

# Towards an Epistemological Classification of Usability Research

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## Abstract

How is software usability analyzed in literature? This paper aims to act as a first step towards an epistemological classification of usability research approaches, taking into account both the producer and consumer sides of software. Building upon the framework for research methods by Meredith et al. (1989), it sorts 60 conference works on usability engineering and usability testing along the research paradigm dimensions "rational/existential" and "natural/artificial." It compares the distributions of works of the two subfields, finding different methodical foci and hinting at under-represented research perspectives.

## 1 Introduction

How do human beings perceive software? Generally speaking, software involves a producer and a consumer side. While an IT firm develops it, it is used by another group, the consumers. This friction can be seen as the reason for the mere existence of usability research: one might argue that the majority of problems concerning usability has their roots in different perceptions of reality. Depending on the background knowledge and other context factors, software can be regarded as highly intuitive from the producer's point of view, whereas consumers can find themselves confronted with problems understanding it. Mirroring these two perspectives, usability research includes two subfields: Usability engineering (UE) rather focuses on the production side of usability and e.g. provides structured process models for organizations to achieve higher usability (Mayhew, 1999). Usability testing (UT) on the other hand, while being increasingly included in the production process of software, reaches to the consumer side and typically evaluates the perceived ease-of-use of software on its users (Dumas & Redish, 1999). Meanwhile, both sides have developed their own research approaches and methods.

It is counterintuitive that epistemology has not been prominently featured in usability research. Epistemology questions how knowledge is generated, that is how and what aspects of reality

are grasped by research (Chalmers, 2013). In the case of usability, where misunderstandings on an object reality between the two groups of producers and consumers are commonplace, it would seem of value to compare the research methods that go along with usability engineering and usability testing: How is knowledge on actions of both sides derived? What perspectives do their methods take? What are the differences in their knowledge generation?

This paper wants to provide a basic approximation to these problems by classifying research approaches on software usability. The framework chosen has been proposed by Meredith et al. (1989). It categorizes methods in dimensions "rational/existential" and "natural/artificial" and has been proven suitable for arguing for new orientations in certain fields (Steenhuis & Bruijn, 2006). The present paper follows this approach, contrasting UE and UT.

## 2 Definitions

**Epistemology** describes the theory of knowledge, or as Steup (2005) defines: "[E]pistemology is the study of knowledge and justified belief. As the study of knowledge, epistemology is concerned with the following questions: What are the necessary and sufficient conditions of knowledge? What are its sources? What is its structure, and what are its limits?" A related topic with epistemology is ontology, but whereas the latter focuses on the existence of things (what are things?) the former questions the (scientific) ways in which we know things (Gialdino, 2009). The two main positions epistemology engages with can be summarized as positivism and anti-positivism or its subset interpretativism. Positivism follows natural science as a model. By observation and experiments facts are acquired, then through induction laws and theories derived, and finally predictions and explanations deducted (Chalmers, 2013). Interpretativism rather aims at understanding and is anchored more in the social sciences. Recognizing the complexity of truth, it concentrates on the subject, on their individual meanings, actions and on social context (Klein & Myers, 2011).

The **Framework for Research Methods** by Meredith et al. (1989) is based on epistemological reflections and consists of a 4x3 matrix with the two dimensions "rational/existential" and "natural/artificial." The axis from the rational pole (deductive, formal, objective etc.) to the existential pole (inductive, informal, subjective etc.) relate directly to the epistemological structure of the research. It locates the logical positivist/empiricist perspective in the rational half, the interpretive perspective in the existential half. As two extremes, the framework adds the axiomatic (highly rational, "theorem-proof world of research") and the critical theory perspectives (highly existential, own subjective understanding of acting). On the range from natural to artificial, the authors make a distinction between the kinds of information used in research. "Unfiltered," direct observation by the researcher is put on the natural pole, followed by the "filtered" view through somebody else's eyes ("people's perceptions") and the artificial reconstruction of object reality on the other extreme. In the subsequent sections, this framework will be used to classify usability research methods and the quadrants.

		NATURAL ← → ARTIFICIAL		
		DIRECT OBSERVATION OF OBJECT REALITY	PEOPLE'S PERCEPTIONS OF OBJECT REALITY	ARTIFICIAL RECONSTRUCTION OF OBJECT REALITY
RATIONAL ↑ ↓ EXISTENTIAL	AXIOMATIC			<ul style="list-style-type: none"> <li>• REASON/LOGIC/THEOREMS</li> <li>• NORMATIVE MODELING</li> <li>• DESCRIPTIVE MODELING</li> </ul>
	LOGICAL POSITIVIST/EMPIRICIST	<ul style="list-style-type: none"> <li>• FIELD STUDIES</li> <li>• FIELD EXPERIMENTS</li> </ul>	<ul style="list-style-type: none"> <li>• STRUCTURED INTERVIEWING</li> <li>• SURVEY RESEARCH</li> </ul>	<ul style="list-style-type: none"> <li>• PROTOTYPING</li> <li>• PHYSICAL MODELING</li> <li>• LABORATORY EXPERIMENTATION</li> <li>• SIMULATION</li> </ul>
	INTERPRETIVE	<ul style="list-style-type: none"> <li>• ACTION RESEARCH</li> <li>• CASE STUDIES</li> </ul>	<ul style="list-style-type: none"> <li>• HISTORICAL ANALYSIS</li> <li>• DELPHI</li> <li>• INTENSIVE INTERVIEWING</li> <li>• EXPERT PANELS</li> <li>• FUTURES/SCENARIOS</li> </ul>	<ul style="list-style-type: none"> <li>• CONCEPTUAL MODELING</li> <li>• HERMENEUTICS</li> </ul>
	CRITICAL THEORY		<ul style="list-style-type: none"> <li>• INTROSPECTIVE REFLECTION</li> </ul>	

Figure 1: A Framework for Research Methods (Meredith, Raturi, Amoako-Gyampah, & Kaplan, 1989)

### 3 Approach and Method

The data collection of usability research literature was performed using the ACM digital library, restricted on the ACM Conference on Human Factors in Computing Systems (CHI) (ACM Digital Library, 2015). To receive an impression on the distribution of latest research methods, the abstracts and contents of the 30 latest (2015 and older) and clearly assignable entries of both streams UE and UT – applied as search filters – were looked into. In sum, 68 proceedings on UE and 36 proceedings on UT were viewed. Sorting out 44 works with no recognizable relation to the specific research streams, the remaining 60 works were then classified into the framework by Meredith et al. (1989) according to the author's judgement.

### 4 Results

CHI accepted less papers on UE than on UT (68 vs. 241). The 30 latest and assignable papers on UE reached back until the year 1986, on UT until 2010. Most works on UE fall into the interpretive perspective (15), followed by logical positivist/empiricist (8), critical theory (4),

and axiomatic perspectives (3). Regarding the information dimension, 14 works on UE build upon artificial reconstruction, 11 upon people perceptions and 5 upon direct observation. Concerning UT, most works are classified as logical positivist/empiricist (22), followed by interpretive (5), critical theory (2), and axiomatic perspectives (1). In the information dimension, 15 works are based on people perceptions, 8 on artificial reconstruction, and 6 on direct observation. Taken together, the UE matrix tends towards the existential-artificial paradigm. One example for this focus is conceptual modeling, e.g. process models describing the integration of usability methods into agile development (Wolkerstorfer, et al., 2008). By contrast, the UT matrix has its center in the rational-people paradigm. One example for this focus is structured interviewing – often also addressing certain user groups, e.g. the elderly in a study by Dai et al. (2015). The figure below shows the distributions by quantity.

		NATURAL ← → ARTIFICIAL		
		DIRECT OBSERVATION OF OBJECT REALITY	PEOPLE'S PERCEPTIONS OF OBJECT REALITY	ARTIFICIAL RECONSTRUCTION OF OBJECT REALITY
RATIONAL	AXIOMATIC			3
	LOGICAL POSITIVIST/EMPIRICIST	1	2	5
	INTERPRETIVE	4	5	6
	CRITICAL THEORY		4	
EXISTENTIAL				

  

		NATURAL ← → ARTIFICIAL		
		DIRECT OBSERVATION OF OBJECT REALITY	PEOPLE'S PERCEPTIONS OF OBJECT REALITY	ARTIFICIAL RECONSTRUCTION OF OBJECT REALITY
RATIONAL	AXIOMATIC			1
	LOGICAL POSITIVIST/EMPIRICIST	6	9	7
	INTERPRETIVE		4	1
	CRITICAL THEORY		2	
EXISTENTIAL				

Figure 2: Numbers of Works on Usability Engineering (left) and Usability Testing (right)

## 5 Discussion

The study reveals a broad scope of methods applied in usability research, reaching from classic surveys to usability-specific adapted and newly developed methods. One explanation for this phenomenon could be the various training backgrounds its researchers (psychology, sociology, computer science etc.). Viewing the works in the sample, it also became obvious that more than a few works use mixed research designs and multiple methods. Several papers discuss combinations or compare methods with each other (e.g. Jawell & Salvetti (2012)). While on the one hand the field shows high practical relevance, on the other hand there seems to be a high awareness on methodical questions.

Research on UE and on UT exhibits different foci with regards to methods. UE has a strong emphasis on the interpretive perspective and on artificial reconstruction. UT is strongly concentrated on the logical positivist/empiricist perspective and on people's perceptions of reality. This differentiation can be partly explained with the typical definitions of both research streams: UE is mainly identified with process models, UT with experiments on users. In their

settings, the methods fulfill the tasks assigned. Nevertheless, a part of the explanation could also lie in the rigidity of established methods over time, as well as in the distribution of researchers of certain training in certain areas of usability (e.g. psychologists in UT). It could be argued that the sample also supports the rigidity argument, as no significant changes in the distribution of methods over time and a rather low rate of "non-conform" works are visible.

One might wonder if these rather fixed and different perspectives may be an obstacle for the usability field. Applying different methods, usability research analyzes the production and the consumption of software through different lenses. But is it not important for the purpose of highly usable software that there is similar way of understanding? If, for instance, user actions can be fully explained, but not the one of programmers, is the usability problem really solved? These questions leave space for new approaches and ideas for potential usability research.

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