**DIRCE - Design of Interaction and elicitation of Requirements focusing on the Communication and Exploration of ideas - Experiences of use in content creation systems for digital television**

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**Abstract**—This paper aims to present an approach to help professionals focus on interaction aspects since the early stages of the process of development of an innovative system. This approach guides the application of techniques addressing the integration between the processes of requirements elicitation and interaction design by considering both the experiences of users and other factors which influence the context of use of a system under development. Such approach was applied to a system which creates content for DTV, resulting as major contributions the description of pre-patterns for the context of content creation for DTV, as well as an analysis of the implications of the use of techniques of user experience for the activities of software engineering and interaction design.

**Keywords**: User experience, Experience Prototyping, Human Computer Interaction, pre-patterns, innovative systems, Digital Television.

1. **Introduction**

This paper presents an approach to help Human Computer Interaction (HCI) professionals (such as developers, designers and usability engineers) understand the experiences of target users in a project of innovative computing systems. An innovative system is characterized by the fact that target users — and in many cases developers too — are not yet familiar with the technology being studied. The team that will develop the system must go through a process of understanding the experiences of target users in order to assure the usability of such system. The usability notion of [14] was adopted, which decomposes usability into technical quality (the system should work) and user quality, and then decomposes user quality into functionality (the system should provide users with the right functionality that most users need or strongly want), ease of use (it should be easy to learn and easy to operate) and user experience (most users should have positive experiences when using such system). From this understanding, they could define usability goals and system requirements. Developers (including designers) have difficulties in creating such definitions. Features and system constraints involving the usability as a whole refer to a series of doubts concerning possible combinations among HCI concepts (such as: why will some users probably not accept using a specific modality for a task in a use environment?). To answer this question, a lot of approaches have focused on the interaction study exclusively with users, disregarding the team who will develop the system. As it was previously mentioned, target users are not familiar with an innovative system under development. This is the main reason why users have difficulties when talking about their expectations during experiences with a specific system. Our assumption is that the most relevant professionals developing the system should also have such experiences for better describing the system.

The methodology developed by this work is based on the user experience techniques. When applied to relevant stakeholders of the project (such as target users and HCI professionals), those should be able to:

**Improve the understanding of relevant stakeholders about the interactive possibilities of the system under development.** Throughout the design process, there are situations in which the designer is forced to be creative: be able to see people, things and situations in a new perspective [7]. This situation is reinforced when the system is innovative. In this case, the designers have to "imagine" both the operation of the system — which does not yet exist and the use of the system by users. Dow et. al [5] argue that designers do not have enough information on new technologies to understand the limitations of feasibility, physical properties and the vectors of change. The designers find it difficult to design innovative applications due to the level of complication, the lack of technological support and the unstable nature of new technologies [5]. From this came the need to support them to facilitate their understanding of the system under development.

**Promote an awareness process among stakeholders of the project regarding the contextual factors that influence the use of a system in an environment since the beginning of the interaction design.** In innovative projects, specific techniques have to be used to place the context of use as the principal concept to observe the experiences of use by the target users. Ethical factors (what people like or do not like and how the privacy of information is handled in the context
of interaction), social factors (how users are able to overcome the risks of ownership of technology) and environmental factors (such as weight and portability of the equipment as for the weather, amount of people in streets, etc.) influence the use of the system and are difficult to identify without a detailed understanding of the system. The development team of a system should be able to handle the unexpected, knowing the reaction of users and the return of their interaction. Users can report their concerns, problems that have come from similar systems, etc. By that, the team can improve the interaction design by analyzing contextual factors, checking whether the scenarios presented are consistent with the reality of users, and whether the system will be well received by them.

Provide better communication between stakeholders enabling a consensus on interactive alternatives of the system. Preece; Rogers and Sharp [10] emphasize the importance of multidisciplinary teams in interaction projects. Gathering a group of people with different backgrounds and training promotes the combination of skills with an understanding of the different areas of application needed as to design the new generation of interactive systems. However, the authors also emphasize the difficulty of communication within the team: the more people with different backgrounds in a design team, the harder it can be to make them communicate and advance the projects developed [10].

In software engineering, there is a globally accepted principle: good communication between members of a development team is needed in order to have a better use of their skills as for the system. The developer needs to have good communication with the designer so that the result of the development will be that which they have designed for it and, finally, also the designers have to communicate with the users and usability engineers so that the system will have a good design guide.

This article is organized into seven sections: the second describes the proposed approach; the fourth section explains the application of the methodology in the case study; the fifth presents the results obtained; and the sixth brings a discussion. As for conclusion, some final considerations and future work are presented.

2. Rationale of the methodology

This work focuses on the requirements elicitation and the design of the interaction of innovative systems considering the experiences of users as well as the experiences of the team developing the system. The activity of requirements elicitation is responsible for the specification of requirements for the operation and development of software systems. The design of interaction goes beyond the interface, and its study involves dealing with issues that often arise during the use in a process of participatory design. The participatory design is characterized by the active participation of end users of the software throughout the design cycle and development. There are several techniques of participatory design. The following ones are cited as important for this work:

- User experience: encompasses all aspects of user interaction during their use of the system [14];
- Experience prototyping: this is a technique that combines user experience with prototyping and proposes to provide developers / designers, users and customers of a system with the possibility of "experiencing it by themselves" before the system is developed [1];
- Space-time representation: allows stakeholders of the project to report their experiences of interaction in terms of space and time, and such representation can be made by use of post-it, notes, drawings, photographs, etc. [5];
- Pre-patterns: are emerging patterns that are not yet in common use by the design community and end users. They are used in the exploratory stages of the project of innovative systems, in which the problem to be solved is not yet known with a certain pattern [3].

These techniques are associated in the approach proposed in this work, which is described in the next item.

3. Approach DIRCE

The approach proposed in this paper is called DIRCE – Design of Interaction and Elicitation of Requirements focusing on the Communication and Exploration of ideas. Such approach is suggested to be applied before or simultaneously with the phases of requirements engineering and design of interaction. As a reference point for integrating the approach, the process of engineering requirements of Sommerville [13] and the activities of interaction design of Preece; Rogers e Sharp [10] were taken. The process engineering requirements of Sommerville is composed of four phases, which are: (1) Feasibility Study, (2) Elicitation and analysis of requirements, (3) Specification of requirements and (4) Validation of requirements [13]. Preece; Rogers and Sharp define four basic activities for the interaction design: (1) Identifying needs and establishing requirements, (2) Developing alternative designs, (3) Building interactive versions of designs and (4) Evaluating designs [10].

The proposed approach considers these activities involving the techniques cited by the following steps (Figure 1): (1) Study of similar applications, (2) User experience, (3) Identification of system requirements, (4) Definition and implementation of pre-patterns; and (5) Definition of Interaction Design. In the first step of the methodology, the applicators of the experience do a study of applications which are similar to the system to be developed. The technique used for this is the analysis of competitors, which focuses on the identification of the strengths and weaknesses of competing products before they start working on the design of the system to be developed. Also in this step, the applications studied with the team and participants are presented so that they could acquire some knowledge about the innovative system.
Fig. 1. Methodology DIRCE

In the next step of user experience, the techniques experience prototyping and space-time representation are applied. This phase is divided into four steps: (a) Participants' knowledge, (b) Experience preparation, (c) Experience application; and (d) After-experience meeting. In order to evaluate the participants' knowledge, a questionnaire is provided, aiming to assess how well those participants understand the system to be developed and their experiences as for similar systems. In (2) the applicators should prepare simple low-fidelity prototypes, which will serve as communication tools to demonstrate how participants can use the system. Scenarios of use can also be defined and thus used as a guide for the experience activity.

In (c) the experience should be applied to the participants with the presence of facilitators / observers. In (d) the participants should report their experience and answer a questionnaire in order to provide more details about the user experience.

The last step is the identification of system requirements. In this step, the results of the previous steps are analyzed (interviews, questionnaires, prototypes, sketches, images, etc.) in order to integrate and organize the results.

From the results of this analysis, the pre-patterns for the system are defined. These pre-patterns are then applied, validating scenarios and ethical, social and environmental factors of the system under study and having a relationship with the interaction design for the construction of the final prototypes.

By suggesting techniques to be applied in the phases of Requirements Engineering (RE) and Interaction Design (ID), the approach of this work enabled the definition of a conceptual framework (Figure 2). A conceptual framework consists of a set of concepts used for solving a problem of a specific domain [12].

The framework proposed is a generalization of the methodology, relating the techniques applied in the methodology to the processes of RE and ID. The process of the methodology provides results for all phases of the requirements engineering step, since the feasibility study until the requirements validation. For the interaction design, the needs and requirements are important for the preparation of the user experience and, as a result, alternative designs, interactive versions of the design and evaluation of resulting designs are obtained.
4. Case study

DIRCE approach was applied to a project whose objective was developing a system for creating web content for DTV (DTV). It was applied to 12 participants of the project team: 7 researchers teachers (who will be the end users of the system) and 5 professionals from the development team (3 developers, 1 designer and 1 usability expert). The team consisted of 7 women and 5 men, aged between 20 and 35 (8) and above 35 (4). It was noticed that 7 of those have experience in preparing lessons, from whom 6 had experience in distance learning, but none of those had experience in DTV. The participants answered a questionnaire which enabled the identification of the characteristics described above, besides some other important information as for the system, such as: all of them have a television at home, use a computer and the Internet, normally create content such as blogs, news, warnings to people or websites.

1) Study of similar applications. Two applications were presented to stakeholders aiming to improve their understanding of the interactive possibilities of this new system. The applications presented are meant to create content on the web for viewing in the DTV, such as the system being designed. However, neither has educational context to create classes for DTV.

The sample of similar applications facilitated and clarified a lot of questions, and the following points of interest for research arose: how to have teachers (who are accustomed to preparing classroom lessons) create lessons for a web system to be viewed on DTV? How would teachers prepare such lessons? How would they use what they have already done? Which would their difficulties be?

In this sense, this work focused on a way for providing user experience for teachers to verbalize how they would like the system to be. The starting point was the need for supporting the development of courses in an easy way and which does not disrupt their productivity.

2) Preparation of the experience. In order to provide users with closer scenarios, the experience was contextualized in terms of time and space. Time was chosen based on the assumption that teachers would organize their classes based on a time sequence and that they would like to use these classes later. Space was chosen for defining experienced scenarios of use. The prototype was built by using low cost materials such as paperboard, icons, colored cards, pen and paper.

The paperboard was prepared on a table and was divided into 3 parts grouped into 2 regions (Figure 3). The time representation (Region A of Figure 3) was treated by means of a time line, and the space representation (Region B of Figure
3) was treated by defining three scenarios whose results were freely arranged in the spaces of region B in Figure 3: (1) the 1st horizontal line set the space for the classroom scenario; (2) the 2nd horizontal line defined the space for the scenario in which the system would be used for the classes on DTV; and (3) the last line defined the space that would correspond to the student's vision on DTV. The participants were instructed to use the time line for presenting their experiences in teaching classes (years could be freely written on papers) and to develop scenarios in the context of spaces.

The scenarios of the experience prototyping which were set to be presented to participants were:

- **Scenario 1** – Preparation of classroom lessons. Reflection: Do you currently prepare your classroom lessons?
- **Scenario 2** – Preparation of lessons for DTV. Reflections: How could this new system help you prepare your lesson for DTV? What difficulties would you have in using such a system?
- **Scenario 3** – Creation of the students’ vision on DTV. Reflections: How would students attend such lessons on DTV? What factors would influence their use for content creation or the student's use for the interaction with the content?

3) **Application of the experience.** The application of the experience in this case study had the following characteristics: individual session; duration: from 30 minutes to 1 hour and; monitoring: 1 or 2 observers. During the application of the technique, the participants were provided with a short explanation, ensuring that they would not be tested, but actually participate in an experiment to help the final product which will be developed. The scenarios are explained to the participant before they start using the system; some contextual interviews are applied while they use it. These contextual interviews involve talking to the user while they perform their tasks, by combining the techniques of interview and observation.

The first scenario, focusing on classroom lessons, aimed to motivate the participant in the context that was previously known. This scenario intended to rescue the participant's teaching practices for creation of classroom lessons. The participants were asked to start this experience by explaining how they prepared the class content by using the resources available for improving communication.

The second scenario aimed to introduce the participant in the application context - a system for creating content for DTV. As they have explained their classroom lessons in the first scenario, in this scenario they are encouraged to think about the following: “You have just explained how your classroom lessons work. Now imagine that the institution where you work has provided teachers with a system for creating distance classes for DTV. Therefore, you should adapt your previously created class by using the system for DTV”. In this scenario, the participant should imagine the system and explain what the difference would be between the classroom lessons and the DTV lessons.

Still in the second scenario, the next step consisted in describing what features the system would have. The applicator asked the participants what features they believed such a system would have. The participant makes a comparison between the way they usually teach (classroom lessons) and the way they think it would be in DTV, by thinking of which features would be important for the preparation of their classes, for example whether they would use videos or apply group activities, and what they would like...
to use in the system. They were supposed to imagine how that content would be handled on DTV.

In the third scenario (student’s vision) the user is asked: “How do you think the student will see this class you have created on DTV?” The participant would think as a student, reflecting about how the student would attend that class on DTV. During the course of user experience, the participant takes the position of both a teacher and a student. Then, there is a reflection on contextual factors which may influence the use of the system. The participant is asked whether they have thought of any factor which could influence the use, such as: accessibility, copyright, security, sharing, collaboration or privacy. The images of Figure 3-b represent the application of the technique. In this case study, participants were supported as for the use of the system. They were also monitored as for their experience with the system, both through observation and through questions.

4) After-experience meeting. In this meeting, the process and the experience description were explained, and some questions about the experience were raised. Each participant detailed how their user experience with the future system had been. The participants were then encouraged to point out the possible features of the system previously imagined throughout the three scenarios of use. They talked about their ideas and expectations regarding the system. Afterwards, they filled out a post-experience questionnaire. A week later, the applicator of this methodology together with the participants explored the data resulted from this phase of the methodology and created a requirements document and a prototype of the interfaces considering the data collected. Such prototype was presented to participants and thus validated.

5. Analysis of results

The analysis of results was based on two moments: (1) during the explanation of the experiment, through observation, contextual interviews and use of prototypes and; (2) after the experience, through brainstorming and questionnaires.

The results obtained from the application of these techniques are described below, which are basically the analysis of the information obtained and of the participants’ behavior, noticed through their speech and behavior.

Observation of the experience: This experience brought a lot of ideas and suggestions. By imagining how the system should be, the teachers described important features it should have. They said: “I would like the system to provide us with media such as pictures, audios and videos”, “I would like to know the student’s level”. They made comparisons between their classroom lessons and how these lessons would be applied in the system: “When I teach in the classroom, it’s possible to know whether the student is or isn’t interested in my class, so how will I realize it through the DTV system?”

They also talked about what they did not wish the system to have: “I don’t want to have much work to search for content”. Therefore, they would list what was and what was not necessary for the system, which would then be transformed into requirements and constraints for the system.

Contextual interview: The contextual interview facilitated the conduction of the experiment during its use. The questions were supposed to have the participant reflect about the system. The participants were asked: “How would this system help you prepare your lesson?” and some of the answers were: “The system should be simple and easy to use”; “The system should give me feedback so that I know whether my class was good”; “The system could send me questions from students”; and then the applicator asked the following question: “What features do you think this system should have?”, to which the following responses were obtained: “Teaching tips on how to prepare a lesson and technology tips on how a good class on DTV would be, for instance: not using long texts”; “Possibility of the teacher to determine a logical sequence for the student to view the content, for example: the advanced subject would be seen only after the basic subject has been studied”.

Another question proposed to participants was: What are the main difficulties for the teacher whose habit was to prepare classroom lessons, when they face such a digital system? Some of the answers were: “When I prepare my lesson and go to classroom, the lesson totally depends on the interaction with the class; I can change it and add something more. When using the digital system, how can I do this?”, “In DTV, more people have access to this content, so that will demand me more care when I prepare my content!”?, “I'll have to quote all the references”, “I won't have direct interaction with the students and thus I won't be able to see their interest or their possible questions as to the content of the lesson”.

In the third scenario, the following question was asked: “How do you think the student will see this class on DTV?”, to which some participants answered: “First of all, they should have access to a menu, from which they would choose what to display”, but all the participants explained visually by using drawings and screen assembly of the prototype.

The participants were asked to freely think of factors that could influence the use of the system. The following factors were suggested: communication, location, sharing, privacy, trust, collaboration, reuse, and usability requirements. For each of those factors, they would say whether they had thought of it or not. Some users stated to have thought of it, whereas others had not. Sometimes they did not think of it during the process, but at the time they were asked about it, they began to think of it. One participant has confidentially said: “I did not think of it because the DTV is open”, yet another participant has affirmed not to have thought of copyright for they thought the system would automatically deal with this subject later.

Prototypes: Participants began the experiment by planning their classroom lessons as a function of time. They would put the years when they began to teach and would explain the content and its evolution. The main phrases that show how the technique was used are: “In that year I would use only texts, but in the following year I began to use videos...”, “In that year I would prepare the lectures by using slides and questionnaires, and in the following year I took advantage of such content but added group activities”.

More than one participant would divide their lessons into periods. They explained their classes as follows: “The class
usually starts as a lecture, then a debate is raised, and at the end I suggest some more literature on the subject”; “Firstly I expose the contents, then I assign an exercise for evaluating student's understanding...”

Some participants (2 out of 7 teachers) focused on teaching methods of planning the educational concepts in the application. One participant used free cards to describe aspects of Didactic Engineering (preliminary analysis, a priori, posteriori experimentation and analysis [4]). The system would support the a priori analysis when the teacher would use existing material to generate a new one. The experimentation refers to the use of content by the student, which is followed by a posteriori analysis of learning by the teacher.

In the second scenario, system for classes in DTV, users continued to explain step by step how their classes would be in this context, considering issues such as the reuse of content and media for the preparation of the digital lessons. They said: “Firstly, I would provide the students with a text on the subject, then I would have them answer a questionnaire, then I would show a video...”. And this way they were actually making the lesson for DTV. The same also happened when the participants were asked about how they thought the students would see the class on DTV. Also for this, the participants numbered a sequence of steps: “The student would first see a video, and then they would see a text on the subject...”. Some participants also represented the vision of the student with representative television frames.

**Brainstorming:** Throughout this step, each participant has listened to the others' thoughts regarding the system and have argued about the ideas that emerged. Due to the diversified profile of those involved, different expectations as for the system were detected. Whenever a participant would tell their experience, and their expectation about the system, it was common to hear from other participants: “I have already thought otherwise” or “I think it could be that way”, encouraging them to have a healthy discussion in order to reach a consensus. The applicators of the experience were also mediators during the brainstorming.

It was also noticed that the user experience provided them with more security so that they could discuss reporting their opinions about the system, making their contribution more active compared to meetings happening before the application of the methodology.

In the next paragraphs, the results were grouped into 4 items: (1) Results for the requirements elicitation, (2) Alternative design of interaction, (3) Pre-patterns for the system and, (4) Definition of project interaction.

(1) **Results for the requirements elicitation.** At the end of the experiment, ideas and issues were raised by participants. The technique of space-time representation associated to the experience prototyping have encouraged the participants to think of factors such as reuse and logical organization of content versus time (see Table 1). An amount of 32 valid ideas for the scenario 2 and 12 valid ideas for scenario 3 were raised. These ideas were transformed into requirements, and factors into pre-patterns explained in the following item. The full analysis is described in [8].

![Image](image.png)

**TABLE I. IDEAS AND FACTORS ARISING FROM THE PROTOTYPEING EXPERIENCE**

<table>
<thead>
<tr>
<th>Results</th>
<th>Experience prototyping (associated with the space-time representation, contextual interview and prototypes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title (centered)</td>
<td>Scenario 1 (Classroom lessons)</td>
</tr>
<tr>
<td>valid ideas</td>
<td>-</td>
</tr>
<tr>
<td>Factors</td>
<td>Reuse</td>
</tr>
</tbody>
</table>

(2) **Alternative design of interaction.** An important contribution of this technique was the emergence of alternatives for interaction design suggested by the participants. For instance, the alternative considering a table for the organization of contents. The main screen of the web application would be like a table, and the builder objects of the content would be freely moved, enabling the content to be created on a virtual table, in terms of space and time, like the experience application. In Figure 5-a, the table where the experience was applied is shown, and Figure 5-b shows the alternative proposed (in a paper prototype) by the development team who participated in the experiment. The alternative suggests the User to be able to drag the media in order to build content on the main screen. The Figure 5-c shows the final version of the system. The creativity of the participants involved is originated mainly by the list of alternative solutions to a specific problem. Presenting and exploring multiple prototypes helps to better understand the capabilities of each alternative to meet the needs of users and the requirements of the system under development [2].
(3) Pre-patterns for the system. As a result of the experience and the requirements generated by it, new pre-patterns for the system were found out. The categories in which the pre-patterns were identified are:

A. Accessibility. Refers to the inclusion and extent of use by people with disabilities or limited mobility so that they can participate in activities that include the use of products, services and information;

B. Collaboration. Refers to the action developed jointly by two or more people who understand each other, by sharing values, services or products;

C. Copyright. Refers to names used in reference to the list of rights for authors of their intellectual works that can be literary, artistic or scientific;

D. Security. Refers to protecting the system from possible contingencies;

E. Usability. Refers to how easily the system or component can be operated by the User;

F. Reuse. Refers to using a product or file more than once;

G. Pedagogical. Refers to the educational context addressed in the system.

An example of a collaboration pattern created for the viewing on DTV is shown below:

B2: Collaborative participation of users of DTV content

Synopsis: Students can collaborate on the content by sending questions.

Context: Students may have questions or interesting ideas to contribute to the enrichment of the content. Therefore, when accessing the content on DTV, they can send their questions or suggestions for the system.

Problem: The student (User of DTV) wishes to send their questions and suggestions on the content published.

Solution: Enable the students to participate by sending questions and suggestions.

References: The system will provide users with an option for sending the questions about the content. These questions will be sent to the teacher responsible for the publication of that content.

Some pre-patterns have come from the first study [9] and others have arisen throughout the experiment, as discussed after the experience through brainstorming and raised through the questionnaire. Some were considered in the design of the interface and as non-functional requirements of the system.

After the definition of pre-patterns, it was made an association from which it can be contextualized in the web interface and in the DTV interface of the system.

(4) Definition of Interaction Design. The pre-patterns for DTV have helped to define interface patterns for the system. The accessibility pre-pattern enabled the legend design and the cooperation pre-pattern made it possible to send questions and suggestions from student to teacher.

6. Discussion

The purpose of the application of this methodology was to apply a more effective requirements elicitation and develop the interaction design in innovative systems. In this study, effectiveness refers to how useful the application of associated techniques was while applying the methodology in order to achieve the following objectives which will be discussed below.

Supporting the project stakeholders as for improving their understanding about the interactive possibilities of the system under development. Such objective was developed in the methodology by means of the following decisions: (a) the participants were both users and the system development team. The HCI area has directed its studies in order to increasingly include the user in the software development process. The importance of including also the team who will develop the system is highlighted. The involvement of both components is important for the project, once it not only provides a mutual learning, but also promotes interaction and understanding of both on the use of the system; (b) there was a competitor analysis and a presentation of
results to stakeholders so that they could have an initial knowledge of the future system. This step was important for it provided the participants with an idea about the purpose of the future system and; (c) when moments of user experience were provided for those involved. At the time in which the participants reflect on the system within a context of an user experience, they understand the system better and facilitate their exploration of ideas.

An important point proving that this goal was achieved is the collection of alternatives for the interaction design generated by participants. When users or even the development team do not have enough understanding of the system, they do not even formulate alternatives.

The rich data collection from this experiment would have been insufficient if only techniques such as questionnaire, interview and brainstorming had been applied. Therefore, the application of the experience techniques provided all stakeholders with the opportunity to disclose their ideas and possible alternatives to the system.

Promoting an awareness process among stakeholders of the project regarding the contextual factors that influence the use of the system since the beginning of the interaction design. This objective was addressed in the methodology in the following moments: (a) During the application of the experience prototyping, when those involved were led to think of possible factors that would influence its use; (b) at the moment when these factors are considered for the development of requirements and pre-patterns for the system and; (c) at the time when the pre-patterns are applied in the interaction design of the system. When the participants of the experience were asked whether they had thought of any factor which could influence its use, only 3 of them answered yes and described factors such as reuse, collaboration and copyright. However, when some factors were suggested, the participants who had not thought of those so far would start to think of such factors. All of them (12) gave explanations about the factors, by analyzing them according to the system.

Still during the experience to prepare a lesson, the participants would use the media icons, asking whenever they did not understand any icon. When they had no representation of the media they wanted, they would write it on paper. They would look at the icons for the context of use, but only one participant used them in their experience. After a background alignment and sample of contextual factors that could influence the use of the system, other participants would begin to use them.

The contextual factors that influence the use were considered during the elaboration of requirements and pre-patterns for the system. From the 14 pre-patterns designed, 11 were applied in the interaction design of the system.

The pre-patterns were used for educating users as for the importance of contextual factors for the interaction of the system. The contextual factors have been raised and considered in the definition of requirements and pre-patterns and also considered in the system interface.

Providing better communication between stakeholders enabling a consensus as for the interactive alternatives of the system. At the beginning of the project, there were issues as for the communication and interaction between stakeholders, mainly referring to the vocabulary used. Education professionals would often express themselves by using unfamiliar terms for technology professionals, such as: "preliminary analysis", "a priori analysis", "posteriori analysis", "Fedath sequence", "didactic engineering", "epistemology", among others. The development team would also use technical terms, often not understood by the educational team, such as: "storyboard", "prototyping", "personas" and other technical terms of the domain. The difficulty with communication would generate other interaction difficulties. Professionals from different backgrounds would feel intimidated when trying to consider topics unknown to them during the project meetings. Usually, the meetings did not allow a concrete result due to the number of factors to be considered and the difficulty in expressing them.

In this study, it was observed that the application of the methodology enabled a consensus of ideas between those involved and a clear definition of the system scope. The clearest example of improvement in the communication referred to the moment when participants explained their user experience, ideas and suggestions, which led to the perception that people would work in distinct ways. For instance, in the courses structure, teachers from the educational domain had concepts such as lessons- units-content, whereas teachers from the technological domain had the structure of courses as lessons-files. From these suggestions, alternatives were designed, and with improved communication it was possible to reach a consensus for the final choice. For this factor, a flexible structure for courses was desired, in a more free setting called label. The user would create a label and name it the way they want.

In order to sum up and give a final figure on how effective the result of applying a set of techniques for requirements elicitation and for interaction design, it is worth saying that these three techniques have helped on requirements elicitation and design interaction. The application of the brainstorming technique by itself would not have brought the intended results if an user experience had not been applied afterwards, for instance. The proposed methodology had the objective of organizing these techniques so that the benefit of each technique could be extracted from another one.

As a result of the application of the methodology, documents of requirements were obtained for both modules, definition of 13 pre-patterns and sketches of alternatives of design interaction

7. Conclusion and future works

In this paper, was presented the DIRCE methodology and its application in a case study of development of a system for creating educational content for digital TV from the web, as well as the results of applying the methodology and analysis of results.
The DIRCE approach focuses on the user experience, with a combination of the experience prototyping and space-time representation techniques, which together could provide an experience whose focus was on communication and exploration of ideas from those involved. The user experience, applied together with the techniques experience prototyping and space-time representation, was effective in providing experience of use for those involved. The use of a set of techniques for collecting requirements was important for capturing data from the user experience.

The focus of this work was not to research the users' needs, but the requirements elicitation from experiences of use. When preparing a design project, most designers in our study are based on qualitative methods such as ethnography, focus groups and informal interviews, as well as observations of everyday life. This research mainly focuses on the design and prototyping for interaction design and not on the depth investigation of user which often occurs long before design ideas emerge.

The contributions of this research are divided into methodological and products generated:

1. Methodological: (i) Exploration of the prototyping experience for identifying alternatives of interaction design; (ii) Demonstration of how contextual factors that influence the quality of use of systems can be used for the interaction design and for requirements elicitation; (iii) Step-by-step description of application of techniques of experience through a real example and with significant results; (iv) Presentation of various relations of the results with the techniques applied. These can be useful for providing an analysis of return on investment, for instance: pre-patterns vs. functional and non-functional requirements; pre-patterns vs. interface; factors vs. requirements; factors vs. pre-patterns; ideas considering different points of view vs. system functions; ideas vs. alternatives for interaction design; and

2. Products generated: (i) Pre-patterns; (ii) Methodology; (iii) Generic Framework.

This work is concluded with the following question: How is it possible to achieve more efficient requirements? A possible response resulting from the application of this methodology would be: all stakeholders should participate, be reflective, creative and involved with experiences of use, through good communication.

As future work, more contextual factors that influence the use shall be analyzed, by continuing working with all potential stakeholders of the project (users and development team) and apply again the pre-patterns defined in other projects related to the creation of content for DTV.

In this work, the application of the technique experience prototyping was carried out individually, and data collection (brainstorming) occurred in a collective way, so that one participant would not influence the other participants throughout the process of experience of use, but still allowing them to interact and discuss during the process of experience of use, in which each participant would tell their experience to others. However, [6], in his work Prototyping Social Action, argues that the prototype is composed of human action rather than the technology that supports it. He believes it is important to understand how people interact with others while using a prototype, and how these interactions affect the manner in which individuals use the prototype.

Based on this context, it is intended to apply the DIRCE approach once more for studying factors of social interaction and on how they influence the quality of use. Indeed, television is a social technology and, therefore, it could be interesting to analyze the interaction of people together.

8. References