Participatory Design of Interactive computer-based Learning Systems

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Introduction

We present an iterative evaluation methodology (as part of a participatory design methodology) employed in an online course for learning Modern Greek.

Unlike other educational technology evaluation methodologies that focus primarily on questionnaires that administer summative and formative evaluation methods (Kandaswamy, 1990; Scriven, 1980) we propose a hybrid evaluation that is unique in the following ways:

a) It becomes an integral part of all stages of our design methodology, so every stage of the development is based on user feedback and evaluation.

b) In addition to evaluation questionnaires, we also collected feedback from our users, through our interaction with the students during our collaborative design and development of the course. The students contributed lecture notes, quizzes and student diaries that enabled us to evaluate the pedagogical value of our course, ensuring continuous feedback from the students regarding the usability and adequacy of the course.

The purpose of our hybrid formative evaluation is the iterative improvement of the online course, through the methodology of Participatory Design (DP) (Ellis, Jankowski & Jasper, 1998).

The Learn Greek Online course (with currently over 20,000 registered students) includes 105 audio lessons, the transcribed text of the audio files, corresponding grammar and dictionary notes for each lesson, a Greek-English-Greek dictionary, and a spellchecker. In addition, the course provides an online discussion forum where students post questions for the administrators, or discuss the classes and learning techniques with other students.

The Learn Greek Online management team's focus from the beginning has been to design an online learning community to increase our users' motivation, commitment and satisfaction with the online course. The Participatory Design (PD) methodology blends nicely with our goal, by involving users during the course development to achieve greater user commitment, acceptance, usage, and satisfaction with the course.

Learn Greek Online

The Greek Lessons course was developed and hosted by Kypros-Net, Inc. a non-profit organization that provides information on-line about the island of Cyprus, including news, history, culture, etc. The course includes 105 audio lessons with corresponding notes, a Greek-English-Greek dictionary, and a spellchecker. In addition, a section of the site's discussion board is dedicated to student questions about the course.

The Greek on-line course content evolved gradually over four years. Based initially on 105 (around 20 minutes each) digitized lessons it gradually developed into a

complete Greek Language course. The site was designed to encourage student

participation in its subsequent development (Participatory Design).

Participatory design

Participatory design (PD) (often termed the "Scandinavian Challenge" (Bjerknes,

Gro, Pelle & Morten, 1987) refers to a design approach that focuses on the intended user

of the service or product, and advocates the active involvement of users throughout the

design process. User involvement is seen as critical both because users are the experts in

the work practices supported by these technologies and because users ultimately will be

the ones creating new practices in response to new technologies (Blomberg & Henderson,

1990).

Blomberg and Henderson (1990) characterize the PD approach as advocating

three tenets:

1. The goal is to improve the quality of life.

2. The orientation is collaborative.

3. The process is iterative.

4. Design Approach

Our development model has been implemented in collaborative participatory

design teams (composed of designers from the Kypros-Net team and users/learners of our

course as design partners) which not only enhanced the course content but also played a

role in designing and implementing the course evaluation.

Our focus has been to design an online learning community. We believed that

this online interaction and community would increase our users' motivation, commitment

and satisfaction with the online course. The Participatory Design (PD) methodology

blends nicely with our goal. In particular, involving users during system development is thought to lead to greater user commitment, acceptance, usage, and satisfaction with the system (Baroudi, Olson & Ives, 1986).

In the design phase of the on-line Greek language course, we implemented PD as a four-step process (Blomberg & Henderson, 1990; Ellis, Jankowski & Jasper, 1998; Zaphiris & Zacharia, 2001), each corresponding to one of the four levels of the classical spiral software engineering development (Boehm, 1998) model (Figure 1).
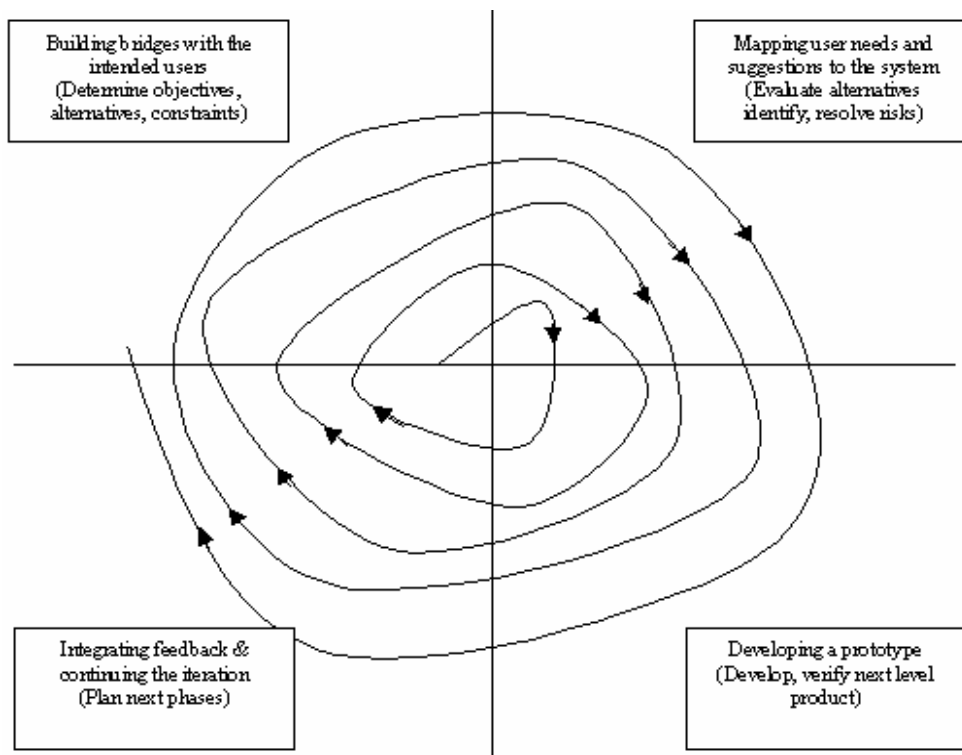

Figure 1. The participatory design methodology employed in this project. In parenthesis the corresponding levels of the classical spiral design methodology

1. Building bridges with the intended users.

This step opened lines of communication between intended users and the development team. Specifically this step involved the initialization of a multidisciplinary development team, identifying key groups of end users, and creating new methods of

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communication with users. As we explained above, the development team came out of the Kypros-Net Inc. (2004) group. Through their involvement in Cyprus and Greece related projects, they had longstanding relations with the intended user community.

The intended users have been especially people of the Greek Diaspora, travelers to Cyprus and Greece and other Greek speaking areas and people who are generally interested in the Greek culture and language or languages in general. In our case, bridges with the intended users were built through our years of work at providing information about Cyprus through the web pages of Kypros-Net, Inc. who primarily attracts the same user population as our intended Greek language online course.

2. Mapping user needs and suggestions to the system.

Our conceptual design model has been "to design an online effective Greek language course that can build and sustain an online learning community of students". Based on the questions and inquiries we received from our users we tried to match their needs (they wanted an easy to follow, both elementary and advanced course that they could attend at their own paste) with our conceptual design model.

3 Developing a prototype.

The project consists of 105 audio files, which were originally recorded as Radio lessons in Modern Greek for English speakers back in 1960's. The lessons were retrieved from the tape archives of the Cyprus Broadcasting Corporation, digitized in Real Audio format and published on-line. Although, an optional textbook accompanied the original Radio lessons, the lessons were designed as a complete standalone course. We used several tools to assist the students of the lessons, including an online English-Greek-

English dictionary, a Greek spell checker and a web-based discussion board for the students of the lessons.

4 Integrating feedback and continuing the iteration.

Feedback from our users and suggestions are continuously incorporated into our design through a series of additions and corrections. At some point, the users started exchanging through email written notes taken by the advanced users. This phenomenon suggested that we should provide the users with the capability to post their notes on the project's site. Users have also compiled lists of verbs and vocabulary words used in the Audio Lessons, and other grammatical notes. Recently users have been involved in groups that design and post quizzes for their classmates. Furthermore, a user has developed (and made it available online for free) a palm-pilot version of the dictionary.

Some students chose to announce these activities on their discussion board, while others chose to notify the development team and seek their technical assistance. Based on student demand, the course was augmented both technically and organizationally to support these activities. Therefore, the students were provided with shared file upload functionality, and they organized an ad hoc peer review committee for the quality of the posted transcription and grammar notes, or more recently the quizzes.

Iterative User-Centered Evaluation

The iterative evaluation of the course has been an integral part of our Participatory Design implementation. Our evaluation methodology was structured in two main phases spread in all instances of our design methodology.

In the first phase a questionnaire was provided for collecting feedback about the general usability of the course; an elaborate analysis of server logs was performed; a

discussion board was created where users could post their questions and comments; and an email address was provided through which users could contact the design team. These tools enabled us to collect and incorporate user feedback into our second cycle of development. Also at this evaluation phase we conducted a series of formal usability test to evaluate the effectiveness and ease of use of our interface.

In the second phase, we continued monitoring and analyzing our server logs and our students' interaction in the discussion board but also performed a summative and formative evaluation using two more questionnaires. An initial questionnaire at the beginning of the course collected both demographic data and information about our users' expectations from the course. Students were also asked to fill a questionnaire after completing 20 lessons of the course (asking questions related to the usefulness and usability of the course).

Discussion

The results of the questionnaire provided valuable suggestions to the design team of the online Modern Greek course.

The course ranks high in terms usability with the majority of the respondents rating all nineteen questions high. When combining all responses to all questions together we get an average overall rating for usability of the course of 1.53 (S.D.= 1.23) with the majority of responses (57.6% of 2974 valid data points) being the highest score of two. Only 11.9% (7.7% gave scores of –2 and 4.2% gave scores of –1) of responses were below zero (rating scale was from -2 to +2 with +2 being the best).

Although the course ranks high in terms of usability the analysis does signal a need for improvement of the course. When looking at the individual questions rankings

one can see that question 9 (The online course gives error messages that clearly tell me how to fix problems), question 10 (Whenever I make a mistake using the online course, I recover easily and quickly), question 11 (The information (such as help, on screen messages and other documentation) provided with this online course is clear) are all related to help and error messages and are all ranked low (below 1.0) when compared to the other ranking questions.

This suggests that users need better feedback from the interface, and that there has to be a better source of suggestions for solutions to errors they encountered. Relating this further to the content of the course, it can be concluded that when users for example get error messages from the real audio player (such as network congestion) they are left wondering what this implies and how and if they could correct it.

Another interesting result is the comparatively low ratings for question 12 (It is easy to find the information I needed). This might suggest a more careful re-design of the information architecture of the course with clearer indications where users can find the different material.

On the other hand users give the highest rankings to question 1 (Overall, I am satisfied with how easy it is to use this online course), question 2 (It was simple to use this online course) and question 19 (Overall, I am satisfied with this online course) showing a high overall satisfaction of users with the online course and its ease of use.

Feedback was also solicited in the form of asking the users to list the most positive and most negative aspects of the course. Looking at those results, it can be seen that students consider the course easy to learn and fun. On the other hand they point out technical problems (especially with the audio streaming) and pedagogical issues (no

instructor, no tests) as the most negative aspects of the online course. The design team of the online course can use this as a valuable source of suggestions for future re-designs. For example, better ways of streaming the audio should be investigated; possibilities of including academics involved in teaching Modern Greek in the online community should be explored

Besides the insights derived from the user questionnaire, we were able to identify additional usability issues from the postings of the users on the discussion board of the course. The users also had additional usability problems, like the lack of technical related instructions. The design team responded by adding links to external resources or actual instructions in the appropriate sections of the course.

Furthermore valuable usability conclusions (what sections are most popular, what software our users are using) can be drawn through the analysis of the server log.

However, the survey evaluation is inadequate in capturing all the deficiencies of an online course. Since the survey questions are designed by the developers of the course, they are limited to the evaluation of the existing aspects of the course, and or other features that the developers can think of themselves. The students themselves know better than the developers of the course what their needs are, and need to be involved in posing the evaluation questions and future development of the course. Therefore, the Participatory Design methodology is not only useful in the design and deployment of the course; it is also useful during the evaluation phase as well, especially for iterative development cycles. The students' contribution can be active, by soliciting their feedback on what the evaluators should ask, or passive by watching their public discussions, and usage of the system and pay attention to their expressed needs. For this

project we implemented both methods, and discovered that there were many student needs and aspects of the course that needed improvement, that we had not anticipated.

Our evaluation methodology has been from the beginning designed to be in two stages. The results presented in this paper, are the results of the first stage of our user-centered evaluation. Our first stage (as can be seen on this paper) was focused primarily on content related evaluation. We focused on receiving feedback that will give us enough information to know whether our content is sufficient and of high quality. In our second user-centered evaluation stage (currently in progress) we are primarily focusing, apart from further usability evaluation, on the pedagogical strength of our course. More specifically, users have volunteered and are currently involved in groups that develop quizzes for each lesson of the course. We strongly believe that the results of those quizzes will give us enough information to judge whether our course is pedagogically successful. Furthermore our team is currently involved in qualitatively analyzing further the interaction among students of this course, this will be done by using Social Network Analysis to further analyze the online community of our discussion board.

Those who wish to study traditional courses have accurate information about their audience from class listings, interviews and surveys. Creators of on-line courses have digital counterparts to these measures. In this paper, we attempted to outline some methods we used to construct a richer conception of the audience of the "Learn Greek Online" course.

The students of the Audio courses included people with no knowledge of Greek language, bilingual members of the Greek Diaspora, as well as high-school professors of foreign languages. These students created an open online community whose collaboration

has boosted the learning experience of the whole community. The web-based discussion board has proven to be the most constructive tool for the students learning experience and the main source of feedback for the maintainers of the project. The experiences shared on the discussion board include tricks and tips on how to record the audio files, installation of Greek fonts, learning methodologies and questions about the Greek language itself that arise from the lessons. They also used it to announce the availability of their personal notes.

The advanced users (some of them retired teachers of foreign languages) have taken a lead role in the vast majority of the threads on the discussion board, answering most of the questions and encouraging the beginners to study the lessons further. They have also become the communication interface between the maintainers of the project and the community's requests. The advanced users maintain the online notes pages and make sure to report to the authors any technical problems or questions coming from the other users.

As we can see from Figure 2, the accesses the audio lessons, the language tools, and the total access of the message board and the notes pages, all kept increasing exponentially. However, once we allowed our users to publish their own notes, there was a dramatic shift of traffic from the message board to the notes pages. The shift happened, probably because it was no longer necessary to visit the message board to find out where other users had posted their notes, since all were aggregated in a central location.
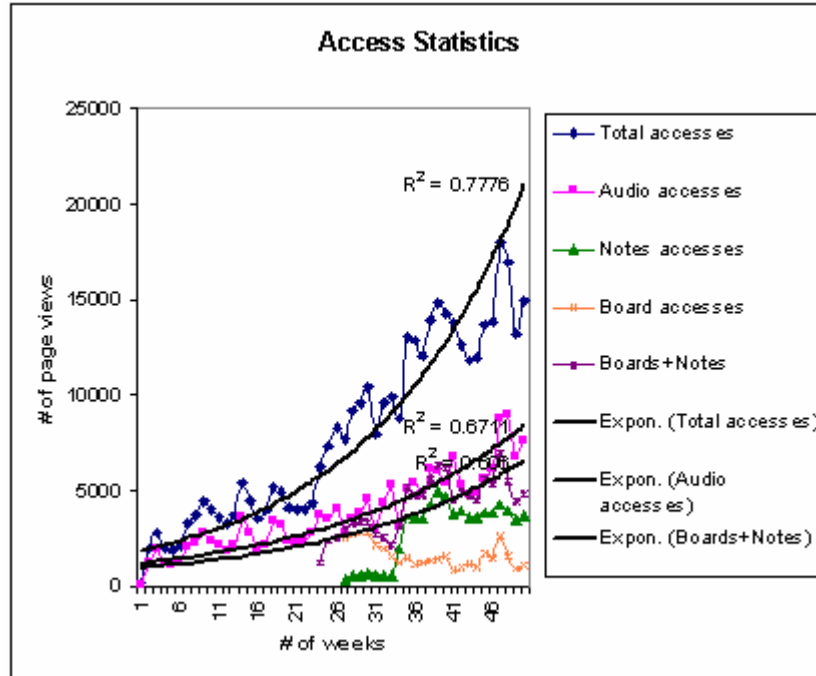
Figure 2: Access Statistics for Greek-Online site.

Conclusions

Design cannot be done independent of the social system in which it will be implemented. Software that will be embedded in a social process should be designed as part of that social process (Chin, Diehl & Norman, 1998). Participatory design implementation for the online Modern Greek language course has achieved our initial goal of developing an online community of students and has increased user's satisfaction and commitment.

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Terms and Definitions

Participatory Design: a design approach that focuses on the intended user of the service or product, and advocates the active involvement of users throughout the design process

Summative Evaluation: Evaluation that is usually performed at the end of the design process. Summative evaluation indicates that the evaluation outcomes are used to describe and portray any given object of the evaluation with no intent to use the evaluation results for improvement and change.

Formative Evaluation: Evaluation performed throughout the design process conducted for the purpose of improving and changing whatever is evaluated.

Prototype: A concrete envisionment of a design.

Usability Evaluation: Evaluation focusing on effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments.

User-Centered Evaluation: An evaluation carried out with users in mind.

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