The User Classes Building Process in a TEL Project

Tania Di Mascio, Rosella Gennari, Alessandra Melonio, and Pierpaolo Vittorini

Abstract. Nowadays, circa 10% of 7-11 olds turn out to be poor comprehenders: they demonstrate text comprehension difficulties, related to inference making, despite proficiency in low-level cognitive skills like word reading. To improve the reading comprehension of these children, TERENCE, a technology enhanced learning project, aims at stimulating inference-making about stories. In order to design and develop the TERENCE system, we use a user centred design approach that requires an in depth study of the system's main end-users, namely, its learners and educators. This paper reports the user classes building process for learners by means of user-centred design field studies.

1 Introduction

Text comprehension skills and strategies develop enormously from the age of 7–8 until the age of 11, when children develop as independent readers. Nowadays, more and more novice comprehenders turn out to be poor (text) comprehenders: they demonstrate difficulties in deep text comprehension, despite well developed low-level cognitive skills. These poor comprehenders represent the end-users type we refer to in this paper.

Finding stories and educational material that are appropriate for is a challenge, and hence teachers are left alone in their daily interaction with them. Most reading material for 7-11 old children is paper based, and is not easily customisable to the specific requirements of poor comprehenders, e.g., in the types, number or position of temporal connectives. Few systems promote general reading interventions

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(see e.g., [3]), but they have high school or university textbooks as reading material, instead of stories, and are developed for old children or adults, and not specifically for 7–11 old poor comprehenders.

TERENCE is an FP7 ICT TEL project for 7–11 year old poor comprehenders, hearing and deaf, and their educators, and it aims at filling such a gap: its reading material (in English and in Italian) will be stories adapted to the specific requirements of such poor comprehenders, and its reading interventions are mainly smart games that stimulate inference-making on text, fostering deep text comprehension. In particular, TERENCE builds an *adaptive learning system* (ALS) for improving the reading skills of 7–11 old poor comprehenders, hearing and deaf. The conceptual model of the TERENCE ALS is described in [1], [2]. In particular, the domain model structures the material of the ALS, namely, stories and games. The user model structures the information concerning the end users of the system, that are: *learners*, that is, 7–11 old children; *educators*, namely, teachers and parents; *experts*, that is, end users providing material for the system.

To guide the design and development of the TERENCE ALS, we adopted the *user centered design* (UCD) methodology [5], which involves the end-users into the project from the very beginning, and aims at the overall usability of the system. In an UCD approach, it is custom to classify potential users of the system under design according to the expected usage of the system. It is important to underline the difference between *user types* and *user classes* here: the first are based on the designer's hypothesis about the users based on the literature and/or documentation studies. Such a hypothesis is generally a reasonable assumption, however, it may not fully reflect the specific context of use and its users, since it based on literature rather than on actual research of the specific target users for the context of use analysis. User classes, on the other hand, are based on the analysis of the context of use. The classification is not a hypothesis of the designers, but the result of the interaction between the designers and the users involved in the context of use analysis.

The goal of this paper is to provide a description of the user classes building process for the learner type (see Sect. 2) coming from field studies conducted in Italy (as described in [8] and [10]) on the one hand, and, on the other hand, on the input from other sources (e.g., brainstorming meetings, documents, see [9]). The paper ends with Sect. 3 focused on future work.

2 The User Classes Building Process

This section contains a description of the building process of user classes for the learners' type in the TERENCE project. It starts with row data (e.g., personal data) and ends with a classification of such users. This building process is based oh the field study conducted in Italy in the middle of 2011, in turn based on field studies run at the beginning of 2011. While the first field study, described in [8], focused on knowing our users and their main needs in relation to the overall goal of the project, the second field study focused on defining the classes of users representing the starting point of the SW engineering process of the TERENCE ALS. Following

UCD practices, see e.g., [6] and [7], we conducted experiments using user-based criteria [9]. The experiment design is reported in Subss. 2.1, the user description is reported in Subss. 2.2, the user teaching is reported in Subss. 2.3, the experiment execution is reported in Subss. 2.4, and the result analysis is reported in Subss. 2.5.

2.1 Experiment Design

The general framework for the design of the user field study is described in [8]. Based on the conceptual maps of this framework, specific user tasks were designed to assess the users' characteristics during the study. See, e.g., Tab. 1.

Table 1 Extracurricular activities.

Goals: To assess the learners' extracurricular activities. **Materials**: Stickers; sheets with pictures. **Description**: Each learner received a sheet with stickers representing activities (e.g., reading, going on the internet, drawing, using an iPhone, running, or going to the park), and a blank sheet with three empty circles representing morning, afternoon and evening. Learners had to paste the relevant stickers into the appropriate circles.	

2.2 User Description

The experiments involved 18 teachers and 282 learners (7-11 years old). Consider that 8 olds belong to Class 3. Tab. 2 presents the user involvement.

2.3 User Teaching

Two of the participant schools, namely, Campalto and Torre di Mosto, had already participated to the first field study. They were already informed about the goals of the TERENCE project. For the other schools, first of all, the experimenters decided

Table 2 An overview of the learners participating in the field study.

School	Class	Deaf/hearing unit	Number of learners
Primary school, Torre di Mosto	3	Hearing	42
Institute Gramsci Campalto	3	Hearing	16
	3	Deaf	1
Pescasseroli	2	Hearing	20
	3	Hearing	21
	4	Hearing	17
	5	Hearing	19
Masseri Avezzano	2	Hearing	35
	3	Hearing	38
	4	Hearing	18
	5	Hearing	16
San demetrio ne' Vestini (AQ)	6	Hearing	37

with headmasters the date of a preliminary meeting to present TERENCE. Once the project was clear to all the involved teachers, practical arrangements were made and general information about the field study tasks were explained, e.g., the duration of class sessions and interviews, the nature of the tasks. During these meeting with teachers, all of them asked the experimenters to administer the same test to all children in the classroom without considering if a child is deaf or hearing, poor or good comprehender. For this reason, where deaf and hearing children are mixed in the same classroom, the experimenters administered the same test asking support teachers to aid deaf children.

2.4 Experiment Execution

The field study sessions were conducted in a period of May, year 2011. In two classes of the San Demetrio ne' Vestini school we conduced the study in two days in the week of May 16th. In 4 classes of the Pescasseroli school, we conduced the study in two different days in the week of May 20th. In three classes in the Torre di Mosto and the Campalto schools, we conduced the study in one day on 26 May. In six classes of the Avezzano school, we conduced the study on May 28th. This resulted in a total of 15 primary school classes with children of all ages. In each class, we spent about 90 minutes with learners, and each class teacher participated in a 20-minutes interview. All tasks described in Sect. 2.1 were done with all learners and we collected all assignments and stored the interviews with teachers.

2.5 Result Analysis

In order to describe user classes, we used the persona framework, see [4]. To do this, we applied the following procedure during our data analysis.

We here report the analysis of data for the learners, gathered conducting a quantitative analysis, described by the following procedure.

1. *Data Management:* all data gathered using the assignments described in the experiment design section (Sect. 2.1) is stored in a database for quantitative analysis.
2. *Statistics:* statistics of the quantitative data were calculated using $Chi2$ and $Fisher's$ analysis. Natural variables like gender and age were defined. Other dichotomy variables were derived from statistics observations (e.g., rural versus urban).
3. *Data Analysis:* graphics describing the variables associations were depicted. Using these data, we derived a first classification that stems from orthogonal dimensions (e.g., North/Centre) and sorts learners according to opposite dimensions, or dichotomies.
4. *User Classes:* using tables, graphics and variables associations, we derived four classes, obtained by excluding some classes based on the behavior of variables associations.

Hereinafter, we detail such steps.

2.5.1 Data Management

All data was stored in an open source DBMS: Open Office. We designed the ER diagram. Attributes of the DBMS were derived from the collected data, reading the learners responses.

The most important tables are the following ones.

- School: this table represents the involved schools. The attributes are:
  - Name: the name of the school;
  - City: the city where the school is located (so we can find out if it belongs to the North or the Centre of Italy);
  - Type: the area where the school is located: rural or urban.
- Learner: this table represents the involved Learners. Attributes are (for example) school, classroom and sex.
- Activities: this table represents all the activities shown in the Extracurricular activities task.
- Learner-has-Activities: this table collects the Learners' responses for the Extracurricular activities task.
- Map: this table collects the Learners' responses for Technology use task and the Games task.
- Homework: this table collects the Learners' responses for Homework task.

2.5.2 Statistics

Afterwards, statistics of the quantitative data were calculated. More specifically, we used the STATA software. Data are presented in relation to the following pure and dichotomy variables:

1. Gender (or Sex) – Male (M) and Female (F);
2. Disability – Hearing (H) and Deaf (D);
3. Skills – Poor Comprehension (PC) and Good Comprehension (GC);
4. Region – North and Centre of Italy (N and C);
5. Area – Rural (R) and Urban (U);
6. Socio-Cultural Level – low level (lS) and medium/high level(hS);
7. Age Class – divided into
   - Low Age: children that are 7 to 8 years old;
   - High Age: children that are 9 to 11 years old.

2.5.3 Data Analysis

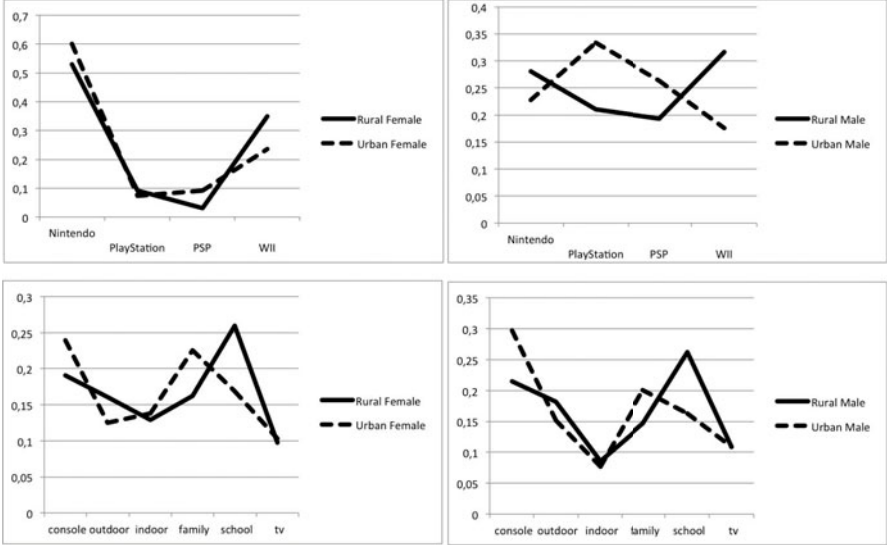

Fig. 1 Cross Analysis – Area vs Gender.

During the statistical analysis, we observed that the significant dichotomy variables with respect to our analysis (e.g., activities, console use and avatar choice) are: (a): Age Class (lowAge and highAge); (b): Gender (M and F); (c): Region (North Italy and Centre of Italy); (d): Area (Rural and Urban).

In order to discover which dichotomy variable is most representative for activities and console use, we analysed the data described in the previous step via cross associations of area, location and age class versus gender, see the Fig. 1.

Observing the graphs in Fig. 1 we observed that both urban female and rural female curves have the same behavior regarding activities and console use. This

means that we can decide to not consider the area dichotomy variable when considering female learners. This is not the case when we observe rural and urban male curves. They have the same behavior only in the console use case, but not in the activity case. This means that we will consider area as a dichotomy variable when we derive classes for male learners. We proceeded with depicting the graphs representing the cross analysis between gender and location here not reported for space constraints. Starting from these data we decided to consider location as a dichotomy variable when deriving classes for male learners. We also analysed graphs representing the cross analysis between age class and area. We decided to disregard the area dichotomy variable when considering male as well as female learners. From the cross analysis between gender and age class variables, we decided to disregard the gender dichotomy variable when considering the age class. We proceeded with graphs representing the cross analysis between area and location deciding to disregard the area dichotomy variable when considering the location variable. Finally, in order to deduce the most important dichotomy variables, we analysed graphs for male learners considering the area plus location versus age class variables, Fig. 2. The two graphs depicted in Fig. 2 show that, in the case of males, we must consider the location as well as the area dichotomy variables. In fact, even if in the case of console use (the right part of the figure) the curves have the same behavior, the behavior is not the same, for activities.

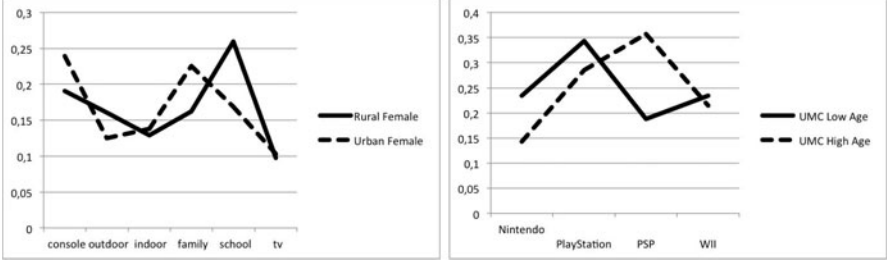

Fig. 2 Cross Analysis – Area and – Location vs Age Class.

2.5.4 User Classes

Studying the behavior of trends in the graphs, we discover that some variables are more significant than others. Based on this, we were able to deduce the following learners classes: (1) – DF (Deaf Female); (2) – HF (Hearing Female); (3) – H R M N lowAge (Hearing Rural Male North lowAge); (4) – H U M N lowAge (Hearing Urban Male Center lowAge); (5) – H U M N highAge (Hearing Urban Male Center highAge).

3 Conclusion and Future Works

In this paper, we described the user classes building process. Currently, we are working on a finer-grained analysis of the user requirements, to be reviewed through small-scale evaluations. The updated requirements will provide the input for the revision of the conceptual model of the TERENCE ALS, in particular, its user model, and hence the implementation of the TERENCE software. Such evaluations, more in general, will serve to assess the usability of our ALS, and in particular: (1) the appeal and adequacy of its learning material, (2) the pedagogical effectiveness of our ALS in improving the text comprehension of 7–11 old poor comprehenders.

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References

1. Alrifai, M., Gennari, R., Tifrea, O., Vittorini, P.: The Domain and User Models of the TERENCE Adaptive Learning System. In: Proc. of eb. TEL 2012. Springer (2012)
2. Alrifai, M., Gennari, R., Vittorini, P.: Adapting with Evidence: the Adaptive Model and the Stimulation Plan of TERENCE. In: Proc. of eb. TEL 2012. Springer (2012)
3. Di Mascio, T., Gennari, R., Vittorini, P.: The Design of An Intelligent Adaptive Learning System for Poor Comprehenders. In: Proc. of Cognitive and Metacognitive Educational Systems 2010. IADIS (2010)
4. Gasperis, G.D., Mascio, T.D., Florio, N.: Tatot: a viewer for annotating stories in the terence project. In: Proc. of ITAIS 2011 (2011)
5. Goransson, J., Boivie, B., Blomkvist, I., Persson, S., Cajanger, J.: Key principles for user-centred systems design. Behavior and Information Technology 22(6), 397–409 (2003)
6. Hartson, H., Andre, T., Williges, R.: Criteria for Evaluating Usability Evaluation Methods. International Journal of Human Computer Interaction 13(4), 373–410 (2001)
7. Mascio, T.D., Gennari, R.: A Usability Guide to Intelligent Web Tools for the Literacy of Deaf People. In: Integrating Usability Engineering for Designing the Web Experience: Methodologies and Principles, pp. 201–224. ICI Global (2010)
8. Pasini, M.: Working document 1.1: User classification and identification. Technical report, TERENCE project (2011)
9. Slegers, K., Gennari, R.: State of the Art of Methods for the User Analysis and Description of Context of Use. Technical Report D1.1, TERENCE project (2011)
10. Slegers, K., Mascio, T.D.: Working document 1.2: Usability goals and user needs. Technical report, TERENCE project (2011)