Communicability in multicultural contexts: A study with the International Children's Digital Library

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Abstract. This paper presents the results of a communicability evaluation of the International Children's Digital Library. The evaluation aimed to identify cultural issues with the ICDL interface. Participants of test sessions had different nationalities and spoke different languages. Although the communicability evaluation method was not originally designed to deal specifically with cultural issues, it allowed us to identify such issues. We also obtained relevant information for improving the users' experience with ICDL in a Brazilian context. Thus, not only do our findings contribute to ongoing research about the communicability evaluation method itself, but they also constitute a contribution to ICDL designers.

Keywords: Semiotic Engineering, communicability evaluation, cultural issues.

1   Introduction

The International Children's Digital Library (ICDL) is a specialized public digital library on the Internet, whose goal is to "build a collection of books that represents outstanding historical and contemporary books from throughout the world." [12] An initiative of faculty and researchers from the University of Maryland, its mission is "to support the world's children in becoming effective members of the global community - who exhibit tolerance and respect for diverse cultures, languages and ideas." [12] As researchers and technologists strive to promote socially responsible use and development of computer systems, ICDL stands out as a worthy example, especially because its targeted users are children. Among many design challenges, ICDL must support multicultural human-computer interaction in various ways and for various purposes. For example, it must help children from different countries read books from the ICDL collection in different languages. Likewise, and perhaps more importantly, ICDL should help children learn from and about foreign cultures, languages and ideas, through books.

Adding to a number of previous multicultural studies in the context of ICDL (e.g. [4,11,15,18]), this paper presents the results and conclusions of preliminary research in the scope of ICDL-Brasil [13]. Among the most difficult social challenges faced by Brazil is the vast share of its population plagued by functional illiteracy. According to recent demographics [14], only 26% of Brazilians between ages 15 and 64 are fully capable of reading and writing, and of using this ability to achieve their social rights

and aspirations. ICDL-Brasil aims to use ICDL and related computer technologies to promote reading among young children, in an attempt to alleviate the threats brought about by such huge functional illiteracy rates in the country.

The first step in our project is to evaluate how users immersed in a Brazilian context interact with the current ICDL interface. Among the tools we have used to this end is the communicability evaluation method, CEM [6,19]. Unlike in most previous ICDL evaluations, our participants were not children, but adults. The role of adults, especially parents, in getting young children interested in reading, is crucially important [14]. Hence, it is important for ICDL-Brasil that adults involved with children feel comfortable and stimulated when browsing, selecting, or reading books from the ICDL collection.

Since CEM is a qualitative method [7], the number of participants was small (six) and their nationalities varied. Test results give us an in-depth perspective into interpretive processes that occur in the context of typical interactions with ICDL. They show some of the challenges – cultural and technical – that must be overcome for ICDL-Brasil to succeed. The study also allowed us to carry out a preliminary analysis of how suitable CEM is to identify and explain interactive problems in multicultural environments online. The analysis focused on two specific questions: (a) if among the interactive problems detected by CEM there are some that are clearly related to culture; and (b) if CEM can distinguish cultural from non-cultural communicability problems.

In the following we briefly describe CEM and its theoretical roots in Semiotic Engineering [6]. Then we present the study. Finally, we discuss our findings in view of related research and present our conclusions. The main contribution of this study was to show that: CEM can indeed help us identify HCI problems that are relevant for multicultural HCI design; CEM cannot, however, tell cultural problems apart from other communicability problems; and CEM can produce important information for the cultural adaptation of ICDL to the contexts of use envisaged by ICDL-Brasil.

2   The Communicability Evaluation Method

The Communicability Evaluation Method [19] has been developed and proposed in connection with Semiotic Engineering [6], a semiotic theory of HCI that views human-computer interaction as a particular case of metacommunication (communication of/about communication). Assuming that software is an intellectual artifact, the result of rational decisions and choices, and is designed to achieve certain purposes and effects in order to benefit and/or please its intended users, Semiotic Engineering stresses the fact that software requires appropriate interactive presentation and introduction. In accordance with this theory, the natural way of promoting good encounters and experiences with technology is to tell users, at interaction time, what they need to know in order to take the best out of it. But the way to do so can vary widely.

A key concept for Semiotic Engineering is communicability. Communicability is the distinctive quality of interactive computer-based systems that communicate efficiently and effectively to users their underlying design intent and interactive

principles [19]. The essence of this communication is the answer that a designer (or spokesperson for a design team, using the 1st person "I") can give to three sets of top-level questions:

1. Who are the users of the product I have designed? What do they want or need to do? In which preferred ways? And why?
2. What is this product I have designed? What can it do for its users? How?
3. What kinds of interactions, conversations, can or should users have with it? What range of effects can these conversations achieve? Are they consistent with who my users are, and with the needs and expectations that they have?

Put together, the answers to the above questions compose a top-level metacommunication message that can be paraphrased in a template message like this:

"Here is my understanding of who you 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."

The message is sent, one-shot, from designers to users, through the system's interface. Users unfold and receive this message progressively, as they interact with the system. Thus, a system's interface is at once a message and an interlocutor, in an elaborate twofold communication process. Users interact with the message in order to get it, fully. Since this interaction is itself a process of exchanging messages, the interface must speak for the designers at interaction time – be "the designer's deputy", as proposed by Semiotic Engineering terminology.

In order to illustrate metacommunication, we can use an instance from ICDL . In Figure 1 we see the interface for the location search. On the right-hand side of the image, there are textual instructions for the users – designers, through their representative at interaction time (i.e. the interface, or designer's deputy), are telling users a portion of their design vision (i.e. what this particular function is for, and how it works). The snapshot in Figure 1 was taken before clicking on the globe. As the mouse floats over a sensitive area of the lower left quadrant of the screen, part of the image changes color (from green to light brown), the cursor changes its shape (from arrow to hand), a tip appears right below the cursor ("South America"), and the label "South America" is shown below the globe.
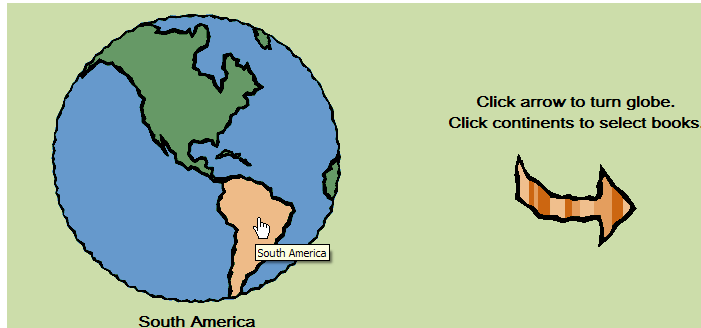
Figure 1: A location search for books in ICDL.

Now, what are the designers telling us (receivers of their message at interaction time, no matter what they actually intended to tell us at design time)? First, that we can click the mouse button and that if we do it we will navigate to another web page (the cursor changing to a hand shape gets this message across). Second, that the highlighted continent is "South America". And they are stressing this by using both a cursor tip and a text message. Third, they are also telling us that they think we might not always realize (or know) which continent a particular shape on the globe represents. Otherwise, they would probably not need to confirm the meaning of visual signs with textual information. This communication creates certain expectations. If you look carefully to Figure 1, you will see that there are other continents on it – North America (fully drawn) and part of Africa (Northeast of South America, across the ocean). So, users may expect that if the mouse floats over those, the designers will tell them which continent is being pointed at. Indeed, if you place the mouse on North America, the designers tell you it is "North America". Designers are thus communicating yet other things through that simple instance of interaction – they are telling users that when the mouse hovers on different continents they will be told which continents those are. However, if we place the mouse cursor on Africa, the communication breaks down. Africa (i.e. the visible part of the African continent) doesn't change color ("Oops!"), no text message appears under the globe ("Why doesn't it?"), and the tip we get is "World Map" ("What happened?"). Where is Africa? Following the designers' instructions on the right side of the screen, we may decide to click on the arrow to turn the globe. Because the arrow is headed east, users are likely to expect that they will move east, where Africa is. However, a click on the arrow positions the globe on Asia / Middle East, and Oceania. What happened to Africa? What is the arrow pointing east supposed to mean?

The above narrative of interaction with a very small portion of the ICDL interface helps us illustrate two important points. One is what metacommunication is and how it is achieved through the designer's deputy mediation at interaction time. In particular, it demonstrates how software is presented and introduced to users through interaction. The other is which kinds of communicative breakdowns can occur in the ICDL interface, some being worked out more easily by the users after only a few seconds of consideration, some requiring more of their time and effort. Our narrative is an example of what users may think they are being told through interaction, and of

the kinds of inferences, assumptions, expectations they may draw from that. It also signals, with such expressions as "Oops!", "Where is [it]?", "What happened?", the points where interaction problems occurred.

CEM is a method designed to capture communicability problems, which are ultimately related to metacommunication issues. It privileges the reception of the designers' metacommunication, and produces not only an identification and an explanation of such problems, but it also relevant information for redesigning the interface. Keeping up with the example in Figure 1, we notice that redesign alternatives naturally follow from the characterization of communicability problems encountered on the location search screen. For instance, aligning the direction of the arrow and the direction of the "travel" around the globe, and using different colors or hues to help users anticipate which continents are "clickable" and which are not, are low-cost redesign possibilities that can be explored.

As already mentioned, CEM is a qualitative method. Its main contribution is to introduce empirically-grounded pieces of knowledge in the collection of interpretive resources that analysts can use to make sense of reality. It is carried out in four steps: test preparation, tagging, interpretation and semiotic profiling. It involves observing users during interaction, analyzing these observations, exploring the application further (based on the results of analysis), and finally listing and explaining identified metacommunication problems, along with suggestions for redesigning the application.

The test preparation step is very similar to typical user testing preparations, except that it requires that the evaluators elaborate an explicit description of the metacommunication message. This elaboration has two important outcomes. The first is that the evaluators will be able to understand and appreciate the designer-to-user communication strategies of the application at hand. This is crucial because they must be able to interpret different recorded instances of interaction, and diagnose communicability problems correctly. The second outcome is a (set of) carefully designed test scenario(s), including tasks that users will have to perform and a well defined context for each task. This is necessary for evaluators to interpret interaction appropriately. Interviews and questionnaires, written instructions, briefings, and other materials and procedures are prepared in much the same way as in any other kind of user testing project.

Tagging is the heart of CEM. Once user sessions have been recorded, evaluators will watch the recorded movies and "put words on the users' mouths", so to speak, in a kind of after-the-fact reconstruction of a verbal protocol. A number of things are fundamentally important about tagging. First and foremost, the "reconstructed verbal protocol" is not a free text annotation of the recorded interaction. It is a principled association of fixed and technically defined expressions – a set of thirteen tags – to those portions of the movies where evaluators detect communicability problems. Each tag is so defined that it expresses a particular kind of miscommunication. For sake of illustration, among the communicability tags used in CEM, we have: "I give up."; "Looks fine to me."; "Where is it?"; "Where am I?"; "Oops!"; and "I can't do it this way.".

"I give up." is tagged when the user believes that she can't achieve her goal, and interrupts communication with the system, by abruptly abandoning a task step or the whole test activity. "Looks fine to me." is tagged when the user believes she has achieved her goal, although she hasn't. When asked (in a post-test interview), she

confirms that she has successfully finished a (sub) task, although the evaluator can clearly see that the system state does not correspond to the expected successful condition. "Where is it?" is tagged in interactive contexts where user knows what she is trying to do but cannot find an interface element that will tell the system to do it. She typically navigates through web pages, browses menus, opens and closes dialogs, looking for that particular element. "Where am I?" is tagged when the user is telling things to the system that would be appropriate in another context of communication, but not in the current one. Symptoms may include trying to select objects that are not active in the current context, trying to interact with signs that are output only, and so on. "Oops!" is tagged when the user makes an instant mistake, and immediately tries to correct herself. A typical symptom of "Oops!" is to undo the faulty operation triggered by miscommunication. When an "undo" function is unavailable, correcting a mistake – if possible – may end up involving a long series of steps. Finally, "I can't do it this way." is tagged when, while trying to achieve a goal or sub-goal, the user engages in a several-step sequence of operations, but suddenly realizes that this is not the right thing to do. So, she abandons that long sequence, and takes a different path.

Table I: Categorized communicability evaluation tags [6]

Category type	Sub-Category		Distinctive Feature	Tag
(I) Complete / Persistent Failures		(a)	User is conscious of failure.	"I give up."
		(b)	User is unconscious of failure.	"Looks fine to me."
(II) Temporary Failures	1. User's semiosis is temporarily halted	(a)	because he cannot find the appropriate expression for his illocution.	"Where is it?"
		(b)	because he does not perceive or understand the designer's deputy's illocution.	"What happened?"
		(c)	because he cannot find an appropriate intent for illocution.	"What now?"
	2. User realizes his illocution is wrong	(a)	because it is uttered in the wrong context.	"Where am I?"
		(b)	because the expression in illocution is wrong.	"Oops!"
		(c)	because a many-step conversation has not caused the desired effects.	"I can't do it this way."
	3. User seeks to clarify the designer's deputy's illocution	(a)	through implicit metacommunication.	"What's this?"
		(b)	through explicit metacommunication.	"Help!"
		(c)	through autonomous sense-making.	"Why doesn't it?"
(III) Partial Failures		(a)	User understands the design solution.	"Thanks, but no, thanks."
		(b)	User does not understand the design solution.	"I can do otherwise."

CEM tags are categorized by five ontological elements: expression, content, intent, illocution and perlocution. Expression, content and intent are three facets of all messages exchanged in communication. In a broad sense, the expression is the form of the message (what signs are used, how they are combined and displayed, etc.); the

content is the meaning associated to the expression according to some code; and the intent is the reason why the message sender is communicating the message. Illocution and perlocution – known as illocutionary and perlocutionary acts in Speech Act Theory [20] – correspond, respectively to the intended effect and the resulting effect associated to the act of using language to change the state of the world around us. Intent is a fundamental element of illocution – without it there is no illocution. However, intent can be obstructed by perlocution, causing frustration to the message sender. Table I shows all the thirteen communicability tags of CEM categorized into three types of failures (failed designers' perlocutions): complete failures (associated to persistent problems that affect negatively the result of a task, sometimes to the extent that they cause users to abandon the task altogether); temporary failures (associated to communicative problems that are resolved during interaction, after exploratory, explanatory, or corrective dialogs, for instance); and partial failures (associated to unexpected forms of communication – from a designer's perspective – that users take to communicate with the system, and that "work" for the user's purposes).

Interpretation amounts to determining how successful the designers' communication is. Success is associated to the absence (or insignificant amount) of communicative breakdowns. Evidence from the tagging step helps evaluators decide on the quality of such communication. The following factors help the evaluators identify and understand communicability problems:

1. How often, and in which particular context, each type of tag appears;
2. The occurrence of tagging patterns (similar sequences of tags);
3. Regular associations of tag types or sequences with problems in establishing communicative goals; and
4. When using additional evaluation methods, a correspondence between the locus of tag occurrence and that of problems indicated by the other methods.

At the end of this step, evaluators should be able to tell when, where, how and why observed users were unable to: express what they meant; understand the system's expressions; choose the right way to communicate their intent; assigned the right meaning to what the system was communicating; or formulate a communicative intent altogether.

Semiotic profiling is the final step in CEM. The evaluators' goal at this stage is to identify and explain problematic interaction design, and to inform redesign. They reconstruct the designer-to-user metacommunication message based on evidence provided by tests with users and on further exploration and inspection of the application. This second round of exploration and inspection (the first happened in the test preparation step) is important because the evaluator can measure the extent (and further consequences) of communicability problems verified in the tests. They can also find out if potential communicability problems (only hinted at in a few test situations) can turn into real problems.

CEM thus achieves two important results. First, it gathers relevant evidence for redesign. Some of the evidence may be drawn directly from interactive evidence collected during the tests. Second, CEM expands the evaluators' and the designers' knowledge about HCI. For design, in particular, Semiotic Engineering explanations for communicative breakdowns can be the seed to more elaborate reasoning and decision-making when choosing between design alternatives, or when generating alternatives themselves. This is why, just like other Semiotic Engineering methods

and models, CEM is an epistemic tool. Its purpose is not to dictate solutions to a problem, but to support problem-solvers in naming and framing design problems, in generating solutions, and evaluating them ones against others [6].

In the next section we will show concrete examples of CEM results when applied to the ICDL interface. Although the focus of our study with ICDL is on cultural issues, CEM has been designed to capture generic communicability problems. But rather than a mismatch between the purpose of the study and the purpose of the method, this decision, as mentioned in the Introduction, helped us appreciate the performance of CEM when evaluating software developed to support multicultural interaction.

3 The ICDL Study[1]

One of the main practical goals of ICDL-Brasil [13] is to elaborate a culturally-adequate interface for ICDL, so that it can be productively used by Brazilian kids and encouraging adult tutors. Because of the leading role of adults in promoting children's literacy [18], we decided to start our evaluation with a group of young adults. Participants of the study were students with experience in intercultural exchange programs, who could speak at least one foreign language. They were comfortable with computers and the Internet, had had previous experience with kids (*e.g.* as ski instructors, teachers, baby sitters, entertainers, family members, and care-takers). The group was a multi-national one: three French and three Brazilian students. All participants received the following assignment.

> *"Suppose that you are a teacher or educator working with a group of 8-year olds. Because you loved your intercultural exchange experiences in the past, you want to light up their interest and curiosity about foreign cultures. Your goal is to search this website and choose a book to show them. You want to be original: you want to pick up a book in a language that they really don't understand, in this case in Persian or Farsi. This should trigger their imagination. It could be about music or poems."*

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[1] All evidence from the ICDL interface discussed in this paper was collected from http://www.icdlbooks.org between September 2006 and January 2007.

Figure 2: A simple search for books about poems / songs / rhymes in Persian/Farsi

The task was fairly open-ended, and explicitly addressed the multicultural character of ICDL. In Figure 2 we see a snapshot of a *simple search* returning the kinds of books that participants might choose. Using the *simple search* for the task is very convenient. The set of books to choose from can be obtained in only four steps: clicking on the appropriate age group; selecting the Persian/Farsi language; asking for "more (search) choices"; and clicking on type "poems / songs / rhymes".

However, it took participants more than 8 minutes on average to finish the test. None of them searched for books in the way suggested in Figure 2, but all except one (who chose a book in Serbian) found an appropriate book. The most interesting aspect of the test was *how* these participants interpreted the task and the ICDL interface.

Before we begin talking about cultural issues in the ICDL interface, we must define what constitutes one such issue. The semiotic theories from which SemEng draws its foundations do not provide a means to single out cultural issues. Eco defines Semiotics as "the logic of culture" [9]. Thus, everything that constitutes an HCI issue for SemEng is, in essence, a cultural issue. Consequently, *by definition*, CEM is prepared to account for cultural issues, and there is no such thing as a "non-cultural" issue to account for. Circumscribing the territory of culture is not a problem for SemEng alone. Most researchers of cultural issues in HCI face the same problem.

Switching from *culture* to *cultural dimensions* has often been the preferred strategy to deal with this problem in HCI [17, 10]. Likewise, we work with cultural dimensions of communication, namely *language* and *pragmatics*. In this specific context, language refers to *the diversity of tongues*, and pragmatics to *the diversity of behavioral practices and attitudes involved in language use and in dealing with linguistic objects* [16, 20]. Language and pragmatics are relevant cultural dimensions for our ICDL studies for a number of reasons. Firstly, ICDL is a collection of instances of language use – books. Secondly, many languages are spoken *in* and *with* ICDL (through books and interfaces). Thirdly, an important part of its mission is to foster "children's tolerance and respect for diverse cultures, *languages*, and ideas" [12]. Finally, cooperating and supporting users when moving across cultural

boundaries, helping them to avoid misinterpretations, mistakes and misjudgments is an important requirement for such multicultural environment.

Table II summarizes our main findings. The first column indicates a communicability problem. The second indicates whether we take it ("✓") or might take it ("?") as a *cultural* problem related to language. And the third column indicates whether we take it or might take it as a *cultural* problem related to pragmatics. Some of the findings ("single C") could be a problem even in a single-culture environment (*i.e.* one where all users speak and understand the same language, and share the same pragmatic knowledge). Some others are relevant in only one dimension.

Table II: A summary of CEM results

Findings	Language	Pragmatics
Selecting the *genre* of books in advanced search requires much navigation.	Single C	Single C
The interface behavior when setting parameters for an advance search is misleading (page reloads to refresh the parameters list but the previewed book set is not updated accordingly).	Single C	Single C
"Read books" is an ambiguous expression (read books = SEARCH; click on a book in simple search = OPEN METADATA; link to this book = BOOKMARK).	?	?
Users don't understand the "simple search" idea.	?	?
"Books by country" is an ambiguous expression (books by country = books by continent; a country's book may not be written in the country's language).	✓	✓
Out-of-sync metadata translation may expose users to unexpected changes of language during interaction (*e.g.* interface in Portuguese, metadata in English).	✓	✓
Users could not find how to reset the interface *default* language.	✓	✓
Users were confused with the order of reading / navigation when exposed to Persian/Farsi interface and book previewing.	✓	✓
Users are confused by "interface / keyword / book" language settings.	✓	
Multilingual representations and multilingual instances of books can be easily confused (translated metadata ≠ a translated version of the book).		✓

Among the problems that we think are not specific of multicultural applications, is the navigation through the parameter-setting pages. Because there are too many parameters to show at once, they are grouped into categories. Each category is a *link* on an HTML page, leading to a sub-category or a set of parameters that users can check. The communicability issue is that each of successive HTML pages is divided into two distinct areas – on the left are the search parameters to choose from, and on the right are the search results. Even before the search starts, a set of featured books are shown with links for browsing them (this is an act of metacommunication that *tells users they can begin browsing*). As the user navigates from one HTML page to the other, clicking on search parameters types, the same set of featured books is reloaded. Our tests provided evidence of this is very confusing. Some users believe the set is changing; others take a closer look and wonder why it is not. This would be a problem even in a single-culture environment, so we don't take it as a cultural problem.

Some problems are pragmatic, rather than linguistic, in a strict sense. For instance, a native speaker of French may not understand Finnish. Yet, if this person picks up a

book in Finnish, the order of pages and direction of reading will be intuitive, even though the words can't be understood. Contrastively, if this person cannot speak Hebrew, and picks up a book in Hebrew, she may or may not realize that the direction of reading is reversed. Notice that, just as with Finnish, she doesn't understand the language. However, there is a sense of familiarity in manipulating books, identifying printed letters, and so on, that is much stronger with Finnish than Hebrew. This familiarity stems from practices and attitudes related to language use and dealing with linguistic objects regardless of how well one can understand one or another idiom.

Other problems are strongly related to language, and only weakly related to pragmatics, like translation problems. For example, there was some confusion about books, themselves, and books metadata. The metadata may appear in two languages (*e. g.* English, the default, and French). When users see a book cover on screen labeled "Mushrooms in the rain", and later the same book cover is shown with the label "Champignons sous la pluie", they cannot tell whether these are two books (one volume in French and the other in English), or the same book, whose title is translated into a foreign language. It is also difficult to decide which is the original book language, unless the user reads the book's metadata.

Before we move to the communicability problems of Table I that we will illustrate with CEM tags, the method detected problems that can be cultural or not (marked as "?"). For example, our participants were confused by the expression "Read Books". Some never reached the simple search because they thought "read books" meant literally *read*, not *choose and read* (one participant even assumed that only registered ICDL members could read books; so he registered before he clicked on "read books"). Although this seems to be a problem with language and pragmatics, we are not sure that in a single-language monocultural environment this problem would not arise.

CEM taggings also yielded some powerful insights into important cultural issues, as the examples below can demonstrate.

Oops!:

All participants except one were deeply confused by the language choice when using both the advanced and the location search (see Figure 3). They took "language" to mean book language, not interface language. Thus, when they set it to Persian/Farsi, they got into serious trouble. None of them could understand Persian/Farsi, so this was a mistake they had to correct immediately. However, this "Oops!" was an expensive one, as will be seen below.

Figure 3: Choosing the *interface* language in ICDL

Where is it?:

When ICDL users first access the website, all communication is in English. If they choose to "read books", or to search "books by country", the default language is also English, which is perfectly acceptable. Our tests provided evidence that when users inadvertently set the interface language to Persian/Farsi, they immediately tried to reset the interface language (see "Oops!" above). They started looking for an interface element (a sign) to communicate they wanted to undo the faulty language setting, to

set it back to the English default. A common pattern in most recorded sessions was to navigate back to the homepage (in English), hoping that the "read books" or "books by country" links would lead back to the default language interface. In other words, while receiving metacommunication, they took "homepage" to mean the same as "restart", which is an interesting misinterpretation of the concept of homepage in web navigation that concomitantly achieves some procedure. Another pattern was trying to set the language back to the desired value. The problem is that participants had to know how to say "English" in Persian/Farsi. Since they didn't, interaction degraded into a lengthy quest for comprehensible communication. One participant took chances at guessing languages, picking up choices at random in the drop-down list shown in Figure 4. But, the situation only got worse – the interface showed up in yet other Asian languages unknown to him. Eventually, for lack of appropriate fonts all there was on screen were question marks ("???????"). This communicability problem led users to important task failures or inefficient performance.

Figure 4: Setting the *interface* language back to English in Persian/Farsi

I give up. / Looks fine to me:

These two tags denote the most serious interactive problems detected by CEM, persistent task failures. There was only one case of "I give up". One participant experienced such a long period of bewilderment after having equivocally set the interface language to Persian/Farsi, that she decided to finish the task when she found a book in Serbian. "Looks fine to me." often denoted an important performance problem. As mentioned above, the simple search is undoubtedly the most efficient strategy to identify the set of books targeted by this experiment. After only four clicks, users can start to browse the targeted books to pick up the one they like most. However, this strategy was not adopted by participants. Instead, they tried to find books by using keywords instead of genres or types of books, by searching books from Iran (Asia / Middle East) instead of setting the book language parameter to the desired value, by browsing and viewing books after failing to use search criteria. All these were very inefficient. Because most of the ICDL design effort was explicitly placed on the "interface for kids", the interactive discourse where the most efficient strategy is communicated possibly failed to reach adult users. Our participants were all grownups, whose interpretation is obviously affected by knowledge and expectations that children don't have. What "Looks fine to me." tells us, then, is that all these grownups got *another message* from the designers. Some even thought theirs was a *good strategy*, not realizing that other strategies were available.

Where am I?:

The inversion of navigation hints in the Persian/Farsi interface confused most participants. For example, advancing (going forward) and returning (going backward) were signified the other way around for Westerners. So, whenever they used arrows to mean "back/previous", they were actually telling the system to move "forward/next". The problem also appeared when the interface language was right for the user, but the desired action was to preview a book. When a Persian/Farsi book is previewed, the pages are displayed from right to left, regardless of the reading order of the *interface* language. This caused great confusion, because it took some participants a while to realize why what they thought should be the book's first book page was in fact an arbitrary page spatially located on the top-left corner of the overviewing area (see Figure 5).

Figure 5: English interface overview page of a book in Persian/Farsi

I can't do it this way.:

The location search is primarily a search by continent, and not by country as the homepage link "books by country" suggests. Only when a particular continent is selected can the search be narrowed to a country (*e.g.* Asia and Middle East > Iran). This strategy cannot be combined with other criteria, such as content and age for instance. Thus, participants that chose this strategy could only meet their goal if they looked into the various books' metadata – or browsed the books themselves – trying to decide whether books were appropriate or not. Moreover, the meaning of "books by country" is tricky – a book "from a country" in ICDL is not necessarily written in this country's official language(s). Thus, participants who tried to use this kind of search either switched to another strategy after a while, or spent a considerable amount of time browsing books sequentially till they found one they liked. Those who took the latter alternative provided evidence tagged as *"I can do otherwise."* This latter tag signals communicative breakdowns where, although users don't understand the system's communication, this doesn't prevent them from achieving their (short-term or long-term) goals. They do so by means of side effects of communication meant for other purposes (a serious communicability problem, in fact), or by resorting to typically inefficient communicative patterns unanticipated by the designers.

Our interpretation of CEM taggings led us to relevant insights in the semiotic profiling stage. After examining the ICDL interface again, based on test evidence, we concluded that the main communicability issues in ICDL are three.

First, as a multicultural online environment *par excellence*, ICDL should provide increased support for multicultural navigation. Users should not lose sight of their

native cultural markers when they move across different cultural settings. The presence of such markers (*e.g.* their native language, their *homeland* or starting point in the multicultural journey, familiar interactive, etc.) could increase their sense of safety and comfort, and encourage them to take even *wilder journeys* in the ICDL globe. Our study scenario, where an Eastern language and culture was chosen as an exploration target for Western users, was deliberately chosen. It is in tune with the ICDL design vision. However, in the absence of such cultural markers, users experienced serious problems with the interface.

Second, decoupling *linguistic* from *pragmatic* issues in multicultural interaction may in fact benefit design, going beyond the methodological constraints that led us to use them with CEM. The problem with the direction of reading and book pagination is an important one. When *reading* a book, the user is supposed to understand the book language. Thus, within the scope of a *visualized page*, the direction of reading is of course affected by the particular graphical encoding adopted by that *language*. Hence, Persian/Farsi *text* can only be read right to left. However, *book manipulation* has to do with cultural practices that are language-separable (think of the French-speaking user who cannot read Finnish or Hebrew, but is more *familiar* with the manipulation of books in one language than the other). Our inspection of ICDL has shown that the direction of reading in ICDL can be very confusing. Not only can users find the situation depicted in Figure 5, but speakers of languages encoded from right to left may even be more confused when they browse pages of books encoded from left to right – the meaning of arrows in pagination is difficult to figure out. Decoupling language from book manipulation allows designers to think of users' intuitions about book pagination, and design better browsing strategies for books written in languages unknown to the user.

Third, although we can read in the ICDL website that the library has not been exclusively developed for kids from three to thirteen – teachers, parents, scholars and researchers are among the classes of adult users that are welcome in ICDL – the interface metacommunication *for adults* can be improved. Communication about the convenient "simple search", designed by and for children [**8**, **11**] and missed by 5 out of 6 adult participants in our test, is a problem. For adults, "searching books" and "reading books" are different things, and efficiency is an important usability criterion. So, why not have a *grownups' version* of the simple search? Moreover, we can speculate that corresponding pairs of kids and grownups versions of ICDL interfaces might benefit the children themselves, who could gently move up into more abstract patterns of representation and interaction. In the context of ICDL-Brasil, preparing the interface for intergenerational group activities is a fundamental requirement.

4 Discussion and Conclusions

The use of CEM as an evaluation tool in the study of ICDL has yielded useful results. Although CEM was not designed to deal *specifically* with multicultural software applications, many of our results are clearly related to research explicitly centered on cultural issues in HCI. For example, the need for cultural references to orient ICDL users as they move across cultural boundaries is in line with Barber and Badre's

findings about the role of cultural markers in improving the usability of international websites [3]. Likewise, much of the problems we have treated as linguistic have been dealt with in cross-cultural research by Bourges-Waldegg and Scrivener [5], although as generalized *meaning* and *representation* problems. The authors concede, however, that "particular linguistic representations […] are a design issue only if they become an obstacle to understanding." [p. 301]. And this is precisely what CEM has allowed us to verify in the ICDL interface.

We also share many of their views. For example, it is our common belief that cross-cultural communication in natural contexts is probably less problematic than culturally-oriented HCI research may lead us to believe. Even coming from different cultures and speaking different languages, people are naturally aware that signs may be interpreted differently by foreign interlocutors. This multicultural awareness can not only be sustained, but also increased, by culturally-informed HCI design.

Previous empirical studies with ICDL were based on Bourges-Waldegg and Scrivener's approach. Bilal and Bachir [4] tried to find out how Arabic-speaking children (who could not understand English) interpreted ICDL interface representations. The focus was placed on navigation controls (buttons, accelerators, icons). Their findings showed, for example, that because of the visual cue (the text box) participants could make sense of the keyword search, but could not understand the meaning of simple, advanced and location searches. The authors comment that images associated to the different types of searches should have facilitated understanding, even without linguistic support. They also found that younger children in the group (6 and 7) could not understand the ICDL interface in the test conditions they were exposed to, whereas older children (8 to 10) could, possibly because of their previous experience in using the Internet.

It is interesting to contrast these results with CEM's, obtained from participants with a completely different profile in terms of age, culture, task scenario, and evaluation purposes. Despite all differences, adult participants in our tests, who *did* understand the language, did not fully understand how the keyword, advanced, location and simple searches worked. An important study to compose the larger picture is to investigate how children that cannot understand English but can understand one of the other interface languages of ICDL interpret and use the digital library.

CEM also helped us find *usability* problems detected in previous ICDL evaluations. Hutchinson and co-authors [11] discuss a number of tradeoffs that ICDL designers had to resolve. Among these was the problem with flattened search hierarchies. Because hierarchical search is more difficult for children, the design team decided to present search criteria in a non-hierarchical structure. As a result, in the simple search, for example, not all criteria can be visually presented in one screen – buttons are displayed in two consecutive screens that require navigation with a click on "More Choices" (see Figure 2, for illustration). Hutchinson and colleagues report that evaluation tests with children, ages 6 to 11, revealed that participants *did not* find the navigation button more often than they *did*, leading evaluators to the conclusion that the "paging design was a usability problem for children." [p. 110] The dual problem was found with adults in our study. Although using the advanced search, a similar design choice led to problems in *communicating* what search criteria are actually available for them. Thus, many did not reach the page with all search criteria.

Turning our attention to the specific context of ICDL-Brasil, previous work by Kaplan and Chisik [15] has also focused on the potential of ICDL in developing literacy skills. The authors underline the fact that literacy is not an isolated skill (an ability to read), but rather a social practice that takes many forms. Therefore, one of the promises of ICDL as a literacy-supporting technology would be to support "sociable literacy" (*e.g.* group reading, reading circles, etc.).

Our evaluation, unlike most (if not all) of evaluation studies with the ICDL, involved adults – not children. This is an important research strategy for ICDL-Brasil, for two main reasons. First, because of the crucial role of adults, especially parents, in stimulating, supporting and developing literacy in Brazilian children [14]. If we hope that ICDL can be used as a tool in a major effort to alleviate functional illiteracy in this country, Brazilian adults *must* be able to use it and to like it, to the extent that they will be able to stimulate and support children – the ultimate users. Second, because recent research among Brazilian educators [1] has shown that using computer technologies in pedagogical practices constitutes a source of personal conflicts, tension, and distress among these professionals. One of the reasons for this is that educators feel that they no longer master all the necessary skills to be sure of themselves in all situations, running the risk of being bewildered by a system's behavior in front of their class, for example. Moreover, the possibility of kids will know how to solve problems that they don't, is leading many educators to revise their professional identity.

Our study shows that the ICDL interface is challenging for adults in many respects. We concluded that this may be due to the fact the largest portion of the design effort in developing ICDL has been placed on its suitability (and *communicability*) for *kids* [8]. Our proposed solution is not to build an interface for *grownups*, but to expand the ICDL interface so that it supports intergenerational *sociable literacy* processes. This is a necessary pre-requisite for the success of ICDL-Brasil, and possibly an important feature for other cultural contexts targeted by ICDL.

Finally, with respect to the use of CEM for evaluating cultural issues, this study gives evidence this method is indeed a useful tool. A strict interpretation of its theoretical foundations in Semiotics could lead us to say that *every communicability issue is a cultural issue*. But this would be hardly of any value for a community striving to face the challenges of multicultural HCI design for internationalization and localization of information technologies [2]. We have thus narrowed the focus of our attention to distinguish between cultural and non-cultural communicability issues detected by CEM. To this end, we singled out two cultural dimensions of great importance in the context of ICDL – language and pragmatics. By language we referred to the diversity of tongues, and by pragmatics we referred to the diversity of social practices, behaviors and attitudes involved in language use and manipulation of linguistic objects, books in particular.

After a standard communicability evaluation process, applied to ICDL, we classified our results as "cultural" and "non-cultural", according to the two cultural dimensions described above. Some results were unmarked for both dimensions, and we considered those "non-cultural". Others were marked for language and/or pragmatics, and we considered those "cultural". Some results might be cultural or not. The ambiguity is due, on one side, to the deep connections between language and culture, very well known to linguists, and on the other to the semiotic foundations of

CEM, which must not and cannot be forgotten. However, in our list of 10 relevant instances of communicability issues, only 2 classifications were unresolved after this initial application of the method. We take this as a sign that the selected cultural dimensions were appropriate for the task.

Our attempt to find out if among the interactive problems detected by CEM there are some that are clearly related to culture, and if CEM can distinguish cultural from non-cultural communicability problems, was thus successful. This study has shown that some results **are clearly related to culture**. This is not supported by our particular means to separate cultural from non-cultural issues dealt with by CEM, but by comparison with reported results from other ICDL studies that took other cultural and usability references as a basis. The study has also shown, however, that CEM itself **cannot distinguish cultural from non-cultural problems**. The distinction was made by means of concepts and criteria that are not part of CEM, although they are theoretically compatible with its foundations.

Last but not least, CEM proved to be a useful evaluation tool to support HCI design and redesign. Not only did the semiotic profiling stage enabled us to identify top-level design issues that should be addressed in the ICDL interface (supporting cultural orientation, decoupling language and pragmatics as separate design dimensions, supporting both adult users and children), but it also helped us identify specific communicability problems whose solution can benefit from the evidence provided by the participants of our tests.

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