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# The Challenge of Teaching HCI Qualitative Evaluation Methods: a Case Study on the Communicability Evaluation Method

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# The Challenge of Teaching HCI Qualitative Methods: A Case Study on the Communicability Evaluation Method [1]

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**Abstract**. The challenges of teaching qualitative HCI evaluation methods for undergraduate students in computing-related programs are presented here through the description of a qualitative study about Communicability Evaluation Method (CEM), a Semiotic Engineering evaluation method, which is an example of qualitative HCI evaluation method. Different perspectives on CEM, expressed by the methods creators, by teachers, practitioners and students bring some interesting outcomes that are also shared by other qualitative HCI methods.Among the most relevant results, is the fact that teachers themselves express their difficulty with mastering knowledge paradigms and methods that are not popular in their own professional training.

**Keywords**: teaching HCI, qualitative methods, communicability evaluation method, semiotic engineering

**Resumo**. Os desafios do ensino de métodos qualitativos de avaliação de IHC para alunos de graduação de cursos da área de computação são apresentados neste artigo através da descrição de um estudo qualitativos sobre o Método de Avaliação de Comunicabilidade (MAC), um método de avaliação da engenharia semiótica, que é um exemplo de método qualitativo de avaliação de IHC. Diferentes perspectivas sobre o MAC, expressadas pelas criadoras do método, professores, avaliadores e alunos trazem resultados interessantes que também são compartilhados por outros métodos qualitativos de IHC. Entre os resultados mais relevantes, está o fato dos próprios professores expressarem suas dificuldades no ensino de paradigmas e métodos de conhecimento que não são comuns em seus cursos de formação.

**Palavras-chave**: ensino de IHC, métodos qualitativos, método de avaliação de comunicabilidade, engenharia semiótica

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# Sumário / Table of Contents

# 1 Introduction

The aim of this article is to discuss the challenges of teaching qualitative HCI evaluation methods for undergraduate students in computing-related programs, such as Information Systems, Computer Engineering and Computer Science. An affirmative attitude towards innovation and the ability to imagine and create novel technologies and experiences for users are key targets in the professional education offered in these programs. But in order to explore the vast possibilities for innovation brought about by computing technologies, students must become familiar with some of the challenges posed to the very foundations of Computer Science. Dourish [2001] remarks that "traditionally, the central component of any account of computation has been algorithms or procedures – step-by-step models that specify the sequential behavior of a computer system" (p. 3). However, the author continues, the classical procedural approach has been challenged by models of computation that "have more in common with ecosystems than with the vast mechanisms we used to imagine [and] emphasize diversity and specialization rather than unity and generality" (p. 4).

The ability to expand the students' perspectives from a paradigm of fixed, predictable and generalizable behavior to one of emerging and contingent diversity in computation requires from teachers a familiarity with very different traditions in science. The first one is the logico-mathematical tradition, which favors quantitative and experimental research methods, and is actually the basis for many techniques and methods used in HCI research and professional evaluation. The second is the hermeneutic tradition, which favors qualitative methods, and has gained popularity in HCI with ethnographic techniques used mainly by anthropologists [Suchman, 1987]. Qualitative methods are very different from the methods used in most of the disciplines taught in undergraduate computing courses. However, unlike quantitative methods, they can deal with social, cultural, communicative and organizational aspects of the development, deployment and use of computational systems in an 'ecological' way, to follow Dourish's metaphor.

Online communities provide us with a good example of why an 'ecological' approach is desirable. Computer technology to support communities of practice and social network services, for example, requires an adequate understanding of far more than algorithms and computable representations. An understanding of the users' individual and group experience, as well as the capacity to anticipate what kinds of novel social and cultural phenomena may emerge from such technologies, is the key to successful products. The same can be said about e-commerce. Unless developers can grasp the ingredients that can make users trust e-commerce applications, and feel compelled to by the products being offered, failure will certainly follow. In both kinds of technologies, the users' experience is determined by a set of technical, cognitive, cultural and even ethical factors. And, to understand these factors, computing professionals need to feel comfortable with techniques and concepts that are neither logico-mathematical in nature, nor the result of generalizations and predictions made exclusively from statistical treatment of collected data.

Our work aims primarily to contribute to the teaching of qualitative HCI evaluation methods, by helping teachers and researchers understand some of the basic challenges faced by teachers, students and practitioners of a specific instance of such methods: the communicability evaluation method (CEM). CEM [Prates et al, 2000] is one of the evaluation methods proposed by Semiotic Engineering [de Souza, 2005a]. It allows the evaluator to appreciate how interactive systems' designers communicate their vision and the logic of their product to the users *via* the system's interface. This involves *telling* the user, in the system's *interface language*, what the system is, what its advantages are, how it can or must be used, what kind of goals the users are expected to accomplish with it, and why. This perspective translates the gist of Semiotic Engineering, a theory which focuses on the communicative elements and processes that bring developers and users together at interaction time [de Souza, 2005b].

We report the results and conclusions of a qualitative study carried on with students, teachers, practitioner, and creators of CEM. Our findings suggest that the challenges of teaching CEM are considerable for mainly three reasons. First, qualitative methods require a big intellectual leap across scientific paradigms. Students are massively trained in the logico-mathematical tradition, and then they must learn and gain familiarity with a completely different way of perceiving and interpreting the world around them. Second, HCI contents are typically taught in only very few disciplines, where a very large and diverse spectrum of concepts and techniques must be compressed to fit academic schedules. Therefore, teachers cannot help but select what – in their view – constitutes the essence of the subject matter. This selection, however, comes at the expense of a broader and more articulated account of what is actually involved in the users' experience with interactive computer technologies, and of how professionals can deal with it. Third, since most teachers of HCI disciplines have themselves been trained under such challenging circumstances, they have to struggle with certain aspects of qualitative methods that they haven't practiced or learned appropriately during their own professional education. This is a very serious problem that we, as researchers, must try to solve, because it perpetuates a chain of misunderstandings whose results are bound to affect the quality of future computer technologies produced by students of the programs we are focusing on.

Although this article focuses specifically on CEM, it can catch the interest of researchers and teachers who are more familiar with other qualitative methods. We believe there are two main reasons for this. One is that we explicitly establish a correspondence between the challenges of teaching and learning CEM and the tenets of its foundational theory, Semiotic Engineering. This correspondence has allowed us to formulate some deeper investigative questions about certain aspects of HCI education that, in our opinion, transcends the sphere of CEM and Semiotic Engineering. The other is that we have been able to identify certain aspects of CEM that clearly must be elaborated and revised in order to facilitate (and ultimately make possible) its use in the professional practice. This helps researchers interested in comparative analyses to establish more easily some relevant dimensions for conducting similar studies with other qualitative methods (such as ethnography, for example).

In the following, we start with a section contrasting the essence of qualitative and quantitative methods in research. Then we briefly describe how post-cognitivist approaches to HCI are all aligned with qualitative perspectives on science, with a special emphasis on Semiotic Engineering – our own theoretical choice. Next we introduce the Communicability Evaluation Method, followed by a section describing the details and results of our study. In conclusion we consolidate the main findings and implications of this research, and list future work alternatives.

## 2 Contrasts between Qualitative and Quantitative Methods

The conception, development and, subsequently, the choice of scientific methods are strongly connected with the objectives of each investigation, the nature of each study object and, ultimately, with the characteristics of different disciplines and scientific fields. Qualitative methods have emerged from human and social sciences as a response to the inadequacy of quantitative methods to deal with certain inherent characteristics of their objects of study – human intelligence and emotions, social structures and processes, culture and values [Guba and Lincoln, 1994; Bogdan and Taylor, 1975]. They have evolved into a heterogeneous set of methods and techniques that carry the intellectual heritage of the disciplines from which they have sprung, "the traits of its own disciplinary history" [Denzin and Lincoln, 2003, p. 21]. For example, ethnographic methods carry the hallmark of sociology and anthropology, semiotic and discourse analysis that of language studies, and so on.

Despite such heterogeneity, qualitative methods have many characteristics in common: they are exploratory; they refer to the context where their object of study is manifest; they emphasize the process of knowledge generation rather than the product; they are interpretive; they favor in-depth exploration; the researcher assumes an active role in the research process; and scientific validation of research is constantly reinterpreted by researchers.

The exploratory nature of qualitative methods leads adopters to investigate specific phenomena starting from a thorough elucidation of their characteristics and context. Unlike experimental and quantitative methods, which examine phenomena in order to confirm or refute previously formulated hypotheses, qualitative methods aim at identifying unsuspected and unexpected aspects, which are never previously formulated in a study's hypotheses.

Qualitative methods also share a basic axiom: human and social phenomena are *not universal* – they are inescapably bound to a specific historical, cultural and social context of occurrence. The exploration of such context is the only key to the whole spectrum of meanings involved in human and social phenomena. Knowledge generated by qualitative research studies is always unique and cannot be generalized in the form of laws, principles, static relationships of cause and effect, and universal abstractions. Although qualitative methods must be flexible in order to account for a wide diversity of contexts and processes, they must not lose the rigorous ingredients expected from every scientific research, namely clarity of goals, consistent planning of research steps, and careful execution [Nicolaci-da-Costa et al., 2004].

In the process of understanding how human and social phenomena occur, researchers who use qualitative methods seek to uncover the meanings assigned to such phenomena. These meanings are built in and encoded in the very context of research by both the participants and the researcher. The meanings construction and interpretation process is unique and cannot be replicated. This is the most striking difference between qualitative and quantitative or experimental methods; there are no predictions in the outcome of research, and each phenomenon bears many possible interpretations [Denzin and Lincoln, 2003]. Interpretation is strongly dependent on the interpreter. Personal and professional experience (both theoretical and practical) of the researcher is an integral part of the investigation [Patton, 1990]. There is neither such thing as neutral research, nor a unique and definitive interpretation of the phenomenon being studies [Denzin and Lincoln, 2003].

With such extreme differences from quantitative and experimental methods, qualitative methods require different validation parameters for the knowledge obtained in research. Firstly, researchers must switch from the notion of *replicability* to those of *credibility*, *reliability* and *plausibility* [Denzin and Lincoln, 2003; Seidman, 1998; Potter, 1996]. Researchers must verify if the conclusions of their qualitative research expand the knowledge of their peers and stimulate them to critically reflect about the phenomenon under study, as well as other related ones, opening the path to new meanings and studies in the discipline [Turato, 2003].

*Triangulation* is also an option to validate qualitative research. The use of different data-collecting techniques, interviewing different participants, submitting the data to the analysis and interpretation of different researchers are some examples of triangulation procedures. They promote the emergence of multiple perspectives on a single phenomenon, increasing the reliability of research results [Denzin and Lincoln, 2003].

## 3 Qualitative Methods in Post Cognitivist Approaches to HCI

The interdisciplinary nature of HCI has naturally favored the use of qualitative methods in research and professional practice. Multi-cultural websites and services like Amazon.com and Google, as well as social network systems like Orkut, provide us with clear examples of HCI research challenges that call for qualitative methods. For instance, building a reputation of trust in e-commerce (cf. Amazon.Com), informing the users' choice between sponsored and non-sponsored search results (cf. Google), helping individuals and groups avoid social harassment and threat (cf. Orkut), involve design decisions based on knowledge about many inter-related psychological, social and cultural phenomena that quantitative methods cannot suitably account for.

Activity theory [Bødker, 1991; Nardi, 1996], phenomenology [Winograd and Flores, 1987; Dourish, 2001], distributed cognition [Hutchins, 1995], ethnomethodology [Suchman, 1987] and Semiotic Engineering [de Souza, 1993, 2005a] are instances of HCI approaches/theories coined as *post-cognitivist* [Kaptelinin et al., 2003]. All of them use or advocate qualitative methods in research and practice, since they all give priority to an in-depth and situated perspective on the users' experience.

In the words of Nardi [1996] "activity theory is a powerful and clarifying descriptive tool rather than a strongly predictive theory" (p. 7). The theory was formally presented to the HCI community by Bødker [1991]. This Russian psychological theory, which began with the work of Vygotsky, was applied to HCI in an attempt to elucidate the relation between consciousness and activity with a focus on the interaction between people and computer artifacts.

Different methods and techniques have been derived from the activity theory framework. Some of them are: focus shift analysis [Bødker, 1996]; the activity checklist [Kaptelinin et al., 1999]; and the activity walkthrough [Bertelsen, 2004]. The first one tries to map how focus shift and breakdowns are instrumental in analyzing human-computer interaction recorded on videotape. The second is a practical tool intended to be used in the early phases of system design or in the evaluation of existing systems. It allows for an understanding of the context where the system is (or will be) used, by means of an in-depth analysis of identified areas of interest. Finally, the third one is a modified version of the cognitive walkthrough, which aims at systematically including the context and history of use in the process of analysis. It is carried out in six phases: preparation, contextualization, verification of tasks, task analysis, walkthrough and task analysis verification.

The work of Winograd and Flores [1987] is a language/action approach developed with the aim to contribute to the design of systems which helps people to work more effective improving the way they communicate with each other. The basic premise of the Conversation for Action framework it that people act through language. The framework combines a hermeneutic orientation with concepts of the philosophy of language. Winograd and Flores propose that the use of hermeneutic methods and techniques can inform the design of information systems in ways that rationalistic approaches – typically advocated by classical Artificial Intelligence enthusiast – cannot do.

The contribution of Dourish [2001] to the HCI field is an attempt to outline a new model for HCI design based in the notion of embodiment. Embodiment is a property of interaction rooted in the ways in which people and technologies participate in the world. The model emphasizes the environment and the social contexts where the technology is used. A small passage in Dourish's book can illustrate the qualitative inspiration of his work: "Physically, our experiences cannot be separated from the reality of our bodily presence in the world; and socially, too, the same relationship holds because our nature as social beings is based on the ways in which we act and interact, in real time, all the time" (p. 18). Ethnomethodology is particularly well suited for the purposes of this research project inasmuch as it amounts to an ethnographic investigation of social practices.

The distributed cognition [Hutchins, 1995] is an approach to describe what happens in a cognition system explaining the interactions among people, the artifacts they use and the environment where they work. This approach can be very useful in the design and evaluation of new collaborative technologies [Preece et al., 2005]. Its framework can be used for analyzing complex distributed settings in order to comprehend the relationship of social activities and the cognitive processes of the participants. The influence of culture is also extensively taken into account in this analysis.

Suchman [1987] proposes the use of ethnography as an ideal resource to investigate the use of technology. The ethnographic approach is mainly used in the design phase of interactive computational systems in order to generate a better understanding of how people use current technology. From there, designers can make scenarios of future technology and how they will be used. Suchman claims that by focusing its analysis on unique details of a specific user situation ethnographic methods yield better results than preconceived models of how people must follow instructions and procedures while dealing with technology.

Semiotic Engineering is a semiotic theory of HCI, which has evolved from a semiotic design approach [de Souza, 1993] and was formally presented in [de Souza, 2005a]. It views HCI as a unique phenomenon of computer-mediated communication between designers and users. The system's interface *voices* the designers' communication and messages, and thus designers and users are brought together at interaction time [de Souza, 2005b].

The designers' message to users presents them the design vision, which can be paraphrased as: *"Here is my (the designer's) understanding of who you (user) are, what I've learned you want or need to do, in which preferred ways, and why. This is the system that I have therefore designed for you, and this is the way you can or should use it in order to fulfill a range of purposes that fall within this vision."* [de Souza 2005a, p. 25] This message is unfolded and interpreted by users as they interact with the system. Hence the idea that HCI is, according to Semiotic Engineering, a case of *metacommunication* – communication about how to communicate with systems, what for, and why.

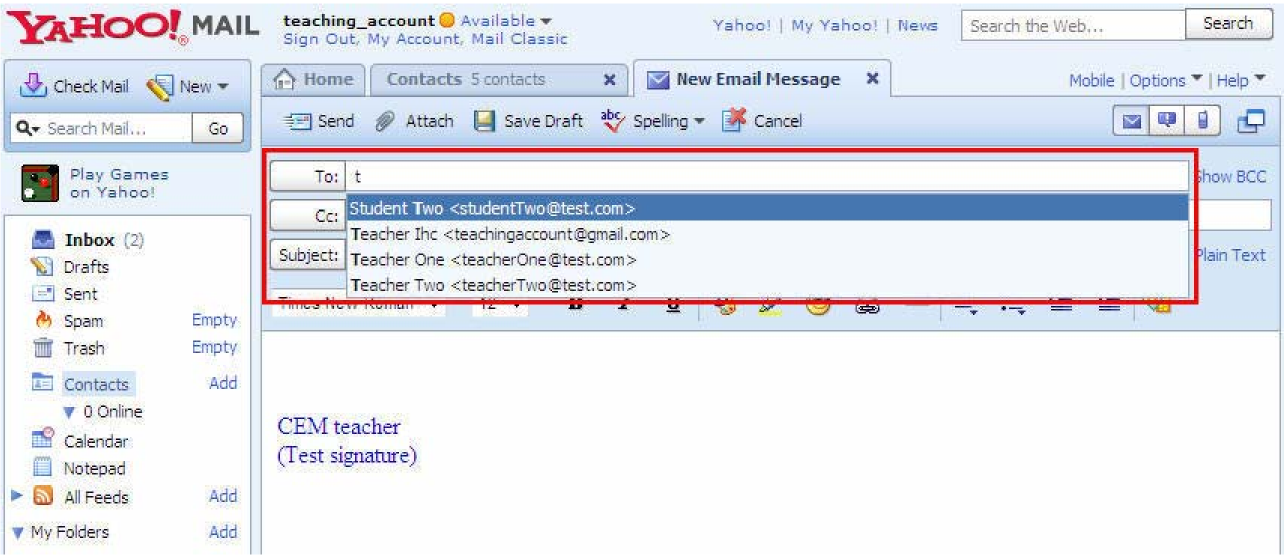


Figure 1 – YahooMail metacommunication example

As an example of how this metacommunication paraphrase can be instantiated in a small portion of a real system's interface, we can analyze designer-to-user communication through the YahooMail New Email Message interface. In Figure 1 we see a snapshot of interaction where the user is writing an email message and starts by typing an email address in the "To" textbox. A significant portion of the designer's metacommunication message regarding this use situation is this:

*"I believe you make an intensive use of email, with many contacts. Memorizing email addresses can be hard, and typing them fastidious. So I have designed this special feature to make things easier for you. As you start typing the first few characters of an email address, I automatically search your address book (which I automatically feed for you) for matching entries. Then, unless this is the first time you are writing an email to a particular recipient, all you have to do is jot in a few characters of the address, and then select the right address from the list of matching addresses I show you right beneath the 'to:' textbox. "*

Given its focus on communication, the key quality of interactive artifacts in terms of Semiotic Engineering is *communicability*, formally defined as *"the property of software that efficiently and effectively conveys to users its underlying design intent and interactive principles.."* [Prates et al., 2000, p. 32]. The designer has the challenge of communicating to users his/her intention, by using a consistent set of signs2 that will enhance the system's communicability.

Because a sign can be interpreted by different ways depending on various factors as the previous experience of the interlocutor3, his or her culture, the context where the signs appears, each interaction experience is unique and cannot be replicated. Consequently, designing and evaluating human-computer interaction, in the Semiotic Engineering, are the result of reflective activity and interpretive choices, rather than the application principles and measures. This perspective is fully aligned with Schön's [1983] conception of design, a complex process where the designer works with singular situations, using specific materials and making use of distinctive languages. Schön claims

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2 Sign is anything that means anything to someone. (Peirce 1992-1998]

3 The person involved in the communication process.

that each design process is unique, requiring constant reflection about the possibilities (of elements and tools) the designer can use and the consequences of each choice made.

In the next section we will show the use and implications of the basic tenets of Semiotic Engineering in the process of evaluating the users' experience with interactive systems. We will highlight the intensively interpretive and reflective nature of the Communicability Evaluation Method (CEM), which clearly characterizes it as a qualitative evaluation method.

## 4 The Communicability Evaluation Method

The Communicability Evaluation Method (CEM) investigates the quality of the communication between the designer and the user through the system's interface. It doesn't focus on other crucial aspects of interaction, such as performance and user satisfaction, for example. But, by concentrating solely on communicative processes and sign systems, it helps evaluators and designers understand and decide how to improve the various modes and means of expression with which software producers and software consumers can manifest their intent regarding the use of technology. The method is not designed to identify 'interaction errors', but to identify actual *and* potential communicability breakdowns, which may be the cause or consequence of a various types of interaction errors. CEM, as all other methods, models and tools proposed by semiotic engineering, has an epistemic nature – it aims to expand the evaluator's knowledge about how the quality of designer-to-user communication is related to the quality of the user's interactive experience. The product of evaluation – typically handed to a design team – is, likewise, meant to expand the designers' knowledge about the challenges and possibilities of metacommunication. So, it is once again clear that CEM, and Semiotic Engineering, subscribe a qualitative paradigm that is not usually familiar to teachers, students and professionals in Computing.

CEM involves observing, recording and analyzing how users interact with systems (or system prototypes). It is conducted in five steps: test preparation, test execution, tagging, interpretation and semiotic profiling (see figure 2). The first two steps are common to all user observation tests, although they have some peculiarities in CEM. During test preparation, the evaluator must carry out an inspection of the object system in order to instantiate, at least partially, the metacommunication message paraphrase illustrated in the previous section. This amounts to finding out *what designers are telling the users* through the system interface and its interaction possibilities. This instantiated message will be compared with the metacommunication instantiation reconstructed in the later steps of the method, based on observed evidence of how users interpret the system's interface and interaction.

There is also an important difference between CEM and other user observation tests in the execution step. The main purpose of post-test interviews is to help evaluators understand and disambiguate certain passages of the observed interaction. Evaluators must try to eliminate as many ambiguities as possible, so that their subsequent interpretations in the next steps of the method (tagging, interpretation and semiotic profiling) are credible, plausible, and reliable – as must be the result of all valid qualitative studies.

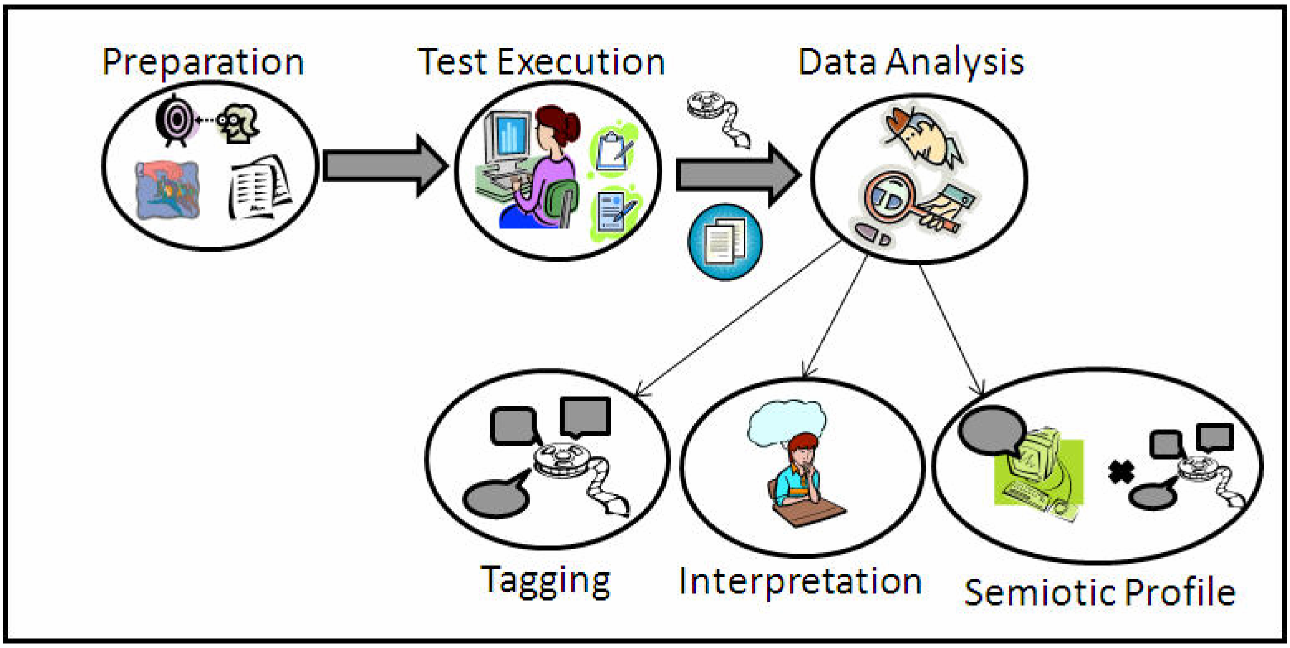


**Figure 2 – CEM steps**

The tagging step consists of screening recorded interaction for evidence of communicative breakdowns, and classifying instances of breakdowns according to pre-established categorizations of problems with expression, content and intent [de Souza, 2005a]. Notice that CEM concentrates on communication *problems*. If there is no evidence of communicative breakdowns, the method does not provide classes or grades of *successful* metacommunication. In fact, there is a theoretical explanation for this. According to semiotic theories of Peircean inspiration [Peirce, 1992-1998; Eco, 1976; Eco, 1984], sign interpretation is a continuous ongoing process, halted and resumed for reasons that are completely contingent to the context of interpretation. Hence, the absence of communicative breakdown evidence *does not mean* that the user's interpretation of the signs he or she is exposed to while communicating with the system (and with the designer, through the system) is definitively *correct* and free of misunderstandings. It just means that in the specific context of observed interaction, no problems have been observed.

So, the goal with CEM is to identify communicative problems for which there is actual evidence in the user test, and from there to generate knowledge to improve the system's communicability. There are thirteen communicative expressions that the evaluator must use to tag the interaction video as he or she interprets that there is a communication breakdown. Each one corresponds to a different class of communicative breakdown. The tagging activity is like "*putting words in the user's mouth, in a kind of reverse protocol analysis*" [de Souza 2005a, p. 126], as can be easily seen from the tagging expressions themselves, which are: 'What's this?', 'Why doesn't it?', 'Help!', 'Where is it?', 'What now?', 'What happened?', 'Oops!', 'Where am I?', 'I can't do it this way.', 'Looks fine to me.', 'I give up.', 'Thanks, but no, thanks.', 'I can do otherwise.'.

All these expressions and the communicative phenomena that they represent are extensively explained elsewhere [de Souza, 2005a]. But for sake of illustration, we can have a closer look at common problems that users have with choosing or finding the appropriate *expressions* with which to communicate what they mean to the system. One such problem arises when ongoing interaction is halted because, although the user knows what she wants to tell the system to do, she cannot find an interactive sign that she recognizes as meaning what *she means*. A typical symptom of this breakdown is that the user starts to screen menu options and toolbars in search of a word or icon that looks like a proper expression for the content she has in mind. Interaction like this is tagged with the 'Where is it?' tag. Another problem related to expressive breakdowns is when the user misinterprets the meaning of interface signs. For instance, the user may take a particular menu option word (like 'resize') or toolbar icon (like '⇖') to mean 'change dimensions proportionally', but after telling the system to do it (by clicking on 'resize' or '⇖') she realizes that the size is changed but proportion is lost. We tag this breakdown with 'Oops!'. The benefit of classifying 'Where is it?' breakdowns as related to but different from 'Oops!' is that evaluators (and designers) can appreciate the distinction between miscommunication due to a sign's obscurity (the user is unable to take the sign as a representation of a familiar and expected range of meanings) in contrast with a sign's ambiguity (the user affirmatively takes the sign to represent something else).

Frequently the user's behavior during interaction can be tagged ('interpreted') in different ways. Sometimes the evaluator is instantly aware of the various tagging possibilities, and sometimes not. Therefore, the evaluator must explore pre-test and post-test interviews, in order to elicit from the user as many contextual signs as possible, in an attempt to disambiguate interpretations of evidence provided by the test. Persisting ambiguities, however, do not necessarily mean failure in evaluation. As will be discussed, below, in later stages of the method, evaluators explore semiotic possibilities of sign interpretation based on evidence collected during the test. Ambiguities are thus legitimate semiotic possibilities to be explored at this stage.

After tagging interaction the evaluator interprets the emergent classification of communicative breakdowns associated to it. The interpretation is directly dependent on the evaluator's semiotic awareness and skill. Additionally, the greater his or her familiarity with Semiotic Engineering concepts is, the more productive his or her analysis. As mentioned before, the theory defines HCI as a unique phenomenon. Consequently, the evaluator's conclusions are also unique. The idea is not to achieve *replicable results* (cf. the discussion of contrasts between quantitative and qualitative methods in research), but elucidate and consolidate processes of interpretation that generate valid and useful knowledge.

In the interpretation step the evaluator analyzes and interprets the frequency and the context of occurrence of each type of tag. This activity may lead the evaluator to recognize patterned sequences of tag types and systematic correspondences with goal-related or task-related problems in interaction. At this stage, subsidiary ontologies and taxonomies of HCI problems, from other theories and approaches, can enrich and expand the evaluator's interpretation. For instance, establishing a correspondence between communicative breakdowns and failures in traversing the executions and evaluation gulfs proposed by Norman's Cognitive Engineering [Norman, 1986] can yield powerful insights for improving both communicability *and* usability of the artifact, even if improving *usability* is not the goal of CEM.

The last step of CEM is the generation of the semiotic profile, which consists of achieving an in-depth characterization of the designer-to-user metacommunication. The focus of CEM is on how users may *receive* (interpret) the designers' metacommunication message. The evaluator contrasts the metacommunication message instantiation produced in the test preparation step with the results of the tagging and interpretation steps, which are fully based on observable evidence of the user's behavior.

Semiotic profiling can be practically defined as finding the answers for the following questions, formulated from a designer's point of view (*i. e.* the pronoun 'I' refers to 'me, the designer'):

- *Who do I think are (or will be) the users of the product of my design?*
- *What have I learned about these users' wants and needs?*
- *Which do I think are these users' preferences with respect to their wants and needs, and why?*
- *What system have I therefore designed for these users, and how can or should they use it?*
- *What is the gist of my design vision?* [de Souza 2005a, p. 147-148].

Answers are likely to spell out the mismatches between the designer's view (and interpretive context) and the user's. For instance, YahooMail designers' vision may be that automatic search and selection of email addresses is a nice feature for all users. However, there may always be some peculiar organizational context in which email addresses are so patterned (as is actually the case with email addresses of our department's undergraduate students, where the students' enrollment numbers, and not their names, serve as the base for their login account), that the list of matching addresses for selection is rather long. Then, the relative advantage of selection over typing is lost. In this situation we are likely to observe the user fighting with the designed feature, rather than taking advantage of it. Notice that users of this organization *may* recognize the advantage of this feature in *other* contexts of use. Nevertheless, they cannot benefit from it in the context where they are. The Semiotic Engineering lesson is to be constantly aware of the fact that contexts are immensely diverse, and that features should be as (easily) customizable as possible, to facilitate the user's communication.

The diversity of contexts should be explored by evaluators in the semiotic profiling stage. Interaction often provides signs of 'quasi failures', so to speak – instances of communication where users almost fell into a communicative trap, or showed telltale signs of hesitation. In traditional user testing situation, where evaluators are typically looking for errors and collecting statistics of how many mistakes were made, how long the test lasted, and so on, the meaning of such telltale signs is marginal or lost altogether. With CEM, however, these signs provide a legitimate input for the evaluator's interpretation of *potential* breakdowns, for whose recovery designers should provide the appropriate means. This characteristic, which is clearly not *predictive*, is an anticipation of interactive challenges that designers should account for in their design vision. And, as will be seen in the next two sections, although in the creators' view it constitutes the main value of the method, it is also the most difficult aspect of CEM for teachers, students, and practitioners.

# 5 The challenges of teaching CEM

In this section we present the details of the qualitative study we carried out with teachers, students, practitioners and creators of CEM. We begin with a description of the methodology we used, and then report the study's results.

## 5.1 Methodology

During the first semester of 2007 we conducted a qualitative study about CEM, as part of a larger research project, whose aim is to produce a comprehensive and detailed account of this method. Our ultimate goal is to revise CEM so as to improve the way it is taught in professional education programs and used by HCI experts in practice. Our qualitative study seeks to investigate this method's origins, its evolution, its proposed steps in the evaluation process, as well as how it is taught and learned in undergraduate courses in Computer Science (CS) and Information Systems (IS), mainly. In this paper we present our results concerning the latter – how CEM is taught and learned.

We conducted a series of in-depth interviews with open questions previously structured in a general script [Seidman, 1998]. The average duration of interviews was ninety minutes. Variations were essentially related to the interviewees' experience with the method (the more experienced the participant, the longer was the interview). Participants were selected using the purposeful sampling approach, which gives priority to potentially information-rich cases for in-depth studies [Patton, 1990]. The Semiotic Engineering Research Group (SERG) was the source of recruiting for teachers and practitioners, whereas CS and IS courses of the Department of Informatics at PUC-Rio were the source for undergraduate students.

In order to power the diversity of experiences with CEM inside the same group, participants were selected to constitute a maximum variation sampling [Seidman, 1998]. In spite of a purposeful choice of a wide spectrum of variation in perspective about the study's question, it is nevertheless possible to identify a common and significant characteristic shared by all participants. In our study, participants had at least a basic training in Semiotic Engineering, and learned CEM at SERG (where Semiotic Engineering originated). We recruited two undergraduate students, two teachers, two practitioners and two of the method's creators. The interview with CEM creators was the only pair interview. All the other ones were conducted individually.

Our group of participants included three men and five women, whose ages ranged from 25 to 49. In Table 1 we summarize relevant characteristics of the various participant profiles in our study.

| | **Quantity** | **Experience in HCI (time average)** | **Kind of experience in HCI** |
|---|---|---|---|
| **Practitioners** | 2 | 1 year and 6 months | Have used CEM in their own training course projects and in scientific research projects. |
| **Students** | 2 | 9 months | Have only used CEM in their own training course exercises and projects. |
| **Teachers** | 2 | 5 years | Have used CEM in their own training course projects and in scientific research projects. Have taught CEM in undergraduate training courses. Are professionally trained in Computing. |
| **Creators** | 2 | 14 years | Have been teaching undergraduate and graduate courses, and supervising MSc and PhD students investigating Semiotic Engineering. Have also coordinated various research projects in the field. One is trained in Computing; the other is trained in the Humanities. |

**Table 1 – Subjects profiles**

CEM creators have a deep knowledge of HCI in general and of Semiotic Engineering in particular. They obviously have a wide experience with CEM, and are recognized for their authority in this subject matter. Students, on the other hand, have only little experience with CEM. All they know is restricted by the pedagogical activities carried out in different disciplines where the method was being taught and used. Their grade in such disciplines was at least *good* (in a scale from insufficient to acceptable, to good, and very good).

Practitioners are graduate members of SERG. Their deeper knowledge of Semiotic Engineering was gained in disciplines and studies conducted during their MSc and/or PhD programs, and in applying CEM as part of larger research projects at SERG. Teachers are also SERG members, with solid knowledge of HCI, Semiotic Engineering, and CEM. Their teaching activities have increased their familiarity and experience with the method. Undergraduate disciplines that they teach total sixty hours of teaching, ten of which are devoted exclusively to teaching CEM.

The interviews were analyzed in two steps. Firstly, we conducted an intra-subjects analysis, studying the individual transcripts so as to identify categories in the interviewee's discourse that corresponded to each of the interview script's topic [Seidman, 1998; Nicolaci-da-Costa et al., 2004]. Then we made an inter-subject analysis, at first across different members of each profile sub-class and subsequently across all members of all profile sub-classes [Nicolaci-da-Costa et al., 2004].

### 5.2 Results

In typical CS and IS undergraduate courses in Brazil, HCI is at best the subject matter of only one or two disciplines. With a small amount of hours covering many unfamiliar concepts in the curriculum, the learning process may be deeply affected. Right at the start, teachers must face a challenge when introducing *users* to HCI novices. Will they teach them that users have universal and predictable characteristics that students should seek to design for, or that users are widely diverse even if they share certain goals, preferences and basic knowledge? In the latter case, which should be the students' attitude and choice in design?

Some evaluation methods are suitable if the teachers' choice favors universality and predictability, whereas other methods are more suitable if their choice favors diversity and the unique characteristics of real-life contexts. However, this interdependence between ontological paradigms and methodology is very difficult to teach and to learn in introductory courses, especially in CS and IS. Students are used to learning and applying general principles, laws and formulas in order to solve known classes of problems. Therefore, they almost naturally expect to learn universal rules and patterns that will surely lead to successful HCI designs. Because Semiotic Engineering is explicitly aligned with non-predictive perspectives and interpretive methods, the challenges in teaching are big. In the words of CEM creators:

*"(...) not everyone knows what to measure. Each new interactive application has a new measure, a new universe, a new reason. Everything is different at each time. In Informatics, people are not used to working with things that change all the time. It is rooted in a paradigm where things are invariant. (...) Consequently, the difficulty to our students is to feel comfortable when they see things they have never seen before. (...) Students have an inescapable vision of predictability. They think that the important thing to do is to predict and control. For these people, when you say 'I can't predict it, I can't control it…' it actually means 'I can't understand it'"* – Creator1

*"This is not specific to Semiotic Engineering. What the Creator1 said is about Computer Science. Professionals trained in Human and Social Sciences can deal better with this situation. They comprehend this problem of 'I don't want numbers'. (…) In the case of our students, and maybe because of a training problem, they deal with calculus, physics, and similar subjects. HCI, if they have any HCI disciplines in their curriculum at all, and perhaps also Software Engineering, is the only disciplines where they discover that there is no right answer."* – Creator2

Teachers also agree that it is difficult to lead the students into reflecting about the problems they see when observing the users' experience, and about factors involved in trying to solve them. They point out that the small amount of time available to guide and elaborate on this reflection makes the teaching challenge even worse.

*"The teacher has thirty students to teach how to interpret things… it's unfeasible. I don't know how it happens in Informatics in general, but teaching a student how to think and how to interpret [things and thoughts], in a thirty-student classroom, during one semester… this is… (laughs) the teacher needs to be He-Man, you know?"* – Teacher1

The teaching of new ways of thinking is, thus, a long process, much longer than can be taught in one semester. Besides, the discipline's program is also very long. It's necessary to give the student an adequate overview of the whole HCI area, its main theories and methods, before teaching CEM. Too much information is concentrated in a very short period of time. One of the consequences of having to teach (and learn) so many different concepts and contents in so little time is the students' confusion about what they were taught. This is very clear in one of the students' interviews:

*"Communicability? Hmmm… I don't know… I think I'm a bit confused with this and heuristic evaluation. I think it is confusing because they are similar methods with the same objective: improve the system communication. We couldn't consolidate this topic (…). It may be confusing [to me] because I don't use it professionally. (…) I did not have a chance to go deep into this discipline."* – Student2

The alternative to minimize the consequences of time constraints is to focus solely in some of CEM steps, typically the tagging step. In order to do this, teachers do tagging exercises with previously recorded interaction videos. Here is what one teacher says about it:

*"I give them the scenario. I record the video and give it to them to do the tagging."* – Teacher1

Although the students are able to tag the video, their interpretation of the problem is only local, leading to poor evaluation results. Here is how teachers see it:

*"The students lose the overall surrounding context and then they have only this little span of interaction. So, it's difficult to tag correctly with only this narrow view."* – Teacher1

*"When the students don't see how the test is conducted, it's difficult for them to know [the context]. (...) They need to watch the video many times. So, when they watch the video more times, they can comprehend it better. (...)."* – Teacher2

Superficially, the tagging step can be said to focus on communication breakdown symptoms, whereas the interpretation step can be said to focus on the causes of such breakdowns. However, when students have to reconstruct the relation between symptoms and causes for the semiotic profile, in an *interpretive* rather than a *predictive* way, they simply feel they are incapable of doing it.

This interpretive aspect is related to an additional problem with tagging. Tagging is actually more than "putting words in the user's mouth". It requires a lot of interpretation in itself. As one of the teachers puts it, this sort of interpretation is unique. Each evaluator will have his or her own interpretation of what is happening while the user interacts with the system.

*"So I think tagging is complicated in this sense, this interpretation is very personal"* – Teacher2

In this statement we can notice this individual's difficulty to deal with the fact that there is no single and ultimate right answer for HCI design challenges in a Semiotic Engineering perspective (as in other post-cognitivist perspectives as well).

The emphasis on the tagging step also aggravates the loss of context in yet other important ways. Typically, the teacher does not have much time to introduce and discuss the computational artifact under evaluation, the test scenario, the pre-test and post-test interviews results, and the behavior and attitude of the participant in the test. Thus, even in specific HCI Evaluation disciplines, where students have more chances to study and practice all of CEM steps, they still have problems with interpreting what they see during the tests. Students fail to reach a global perspective on the situation, making the right connections between the system's characteristics, the test scenario, the recruiting of participants, the interview scripts, and ultimately the evidence and implications of interactive patterns. We can see in one of the CEM creators' interview that this is viewed as a consequence of the tendency to work with fragmented knowledge and solutions.

*"I think that the major difficulty in reconstructing of the metamessage is the difficulty that people have in taking a global perspective [on things]. It's extremely difficult. I'm not sure if this happens because of a tendency to reuse [previous solutions], and everybody becomes alienated [from the whole] and works only with little fragments of problems. I think that students are very far, cognitively far, of having this global perspective on problems. In my opinion it's the most difficult challenge for both my undergraduate and graduate students. And the metamessage takes a global perspective. (…) So one of the difficulties intrinsically related to the method is that it demands that you have a global vision."* – Creator1

Because the semiotic profiling step involves the reconstruction of the metamessage, in the absence of a global vision the last step of CEM is seriously impaired. It is important to mention that the global vision is strongly related to the qualitative characteristic of CEM and this becomes evident in the last step of the method. This feeling is also shared by teachers:

*"It's not trivial. (…) You have to know how to look at the interaction and know how to interpret what happened before interaction, what's happening during interaction, and what might happen after it. (…) In my opinion the way of thinking and the reasoning involved [in this] is the difficult thing [about CEM],"* – Teacher1

Even when recognizing the importance of the semiotic profiling step, its teaching is still a challenge for the teachers themselves:

*"I don't know how to do it because I have never read one. I have never read a semiotic profile. (…) I don't know what it must contain."* – Teacher1

*"The semiotic profile is a deep mystery, (…) literally a deep mystery."* – Teacher2

It should be noted that although these are HCI teachers, they have been trained as computer professionals. Most of their training involved numbers, formulae, and quantitative methods. Consequently it is also difficult for *them* to teach something that they have had relatively less experience with in their own education. Understandably, they concentrate their CEM teaching efforts in the tagging and interpretation steps, where the global vision is not as explicit necessary as it is in the semiotic profiling stage.

Avowing their own difficulties with respect to semiotic profiling, teachers explain implicitly the reasons for their emphasis on the tagging and interpretation steps. Besides, we can logically expect that the students' difficulty in comprehending the semiotic profiling stage is directly related to the teacher's own difficulty with it. Here is a student's testimony of how difficult it is to understand the last stage of CEM:

*"I have to confess that the semiotic profile is an open question for me. I have understood that it is part of the final report. Maybe we have done it without knowing that we were doing the semiotic profile."* – Student 1

These teaching and learning difficulties are echoed even in the practitioners' discourse. When asked to describe CEM, one practitioner said:

*"CEM is applied to find interface communication problems: where the user has reacted [unexpectedly], or where he didn't understand, or where he thought he had understood but actually hadn't."* – Practioner1

In fact, as we have seen in previous sections, the final aim of the method is *not* to spot specific interface problems. This is only part of the method's ultimate goal – to generate knowledge about how designers can improve metacommunication in order to support a wide range of productive human-computer interaction. If we only look for interface problems, we will try to *fix* a handful of signs or portions of the messages, without ever getting the higher-level articulation between instances and causes of miscommunication. This articulation, as we have seen, is only produced at the semiotic profiling stage.

One possible strategy to minimize the CEM teaching difficulties is to make use of examples and practice activities where the students can have a more concrete experience, even if only in the tagging and interpretation steps. Teachers remarked the importance of practicing, by saying:

*"... I present the steps, explain the utterances and after they practice in the lab."* – Teacher1

*"You have to use interaction examples, perhaps it could be possible to explore a bit more with some videos (…) the lab classes are fundamental."* – Teacher2

Since the method is an epistemic tool, only practice can lead to more effective learning. The teachers' statements are in strong relation with Schön's [1983] views of reflection in action. According to this author, practice leads the learner to reflect about the object of study and this increases his/her knowledge about such object, in our case the method itself.

Just like teachers, students also recognize the importance of practice and experience when asked to apply this evaluation method. Their interviews state points that are clearly related to Schön's [1983] argument that only practice can improve an evaluator's knowledge, and consequently produce better and more reliable results. Here is what they say:

*"I find it a complicated task. I believe that when you start practicing you can gain experience with the tagging and then what tagging is becomes clearer. But the first time, it is really a complicated task."* – Student1

*"With experience the evaluator can notice the details that tell the difference between one (utterance) and the other."* – Student2

Even if acknowledging the challenges of CEM, it is interesting to see that both the students find that working with it is a rewarding activity:

*"It's funny, because although it's a lot of hard work, I was delighted to do it."* – Student1

*"It seems to be very coherent, it's hard work but it's worth it for the results you get."* – Student2

In the next section we conclude this paper with some considerations about the results obtained in the research presented here.

## 6 Concluding Remarks

Based on the study described above we could identify three important points concerning the teaching of HCI in general and CEM in particular: (i) the difficulty of teaching a different way of thinking where diversity and unpredictability are the main characteristics; (ii) the short period of time available to teach it and (iii) the limitations and difficulties that teachers themselves have to struggle with while teaching.

Differently from other studies about HCI teaching and learning process [*e.g.* Rosson et al., 2004; Vat, 2001] this study, in itself, demonstrates the main features of qualitative methods in research – although the *quantity* of people interviewed is small compared to the typical number of respondents in quantitative studies, the *wealth* and *depth* of information resulting from our interpretive analysis yields relevant and useful results, many of which are in line with findings of previous work. For instance, Vat [2001] talks about the need of practice to improve the student's experience and understanding of HCI design and evaluation methods, and the challenge of providing a holistic vision of HCI in a single HCI discipline. Rosson et al. [2004] propose that practice with realist projects to stimulate the students' interest for HCI is crucial, but advise that they must be manageable within one semester. These studies address (i) and (ii), above. However, (iii) seems to be a peculiar result of our qualitative study.

The teachers' difficulty in teaching how to deal with diversity and unpredictability while using CEM seems to be inherently related to their own basic training in Computing. In this area, a special value is placed on universal and predictable principles that can be abstracted and generalized into applicable and replicable knowledge across a wide range of situations. So teachers must struggle with a conflict that students also experiment: how can they apply CEM results in the design of general (sometimes even called 'universal') interface solutions?

These difficulties reveal a big challenge at the heart of HCI, which is also shared, however, by other areas in Computer Science such as, for example, the construction of fault tolerant and adaptive systems. As Dourish [2001] remarked, a change of paradigm – from procedural, rule-based, universal computing steps to an interactional, 'ecosystemic' model of computing components interplay out of which unexpected behavior can *emerge* – is already in place [see, for example, Wegner 1995]. In all such situations, developers must find a way to anticipate and provide for, at design time, all the diversity of human experience. The challenge at interaction time is to discover how to help the users deal with conflict and novelty, encouraging creative behavior without sacrificing safety.

Teachers must then be familiar with different paradigms and methods. Only then will they be able to support the students adequately in learning how to identify and interpret diversity, and then in generating design knowledge that they can use in successful HCI projects.

It is thus clear that including HCI disciplines in the CS curriculum is important, but there is a lot more to an effective improvement in professional training than just this. Namely, there must be program items in these (and/or in other) disciplines that account for different ways of generating and using *valid knowledge* for designing and developing interactive technologies. Notice that this is not the same as having students take one or two disciplines in Social Sciences or the Humanities, for instance. Given the testimony of the teachers we interviewed, it looks like they can recognize differences in paradigms and methods, but they have difficulties in reaching – themselves – an integrative perspective on such different kinds of knowledge. This, as we know, is a major epistemological task in itself, which could perhaps be facilitated by the inclusion of a basic discipline teaching students different alternatives for generating, validating, and using different kinds of knowledge.

HCI disciplines seem to be an appropriate alternative, in the CS program, to teach these differences. Nevertheless the time to do this is extremely short in most situations. The teacher has the following dilemma: if he/she chooses to give an overview of, say, cognitive and post-cognitive approaches, there are many chances to generate a big confusion for the students. On the other hand, if he/she chooses to teach only one of the two approaches, students will miss the important contributions of the other approach. Even within a single subject matter like CEM, for instance, we saw that teachers who concentrate their teaching in the tagging step end up facing important learning losses and difficulties when students have to carry out further interpretation processes of the method. The ideal situation would be to teach instrumental4 pieces of knowledge, with enough time to practice and consolidate the use of the method. Teachers and students agree that only practice can promote a better comprehension and mastering of the method. This is particularly important in *design* disciplines. Schön [1983] advocates that, while practicing, the learner reflects about the object of study. So, when students do the tagging, they start increasing their awareness of the various contexts of the interaction. Deciding which communicability expression is more appropriate for tagging certain passages already expands their knowledge about HCI and about the diversity they must be prepared to design for.

The challenges of teaching CEM are intrinsically related to the unpredicted and interpretive characteristics of Semiotic Engineering. Interpretation is a long process that needs time to be learned and to be put in practice. It also requires that the person who is using CEM formulates a global vision of the interaction context of evaluation. This method's results can be seriously impaired by the absence of this vision. However, even the practitioners, who have more experience compared with teachers and students, admit their difficulties in the last stages of CEM, where this vision is critical. Students, teachers and practitioners share an uncomfortable feeling regarding the conclusions that they can draw from highly situated observations and interpretations, and the way in which these conclusions can be used while designing *for diversity* as well. They don't really know how to use individual and contextualized results to improve systems that are going to be used in both anticipated and unanticipated ways.

A noteworthy feature in this study's results is how the different perspectives on CEM, expressed by the method's creators, by teachers, practitioners and students, are actually echoing a very solid and clear set of challenges associated with CEM. Such is the effect of triangulation in our interviews. These challenges naturally constitute the

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4 Here by instrumental we mean a more practical/technical knowledge about CEM without ignoring its theoretical commitments.

next step in our path to improve CEM and make it more usable and useful to HCI practitioners and researchers.

Although this is a study about a very specific method for evaluating aspects of the users' experience with interactive systems, we believe that researchers interested in how HCI methods are taught may benefit from it. Firstly, in terms of the *process* we have used to conduct this research, researchers may find it useful to repeat it with other methods of their preference. And secondly, in terms of the *results* we reached so far, these may be used in further studies about learning and teaching other HCI in general.

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