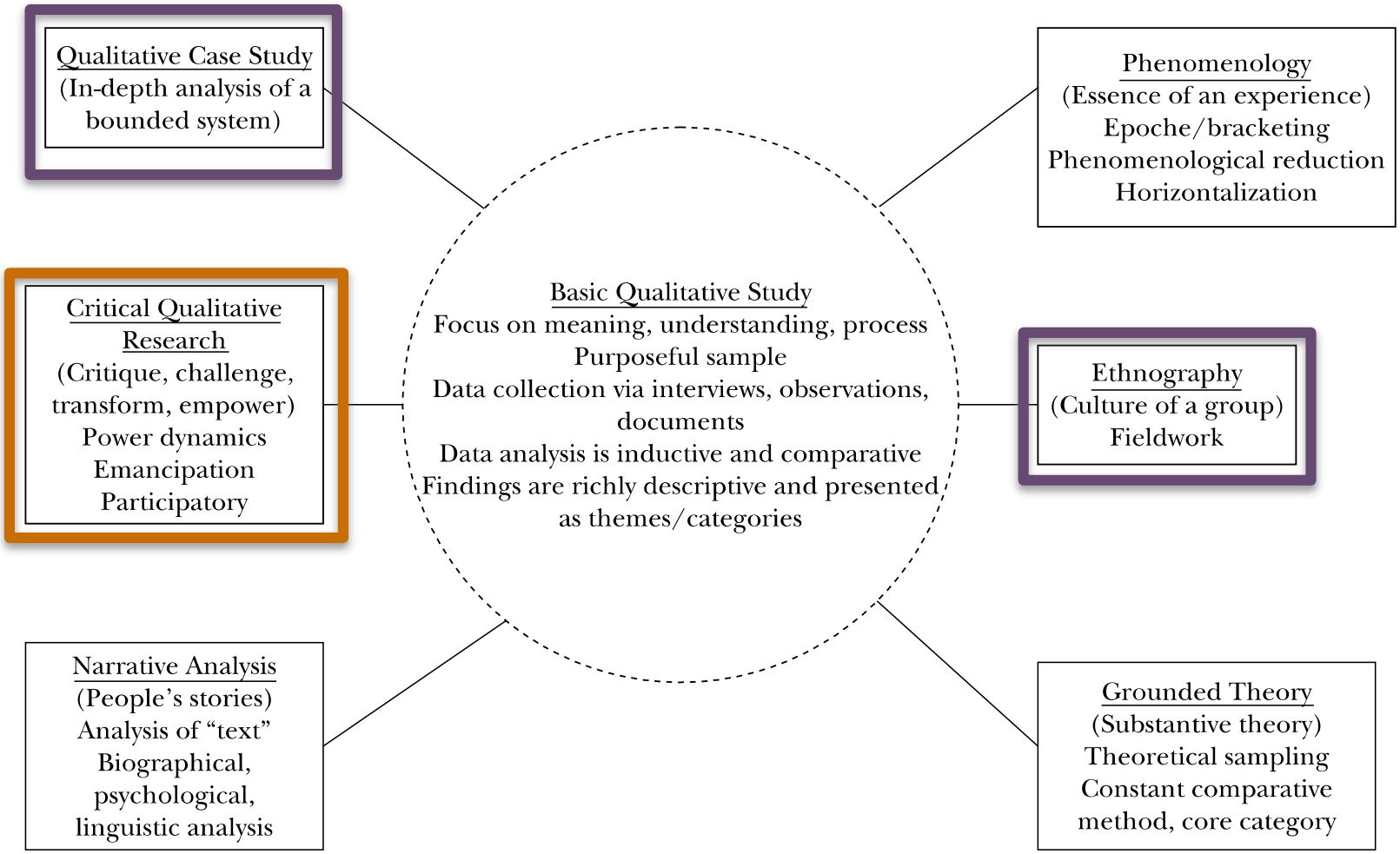
(Merriam and Tiddel, 2015)

Researchers competencies

- A questioning stance regard your life and work context
- High tolerance to ambiguity
- Being a careful observer
- Asking good questions
- Thinking inductively
- Comfort with writing

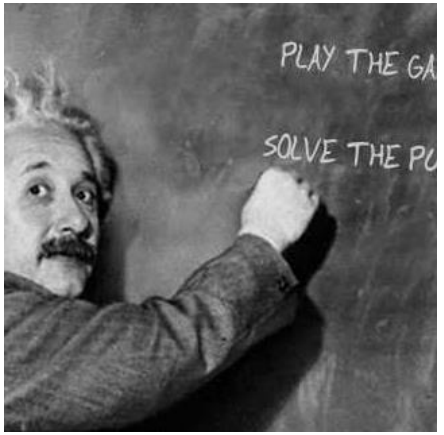
(Merriam and Tiddel, 2015)

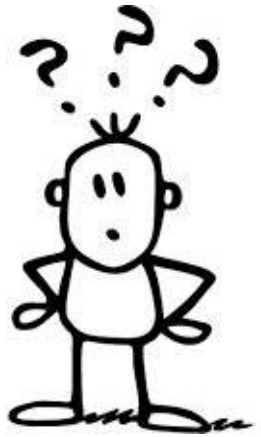
Types of qualitative research



(Merriam, 2009)

Qualitative Case Study





Definitions

- "A *case study* is an in-depth description and analysis of a bounded system." (Merriam and Tisdell, 2016).

- **"**Case study research is a qualitative approach in which the investigator explores a bounded system (*a case*) or multiple bounded systems (*cases*) over time, through detailed, in-depth data collection involving *multiple sources of information* (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case *description* and case-based themes**"** (Creswell, 2013, p. 97).

Case studies for what?

- To explain the regularities and variations of the expression of a phenomenon in the field.
- To investigate a phenomenon that cannot be isolated from the context in which it happens.
- Performing case studies is based on an assumption that warrants careful examination: knowledge of single, unique or specific bounded system is valuable.

Characteristics of Case Studies

- The case is "a phenomenon of some sort occurring in a bounded context"
- It is impossible to separate the phenomenon's variables from their context.
- The unit of analysis, not the topic of investigation, characterizes a case study.
- The case could be
  - a single person who is a case example of some phenomenon,
  - a program,
  - a group or a work team
  - an institution
  - a community
  - a specific policy.

For instance (Stake, 2006, p. 1)

- A case is a noun, a thing, an entity; it is seldom a verb, a participle, a functioning.
- Schools may be our cases— real things that are ease to visualize. . . . Training modules may be our cases— amorphous and abstract, but still things, whereas " training" is not.
- Nurses may be our cases; we usually do not define "nursing activity" as the case. "Managing," "becoming effective," "giving birth," and "voting" are examples of functioning, not entities we are likely to identify as cases.
- For our cases, we may select "managers," "production sites," "labor and delivery rooms," or "training sessions for voters."
- With these cases we find opportunities to examine functioning, but the functioning is not the case.

When it is not a case study

- If the phenomenon you are interested in studying is not intrinsically bounded, it is not a case.
- One technique for assessing the boundedness of the topic is to ask how finite the data collection would be; that is, whether there is a limit to the number of people involved who could be interviewed or a finite time for observations.
- If there is no end, actually or theoretically, to the number of people who could be interviewed or to observations that could be conducted, then the phenomenon is not bounded enough to qualify as a case.

(Merriam and Tiddel, 2016)

A case study is not …

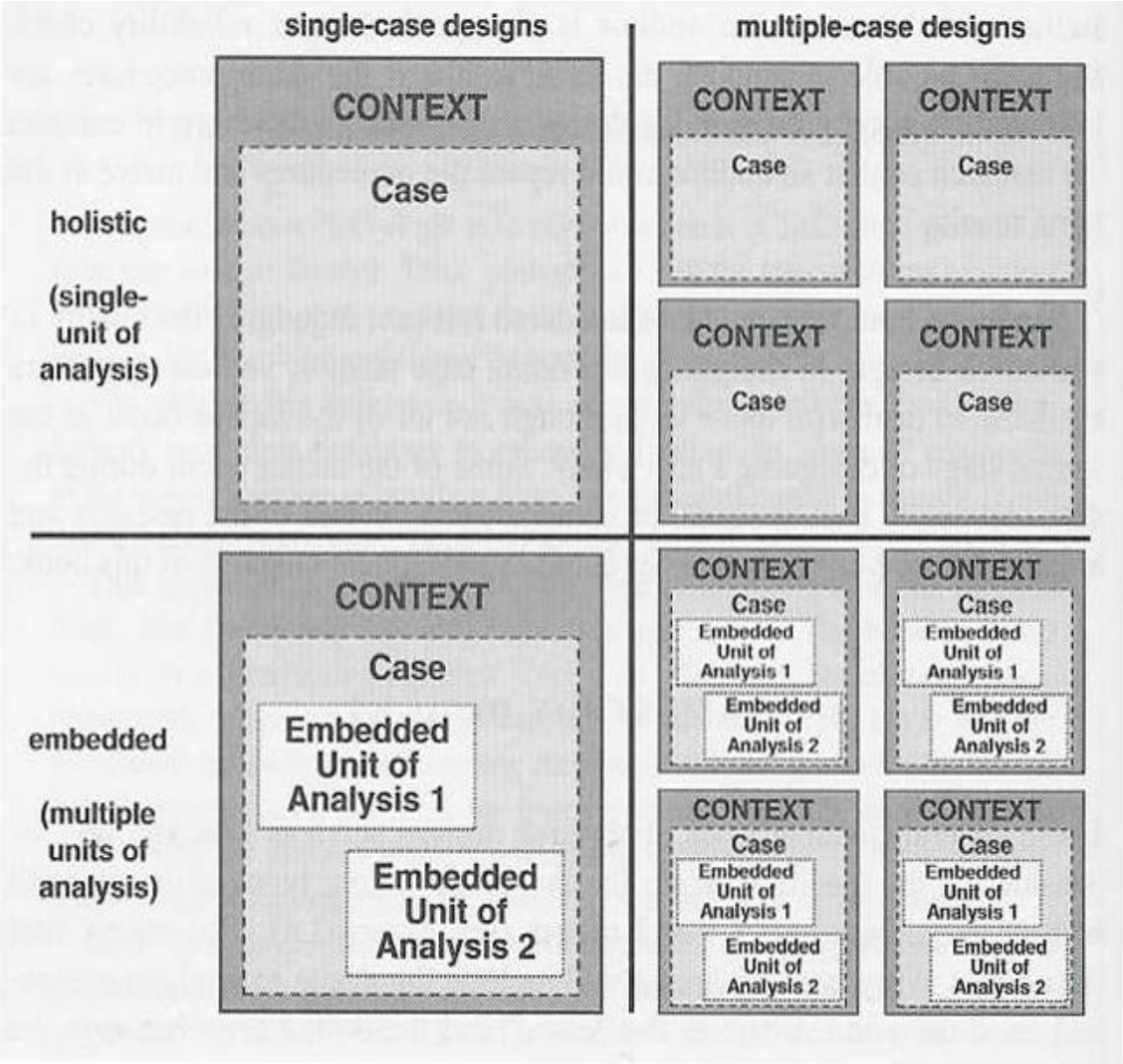
- A quasi-experiment with n = 1 (or any small sample size).
- An industry experience report.
- A trial of a tool, technique, process in an industrial setting.
- The label given to an ill designed research that does not fit in any other research method category.

Case study designs

- Case studies can be:
  - historical, as in the history of an organization or program;
  - biographical, wherein "the researcher conducts extensive interviews with one person for the purpose of collecting a first-person narrative" (Bogdan & Biklen, 2011, p. 63);
  - or comparative.
- Comparative case studies, also called multicase or multisite case studies, involve collecting and analyzing data from several cases
- They can be distinguished from the single case study that may have subunits or subcases embedded within (such as software engineers within a software organization).

(Merriam and Tiddel, 2016)

Four types of design



(from Yin, page 40)

Why multicases?

- As Miles, Huberman, and Saldaña (2014) point out, the more cases included in a study, and the greater the variation across the cases, the more compelling an interpretation is likely to be.
  - "We can strengthen the precision, the validity, and the stability of the findings" (p. 33).
- The inclusion of multiple cases is, in fact, a common strategy for enhancing the external validity or generalizability of your findings.

(Merriam and Tiddel, 2016)

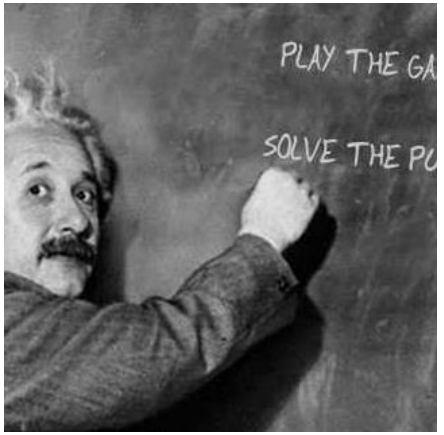
Ethnography

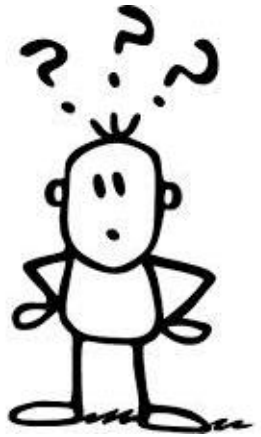
Ethnography may be defined as both a qualitative research

process and method (one conducts an ethnography) and **product** (the outcome of this process is an ethnography)

whose aim is **cultural interpretation**.

Brian A. Hoey





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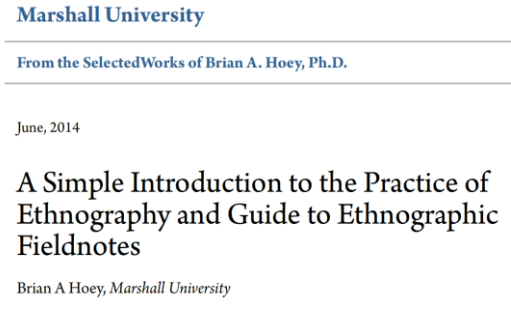

Marshall University

From the SelectedWorks of Brian A. Hoey, Ph.D.

June, 2014

A Simple Introduction to the Practice of Ethnography and Guide to Ethnographic Fieldnotes

Brian A Hoey, *Marshall University*

… while the predominant methods paradigm of ethnography is qualitative,

ethnography is more than simply a qualitative research method

…it has ontological and epistemological properties

Tony Whitehead

Neither **positivism** nor **naturalism** provides an adequate framework.

Both neglect **reflexivity**: the fact that we are part of the social world we study, and that there is no escape from reliance on common-sense knowledge and methods of investigation.

All social research is founded on the human capacity for **participant observation**.

Martyn Hammersley & Paul Atkinson

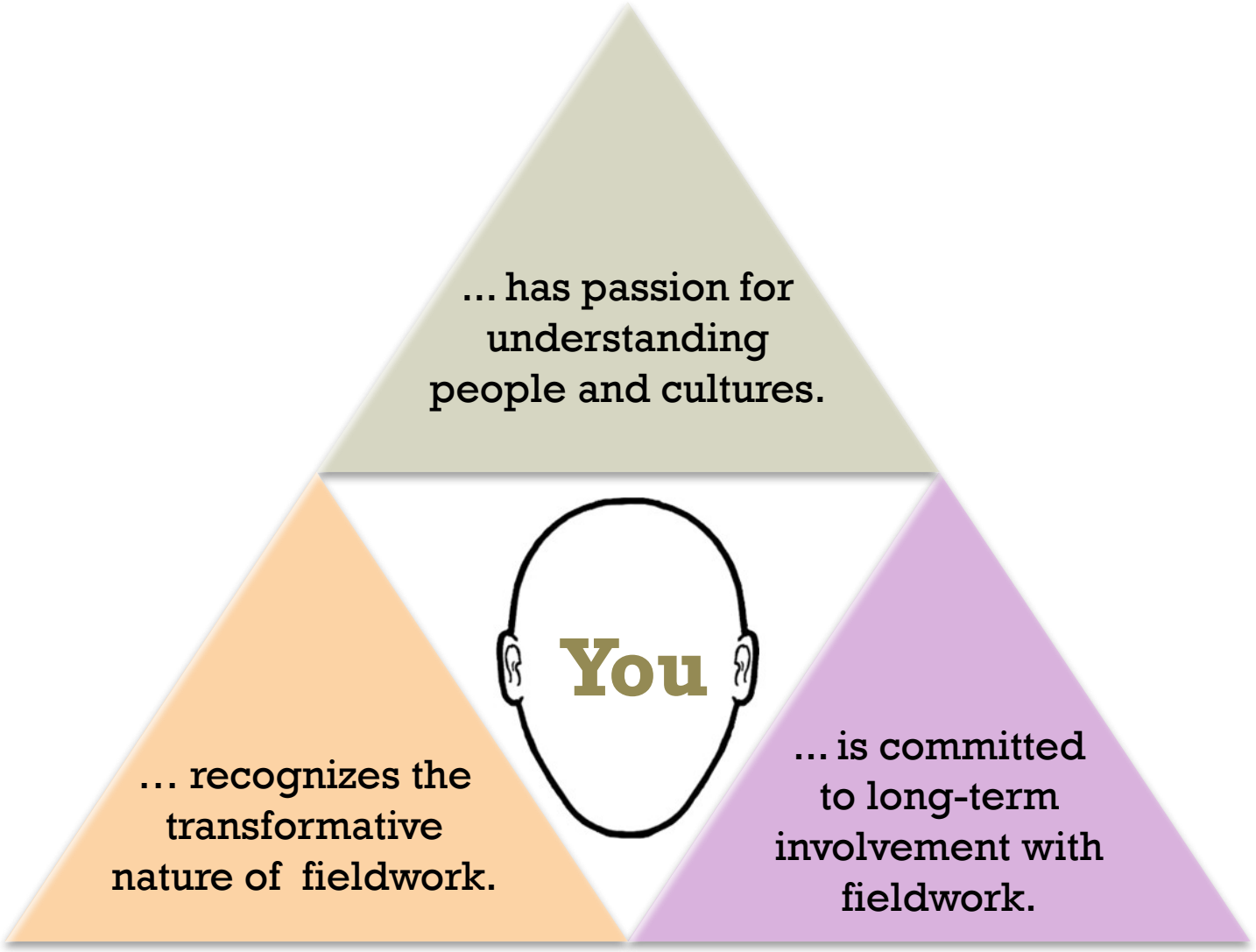
… reflexivity acknowledges that the orientations of researchers will be shaped by their socio-historical locations, including the values and interests that these locations confer upon them.

What this represents is a rejection of the idea that **social research** is, or can be, carried out in some autonomous realm that is insulated from the **wider society** and from the **biography of the researcher**, in such a way that its **findings** can be unaffected by **social processes** and **personal characteristics**.

Martyn Hammersley & Paul Atkinson

Doing ethnography requires you being an **ethnographer**

an ethnographer …



… has passion for understanding people and cultures

Malinowski's diaries hold two especially relevant lessons to ethnographers:

First is that ethnographic writing is a means of expressing an interest for telling stories – stories about **what it means to be human**.

Brian A. Hoey

Ethnography is a holistic approach to the study of **cultural systems**.

Ethnography is the study of the **socio-cultural contexts**, **processes**, and **meanings** within cultural systems

Tony Whitehead

To produce **knowledge** about these systems …

Fabio Silva

… recognizes the transformative nature of fieldwork

Malinowski's diaries hold two especially relevant lessons to ethnographers:

Second is that … explicitly observing, imagining and describing other people need not be incompatible with implicitly **learning about the self**.

Brian A. Hoey

Good ethnography recognizes the transformative nature of fieldwork where as we search for answers to questions about people **we may find ourselves in the stories of others**.

Ethnography should be acknowledged as a mutual product born of the intertwining of the lives of the **ethnographer** and **his or her subjects**.

Brian A. Hoey

Ethnographic fieldwork is shaped by **personal and professional identities** just as these identities are inevitably shaped by **individual experiences while in the field**.

Brian A. Hoey

… is committed to long-term involvement with fieldwork.

Ethnography usually involves the researcher **participating**, overtly or covertly, in people's daily lives for an **extended period of time**, …

… gathering **whatever data** are available to throw light on the issues that are the emerging focus of inquiry.

Martyn Hammersley & Paul Atkinson

Even where he or she is researching a familiar group or setting, the participant observer is required to treat this as **'anthropologically strange'**, in an effort to make explicit the presuppositions he or she takes for granted as a culture member.

In this way, the culture can be turned into an **object available for study**.

Brian A. Hoey

… many students in ethnographic training are reluctant … of the **demands** that ethnographic work places on them.

If you are **judgmental** of the process itself by being dismissive of the work that you are doing, this can be very harmful as well. It is i**nsidiously distortive and destructive**.

This is especially hard for those of us who work within our **own** culture(s) or communities.

Brian A. Hoey

Summarizing ...

Ethnography is an interpretive study of groups with focus on human society and culture of the group. It is an in depth study in which the lens of culture is used to understand the phenomenon of interest.

Good For

- To understand the interleave of phenomenon and social context in which it is studied
- To explore, understand, and explain culture and practices related to the use of tools and techniques in a social group
- To find deep insights about how people perceive and act in a social context

Limitações

- Generalization is limited because the context is critical in the construction of meaning (transferability and interpretation)
- Limited support to the construction of grand theories (why bother?)
- Requires long involvement of the research with the context which can be time and resource consuming

Based on Steve Easterbrook, RE2007 Conference Tutorial T1.

What is an ethnography?

- The method and its result
- A qualitative (interpretive) study about a social group with focus on culture, that seeks to:
  - Understand how people interpret and make sense of their social context
  - Find how people create categories and terminology that are significant to them
  - Understand how social interactions evolve
  - Procude rich and thick descriptions of the culture of the target social groups
- In software engineering, it is useful to understand behaviour and culture of software engineers in the working environment:
  - E.g.: how agile software teams interact in software development using shared code?
- The process is guided mostly by data and not so much by theory
  - There is no previous theory
  - The research must carefully consider her or his biases or pre-conceived assumptions about the phenomenon (as in bracketing in phenomenology)
  - All observations and findings must be seen as interesting and surprising

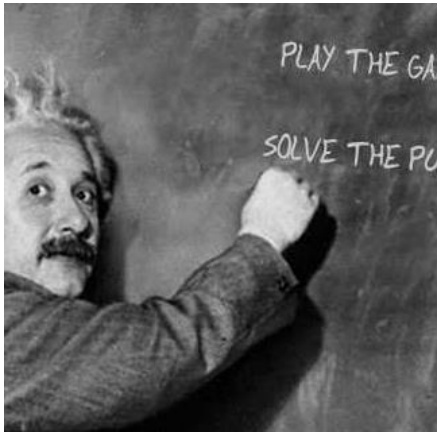
Action research and appreciative inquire

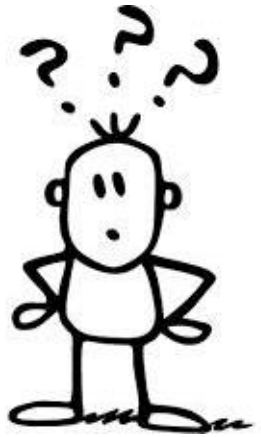
Action research is a form of practitioner research.

The goal of action research goes beyond how participants make meaning or understand a particular phenomenon or problem in their context …

… it seeks to engage participants in the process of research in order to solve a pratical, usually complex, problem.

Appreciative enquire focus on what is positive in an organization or group, and initiating interventions by highlighting what is positive.





We deal with wicked (not tamed) problems

Policy Sciences **4** (1973), 155–169

Dilemmas in a General Theory of Planning*

HORST W. J. RITTEL
Professor of the Science of Design, University of California, Berkeley

MELVIN M. WEBBER
Professor of City Planning, University of California, Berkeley

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ABSTRACT

The search for scientific bases for confronting problems of social policy is bound to fail, because of the nature of these problems. They are "wicked" problems, whereas science has developed to deal with "tame" problems. Policy problems cannot be definitively described. Moreover, in a pluralistic

anticipate all information required for resolution ahead of time), knowledge of all conceivable solutions is required.

Consider, for example, what would be necessary in identifying the nature of the poverty problem. Does poverty mean low income? Yes, in part. But what are the determinants of low income? Is it deficiency of the national and regional economies, or is it deficiencies of cognitive and occupational skills within the labor force? If the latter, the problem statement and the problem "solution" must encompass the educational processes. But, then, where within the educational system does the real problem lie? What then might it mean to "improve the educational system"? Or does the poverty problem reside in d
those etiologies to our info
for a plausible cause. Doe
problems of ego identity? d

persons who are familiar with the established criteria; and the answer will be normally unambiguous.

For wicked planning problems, there are no true or false answers. Normally, many parties are equally equipped, interested, and/or entitled to judge the solutions, although none has the power to set formal decision rules to determine correctness. Their judgments are likely to differ widely to accord with their group or personal interests, their special value-sets, and their ideological predilections. Their assessments of proposed solutions a
"better or worse" or "satisfyin

4. There is no immediate and n

For tame problems one can

9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's

and shared stylistic preferences that differ from those of other groups. As the sheer volume of information and knowledge increases, as technological developments further expand the range of options, and as awareness of the liberty to deviate and differentiate spreads, more variations are *possible*. Rising affluence or, even more, growing desire for at least subcultural identity induces groups to exploit those options and to invent new ones. We almost dare say that irregular cultural permutations are becoming the rule. We have come to realize that the melting pot never worked for large numbers of immigrants to America,[5] and that the unitary conception of "*The* American Way of Life" is now giving way to a recognition that there are numerous

anticipate all information required for resolution ahead of time), knowledge of all conceivable solutions is required.

Consider, for example, what would be necessary in identifying the nature of the poverty problem. Does poverty mean low income? Yes, in part. But what are the determinants of low income? Is it deficiency of the national and regional economies, or is it deficiencies of cognitive and occupational skills within the labor force? If the latter, the problem statement and the problem "solution" must encompass the educational processes. But, then, where within the educational system does the real problem lie? What then might it mean to "improve the educational system"? Or does the poverty problem reside in deficient physical and mental health? If so, we must add those etiologies to our information package, and search inside the health services for a plausible cause. Does it include cultural deprivation? spatial dislocation? problems of ego identity? deficient political and social skills?—and so on. If we can

4. There is no immediate and n

For tame-problems one can

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constant to each other. Therefore, in order to anticipate all questions (in order to anticipate all information required for resolution ahead of time), knowledge of all conceivable solutions is required.

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For wicked planning problems, there are no true or false answers. Normally, many parties are equally equipped, interested, and/or entitled to judge the solutions, although none has the power to set formal decision rules to determine correctness. Their judgments are likely to differ widely to accord with their group or personal interests, their special value-sets, and their ideological predilections. Their assessments of proposed solutions are expressed as "good" or "bad" or, more likely, as "better or worse" or "satisfying" or "good enough."

4. There is no immediate and no ultimate test of a solution to a wicked problem

For tame problems one can determine on the spot how good a solution-attempt

anticipate all information required for resolution ahead of time), knowledge of all conceivable solutions is required.

Consider, for example, what would be necessary in identifying the nature of the poverty problem. Does poverty mean low income? Yes, in part. But what are the determinants of low income? Is it deficiency of the national and regional economies, or is it deficiencies of cognitive and occupational skills within the labor force? If the

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Action research

Method in which research and practice mix and shape each other. The researcher mixes research and intervention, and engages participants in the process.

Good for

- Any domain in which you cannot isolate variables, cause from effect, case from the context, etc.
- Making sure that the research and its objectives are relevant to the participants
- When the effect of change is as important as the discovery of new knowledge
- When dealing with wicked problems

Limitations

- Generalizations are difficult because the results depend on the context as well as on the process, which is decided during the research
- You will not look good in the eyes of positivists

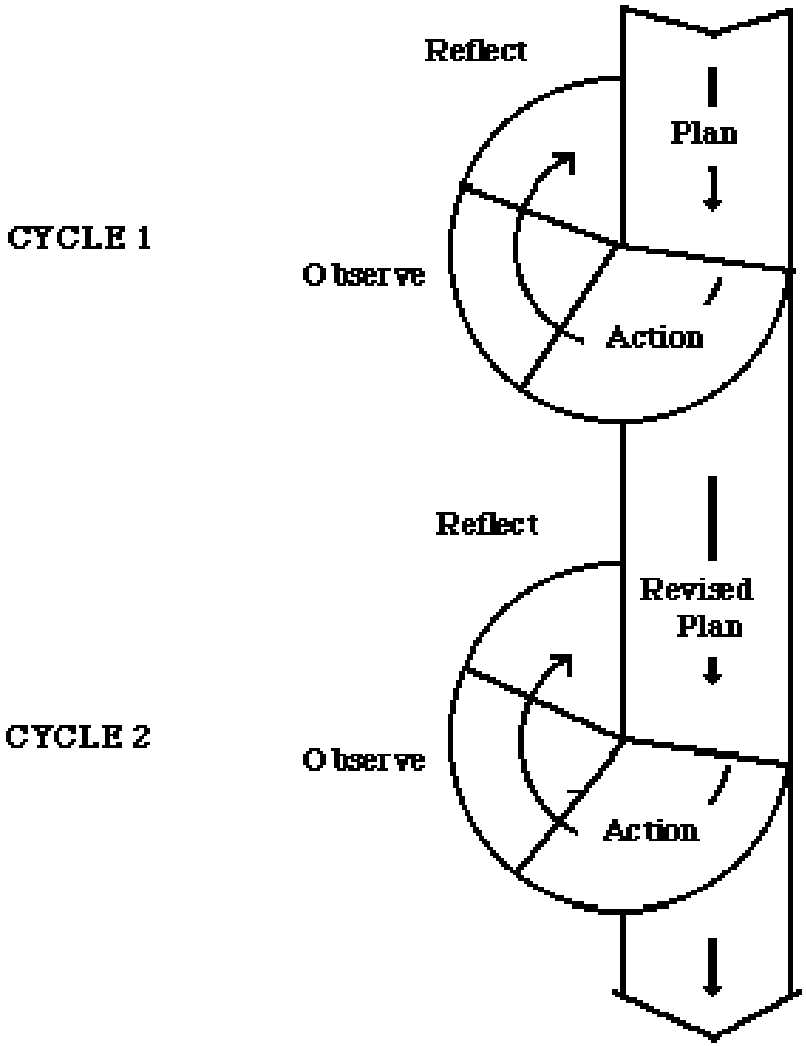
Based on Steve Easterbrook, RE2007 Conference Tutorial T1.

Characteristics of action-research

- Mixes research and intervention
  - Focus on solving real life problems (in general, wicked ones)
  - Study the problem and the process to solve it at the same time
  - Useful in contexts in which to implement change requires long term commitment
- Requires
  - A champion "from the problem situation" that is willing to collaborate
  - Critical reflexivity about present, past, and planned actions
  - An authentic problem (Remember Stu)
  - Return of relevant knowledge to the participants
  - Real commitment to change

Baseado em Steve Easterbrook, RE2007 Conference Tutorial

Simple action research process



(from MacIsaac, 1995)

Three types of action research

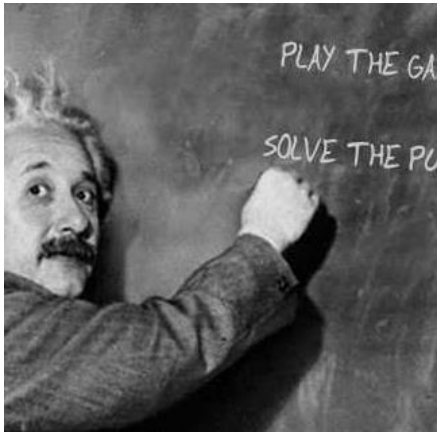
- Technical action research
  - Guided by an interest in improving control over outcomes
- Practical action research
  - Guided by an interest in educating or enlightening practitioners so they can act more wisely and prudently
- Critical action reserch
  - Guided by an interest in emancipating people or groups from irrationality, unsustainability, and injustice

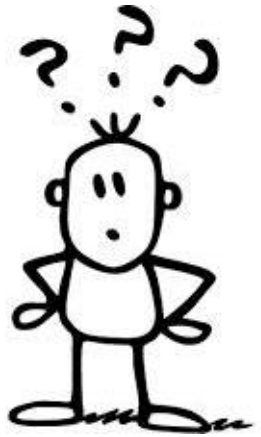
Field Work

Entering the Field

Collecting and Analysing Data

Reaching closure





Entering the field

Research Ethics

- Time to deal with research ETHICS seriously
- Why?
  - Your funding may depend on it
  - Your Review Board might require it
  - Your case almost certainly will impose restriction related to it
    - To (legally) regulate relationships between researcher, organization and participants
  - … and it is the right thing to do

Principles for Research Ethics

- Voluntary Participation
- Informed Consent
- Scientific Value
  - Validity
  - Relevance
- Confidentiality
- Beneficence and non maleficence
  - Benefits -> research topic and results
  - Risks -> research method and tools

Principles for Research Ethics (from the Bristish ESRC)

- Research should aim to maximise benefit for individuals and society and minimise risk and harm
- Participation should be voluntary and appropriately informed
- The rights and dignity of individuals and groups should be respected
- Research should be conducted with integrity and transparency
- Lines of responsibility and accountability should be clearly defined
- Independence of research should be maintained and where conflicts of interest cannot be avoided they should be made explicit.

http://www.esrc.ac.uk/funding/guidance-for-applicants/research-ethics/our-principles-researchers-and-research-teams/

In practice …

- There are (at least) two levels of relationship involved:
  - Researcher(s) and organization
  - Researcher(s) and participants
- Both require formal agreements
  - NDA's are common between researcher and organization
  - Informed Consent are often required between researcher and participant
  - (from the trenches) The type of information you need to collect may affect the level of formality of these agreements.
- You should think about those relationships before starting your study:
  - Formal agreements may impose restrictions on how you collect, analyze and report your research.

Collecting and analyzing data

Data Collection Techniques

- Interviews
- Field observations
- Mining data from documents and artifacts

Data Collection Techniques

- Interviews
- Field observations
- Mining data from documents and artifacts

Interviews

- Types
  - Person-to-person
  - Focus groups
  - Online interviews
- Structures
  - Highly structured
    - Good for demographic or other structured data
  - Semi-structured
  - Unstructured of informal
    - Good when we do not know enough about the phenomenon to ask more structured questions

Interviews

- A conversation guided by questions associated to the research problem
- A conversation with a purpose.
- Used to obtain information that cannot be observed or mined from documents: feelings, thoughts, intentions, etc.
- Good to gather more and/or better information with "low cost".
- Subject to several participant biases.

Registering interviews

- Audio recording
- Taking notes
- Both
- Quick tips:
  - Audio will need to transcribed for data analysis and it is time consuming.
  - Notes are never complete, so do not rely only on them.
  - And never, ever rely on your memory.

Data Collection Techniques

- Interviews
- Field observations
- Mining data from documents and artifacts

Observations

- Data collection in place (where) and time (when) the phenomenon of interest happens.
- It is a first-hand encounter with the data, while the interview provides us with a second-hand encounter, mediated by the interviewee's interpretation.
- Observations need to be systematic, guided by research questions and subject to verification of their reliability.
- It is important to triangulate data from other sources, especially from interviews.

Reasons to Observe

- See things that participants do not notice because they are accustomed to them.
- Record behavior when it happens.
- Use as a reference for future interviews.
- Record occurrences or phenomena that the participants would not say in an interview.

Types of observation

- Completely participant
- Participant as observer
- Observer as participant
- Completely observer

Registering Observations

- Records of observations can be recorded or filmed, but generally taking notes is the most economical and non-intrusive way.
- Field notes can be vary from very structured to completely unstructured.
- Your conceptual framework, research question, personal taste, etc. will guide the choices.
- Most important, you must have one!

Field notes

- Refers to notes created by the researcher during the act of qualitative fieldwork to remember and record the behaviors, activities, events, and other features of an observation.
- Field notes are intended to be read by the researcher as evidence to produce meaning and an understanding of the culture, social situation, or phenomenon being studied.
- The notes may constitute the whole data collected for a research study [e.g., an observational project] or contribute to it, such as when field notes supplement conventional interview data.

(http://libguides.usc.edu/writingguide/fieldnotes)

Field notes contents

- Descriptive information:
  - Accurately documented factual data [e.g., date and time] and the settings, actions, behaviors, and conversations that are observed.
- Reflective information:
  - Researcher's own thoughts, ideas, questions, and concerns as she/he is conducting the observation.

Example of structured field notes

Inspection Data Form

Class(es) inspected Inspection date: Time:
Author:
Moderator:
Reviewers:
Name Responsibility Preparation time Present

Amount of code inspected:

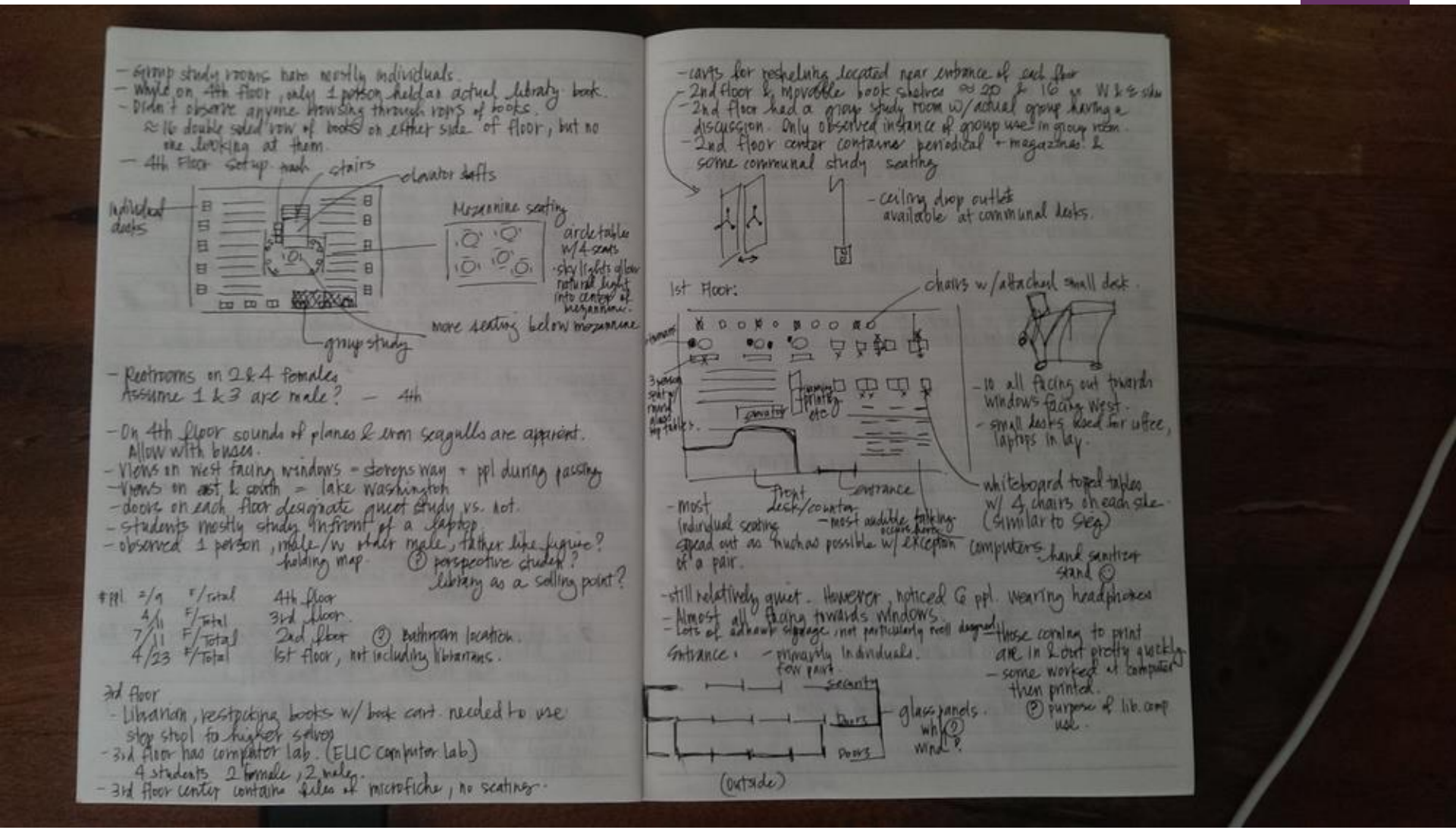
Complexity of classes:

Discussion codes:
D = Defects Q = Questions C = Classgen defect U = Unresolved issues G/D = Global defects G/Q = Global questions P = Process issues A = Administrative issues M = Miscellaneous discussion

Time logged (in minutes):
D_____ Q_____ C_____ U_____ G/D_____ G/Q_____ P_____ A_____ M_____

Using Qualitative Methods in Empirical Studies of Software Engineering. ***Carolyn Seaman***. University of Maryland Baltimore County. ESELAW'2009, São Carlos, Brazil.

Not so structured example



Some guidelines for the reflective content

- Note ideas, impressions, thoughts, and/or any criticisms you have about what you observed.
- Include any unanswered questions or concerns that have arisen from analyzing the observation data.
- Clarify points and/or correct mistakes and misunderstandings in other parts of field notes.
- Include insights about what you have observed and speculate as to why you believe specific phenomenon occurred.
- Record any thoughts that you may have regarding any future observations.

(http://libguides.usc.edu/writingguide/fieldnotes)

Data Collection Techniques

- Interviews
- Field observations
- Mining data from documents and artifacts

Mining data from documents and artifacts

- *Document* is often used as an umbrella term to refer to a wide range of written, visual, digital, and physical material relevant to the study (including visual images).
- *Artifacts* are usually three-dimensional physical "things" or objects in the environment that represent some form of communication that is meaningful to participants and/or the setting.

Types of documents and artifacts

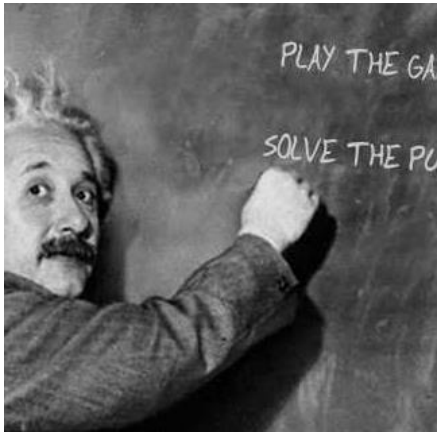
- Public records
- Personal documents
- Visual documents
  - Public or personal
- Physical artifacts or "material culture"
- Researcher generated documents
  - Diary studies
  - Life history
  - Quantitative data produced by questionnaires

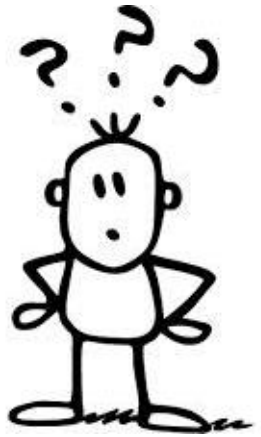
Enhancing Validity and Credibility

Dispelling the myths

Member checking for consistency

The issue of generalization





Validity and Reliability in Qualitative Research

- Credibility (instead of internal validity)
- Consistency (instead of Reliability)
- Transferability (instead of External Validity)

(Merriam and Tidell, 2016. chapter 9)

Credibility (instead of internal validity)

- Internal validity deals with the question of how research findings match reality.
- However
  - there is always interpretation;
  - observation/measurement changes reality;
  - data is an abstraction not reality itself.
- So, we use credibility instead of internal validity.
- Techniques to increase credibility
  - Triangulation: methods, sources, researchers, theories
  - Member checks or respondent validation
  - Adequate engagement in data collection (time, variation, etc.)
  - Reflexivity
  - Peer review

Consistency (instead of reliability)

- Reliability refers to the extent to which research findings can be replicated.
- However, replication of a qualitative study will not yield the same results (and you have to live – or leave – with this).
- So, we use consistency or dependability instead of reliability.
- Techniques to improve consistency
  - Triangulation: methods, sources, researchers, theories
  - Reflexivity
  - Peer review
  - Audit trail (research diary, log of process, etc.)

Transferability (instead of external validity)

- External validity is concerned with the extent to which the findings of one study can be applied to other situations.
- Statistical generalization goes from a sample to the population and is hardly of any use to say something about individuals.
- So, we use transferability instead of external validity, in which the applicability of one case to another is determined by the user or reader.
- We also use the notions of extrapolations, concrete universals, and ultimately analytical generalization (to the theory).
- Techniques to increase transferability:
  - Rich or thick descriptions
  - Maximum variation sampling

Some common questions related to case studies

- What can you possibly tell from an n of 1 (3, 15, 29, and so on)?
- What is it worth just to get the researcher's interpretation of the participant's interpretation of what is going on?
- How can you generalize from a small, nonrandom sample?
- If the researcher is the primary instrument for data collection and analysis, how can we be sure the researcher is a valid and reliable instrument?
- Without hypotheses, how will you know what you're looking for?
- If somebody else did this study, would they get the same results?

(Merriam and Tidell, 2016. p 241)

Flyvbjerg's Five Misunderstandings (2006)

- *Misunderstanding 1*: General, theoretical (context-independent) knowledge is more valuable than concrete, practical (context-dependent) knowledge.
  - *Predictive theories and universals cannot be found in the study of human affairs. Concrete, context-dependent knowledge is, therefore, more valuable than the vain search for predictive theories and universals.*

- *Misunderstanding 2*: One cannot generalize on the basis of an individual case; therefore, the case study cannot contribute to scientific development.
  - *One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas "the force of example" is underestimated.*

- *Misunderstanding 3*: The case study is most useful for generating hypotheses; that is, in the first stage of a total research process, whereas other methods are more suitable for hypotheses testing and theory building.
  - *The case study is useful for both generating and testing of hypotheses but is not limited to these research activities alone.*

Flyvbjerg's Five Misunderstandings (2006) – cont.

- *Misunderstanding 4*: The case study contains a bias toward verification, that is, a tendency to confirm the researcher's preconceived notions.
  - *The case study contains no greater bias toward verification of the researcher's preconceived notions than other methods of inquiry. On the contrary, experience indicates that the case study contains a greater bias toward falsification of preconceived notions than toward verification.*

- *Misunderstanding 5*: It is often difficult to summarize and develop general propositions and theories on the basis of specific case studies.
  - *It is correct that summarizing case studies is often difficult, especially as concerns case process. It is less correct as regards case outcomes. The problems in summarizing case studies, however, are due more often to the properties of the reality studied than to the case study as a research method. Often it is not desirable to summarize and generalize case studies. Good studies should be read as narratives in their entirety.*

What the reviewers are saying

- "One company is not enough to generalize; similarly, the small number of participants is not enough."
  - Our rebuttal: Regarding number of interviewees, in qualitative research we aren't seeking statistical generalization. Therefore, saturation of data is what guides the end of sampling and the total number of participants. "We stopped data collection when … new interviews … were not adding new information" (Section 3.7). We then used member checking and validation with managers to increase our confidence that saturation was reached.

- "Study was conducted in one country/culture, one company, and based on two projects – despite authors claiming that they are [not] seeking generalization (which is the case for most qualitative/interpretative case studies), the study is too specific to be used for theory developed – it could have been a lessons learned from a company type of study."
  - Our rebuttal: "Regarding building theories from single case studies, Flyvbjerg emphasizes that it is possible to create a theory that explains the case, thus creating knowledge that useful for others to learn the phenomenon. Claims of generalization from these theories must be done carefully. We prefer using the term "transferability" instead of generalization, and emphasize that our theory must be further tested."

On the bright side, the reviewers also say …

- "The paper has several points which recommend its acceptance. First, the authors provide sufficient background information to afford others the opportunity to replicate their study and extend it to other organizations."
- "As the authors point out, results .. won't necessarily generalize to other types of software organizations, but they will still inform academia and industry of the factors that play a role in motivation. I also appreciate that the authors clearly state where the results presented in this paper are coming from (even in the title), and do not attempt to over-generalize."

In practice

Member check in a qualitative case study of job rotation in software engineering.

Member Checking

- A research phase performed in qualitative research in which the researcher compares her interpretations and understanding obtained from the data analysis with the view-points of participants to increase accuracy and consistency of results.
- In the Job Rotation case study, we applied MC as the final phase of the study in three steps (ESEM 2017 paper):
  - Presentation of the the results of the study.
  - Evaluation of the level of agreement of the participants regarding the interpretation of the data collected.
  - Presentation of the consolidated results (analysis and member check) to members to verify consistency and raise theoretical saturation.

Lessons learned

- Besides increasing credibility, member checking increases our confidence on saturation
- Member checking stimulates self-reflection, thus also contributing to consistency
- It is an effective way to provide feedback to participants regarding the research results
- Which induces participant's self-reflection on the investigated phenomenon, contributing to learning
- Ultimately contributing to generation and dissemination of knowledge

Recommendations

- Think ahead or plan your member check during data collection and analysis
- Be aware of the extra time required from the participants
- If possible and adequate, use focus groups to speed up the process
- Sample for maximum variation if not covering all original participants
- Add changes to your audit trail (research log or diary) to enhance consistency
- Explicitly show the member check results in your reports

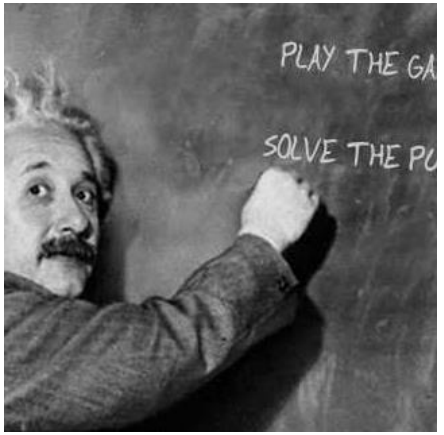
Concluding remarks

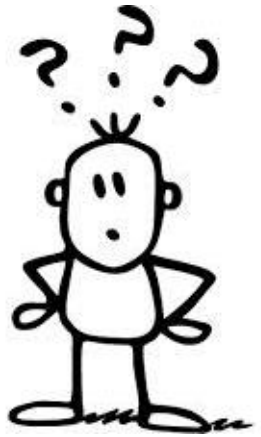
Choosing a research method for empirical research is a challenge in all scientific areas.

A starting point is a carefuly chosen research topic and a relevant and challenging problem.

There are many research methods, and all have limitations and strengths.

The choice of method and corresponding study design should fit your **research questions.**





Summary of your choices

- Use experiments when you want to:
  - Investigate if a tool or technique has an effect on certain outcomes
  - Test for causal relationships
  - (Look good in the eyes of positivists)
- Use surveys when you need to:
  - Discover what is true for a (part of) our target population
  - Establish what is normal, common, or unusual in a population
- Use case studies when:
  - You have a genuine interest in a case
  - You want to have a deep understand of how the phenomenon of interest happens in the case
- Use ethnography when you want:
  - Understand how cultural aspects develop and shape social and individual behaviour
- Use action-research when you:
  - Need to solve a particular (wicked) problem and make sure that the solution will be effective
  - Want to offer the participants an opportunity for change and learning with the research
- Use appreciative enquire when you:
  - There is a sense of past positive achievements among participants
  - Want to ignite innovation and positive changes in the context

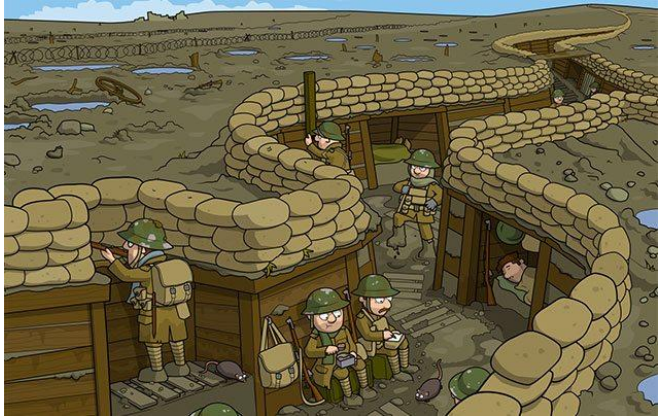
Based on Steve Easterbrook, RE2007 Conference Tutorial T1.

Concluding remarks

You should also consider a method that is consistent with your philosophical orientation (your worldviews), personality, and, last but not least, your skills as a researcher.

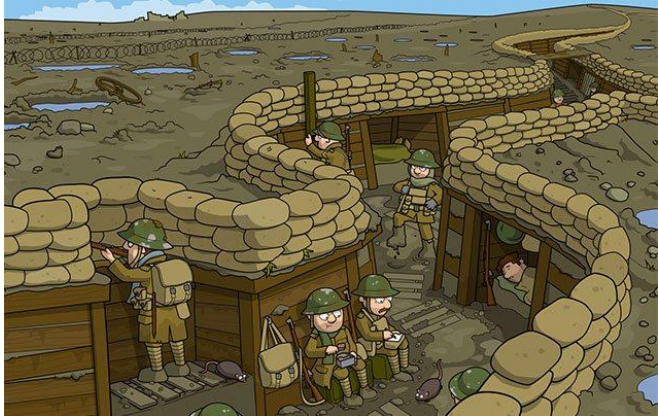
… and, above all, chose a study that has the biggest potential to positively affect peoples lifes and engage them in the change.

Lessons learned in the trenches – 1



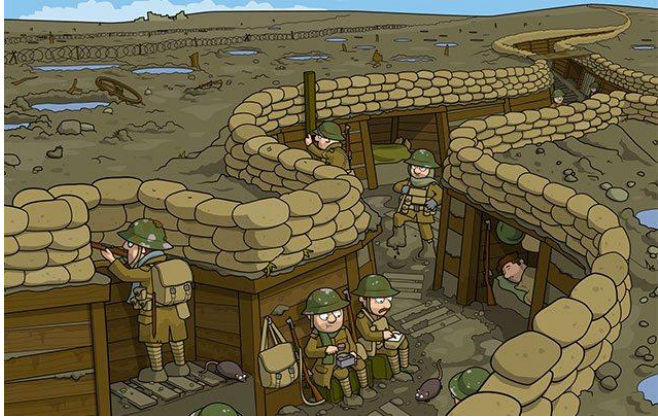
- Always give feedback to the company and participants, this will make them more willing to collaborate with you and others in the future and
  - It is the right thing to do …
  - … and possibly the only way to repay their participation.
- But, be clear about the timing to return the feedback
  - … Because qualitative data analysis takes time.

Lessons learned in the trenches – 2



- Flexibility is golden, so be prepared to:
  - Replace cases – companies drop out
  - Replace participants within the cases – individuals drop out
  - Reschedule interviews as many times as necessary (and possible)
  - Change the course of the research as your results point you to a new direction, but be committed to your research problem as much as possible.
- But, to be able to achieve this flexibility you MUST:
  - **Perform data analysis in parallel with data collection.**

Final and most important lesson …



- Qualitative studies (at least the good ones):
  - Require personal and long term involvement with the research problem and with the field
  - Thus, requiring long term and in depth involvement with participants
  - Both certainly require a lot of effort from you and can be a daunting work.

- So …

THANK YOU

Designing and Conducting (Field) Case Studies

Thank you.

Fabio Q. B. da Silva
Centre for Informatics
Federal University of Pernambuco
E-mail: fabio@cin.ufpe.br
www.haseresearch.com
University of Bari
Italy
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