

Co-authoring Proto-patterns to Support on Designing Systems to Be Adequate for Users' Diversity

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Abstract: This paper describes about co-authoring proto-patterns, i.e., patterns candidate, with successful solutions for recurrent problems on generating adequate system that allows users, as co-authors, create, format and make available the content of system according to users' profile, language, needs, etc. A case study, considering educational environment, was done in order to collect evidences about the use of these proto-patterns and, it was observed that these proto-patterns express the essence of solutions to support on designing systems to allow co-authoring.

1 INTRODUCTION

Designing computer system that allows being adequate has been a strategy to support its use by diversity of users with different profile, necessities, etc. (Dorça et al., 2013; Fischer, 2011; Villena et al., 2010; Ferreira et al., 2009; Silva et al., 2009). System which can be adequate enables users feel in control, identify themselves and, consequently, feel satisfied with it, because its design can be related to their characteristics and needs. That's why this strategy has been used in many areas, as business, health, entertainment, education, among others (Marathe et al., 2011).

On the other hand, designing a system that allows being adequate is a challenged task because users need to realize this possibility and know how to change the system easily. In this context, there is the necessity on formalizing of knowledge, methods, frameworks, i.e., strategies to support on design of this kind of system (Marathe et al., 2011; Neris et al., 2011).

Specially, in this paper, we discuss about adequate system at educational area because of our experience and the necessity to create system to be adequate to different pedagogical purposes, students' needs and characteristics. Piaget (1998) describes the importance to adequate educational materials considering student's difficulties, culture, knowledge, reality, vocabulary, etc., because when students identify the relationship between what they

are learning and their reality, they feel more interested and engaged.

In this context, our research question is how to support on designing adequate educational system?

Our proposal and hypothesis is that formalized knowledge through design proto-patterns supports on designing adequate system at educational area. In our context, the knowledge represents the learning and experience of researches during 10 years on designing co-authoring educational system.

For better understanding of the proposal, firstly explanation about co-authoring system is presented; secondly design patterns and a brief description about how co-authoring proto-patterns have been formalized are explained; thirdly case study to observe designers using proto-patterns are described and; fourthly there are final considerations.

2 CO-AUTHORING EDUCATIONAL SYSTEM

Co-authoring at educational environment means allows user on creating, formatting and making available content of the system according to different pedagogical purposes, students' needs and characteristics (Ferreira et al., 2009; Silva et al., 2009). For example, Figure 1 illustrates an example of educational system that allows co-authoring. This system is a quiz game that shows up until ten clues and, by seeing these clues, students have to guess a

secret word.

There are two roles in co-authoring system design. 1) Author who represents one or more professionals and users responsible for system design. For example, in this quiz game, author defined colors, location to display clues, secret word, etc.; 2) Co-author who represents users to contextualize content. In this quiz game, defining clues and secret word.

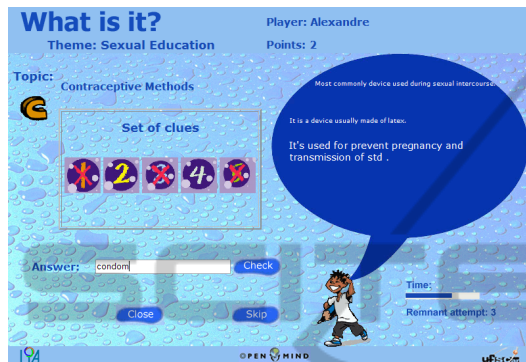


Figure 1: Quiz Game (Ferreira et al., 2009).

Co-authoring has been a useful strategy to support co-authors, e.g., educators, on using of the same system for different reasons, because the purpose of system or game, like that quiz game, can be interesting in many situations or classes, but if its content was pre-defined, probably it could be used just for it was planned before. On the other hand, with co-authoring possibility it can be used in many moments and classes like biology, sexual education, among others, because co-authors can define clues and secret word considering student's vocabulary and what they are learning at classroom (Ferreira et al., 2009; Silva et al., 2009).

Considering co-authoring system design, there are strategies such as class diagram from Unified Modeling Language (UML) (Lorenz et al., 2006), ontology (Sieg et al., 2007) and ConcurTaskTrees (Libório et al., 2005) can support on identification of input and output data system, e.g., clues and secret words are input data. Otherwise, strategies like those are not related to co-authoring process, i.e., what and how display on interface to help co-authors identify co-authoring possibility and insert the content of system.

In this context, our proposal was to formalize proto-patterns considering ten years of researching, observation and experiments on co-authoring design. Six co-authoring educational systems were designed with different professionals like designers, educators, students, psychologists, therapists, etc.

One of them is illustrated on Figure 1. Case studies were also done in order to observe the use of them at classroom (Villena et al., 2010; Carvalho et al., 2009; Ferreira et al., 2009; Silva et al., 2009).

3 CO-AUTHORING PROTO-PATTERNS

According to Borches (2001) patterns contain the essence of successful solutions to recurring design problem in a certain context. In Human-Computer Interaction (HCI) area, patterns have been used as a useful way to formalize and register knowledge and experience about design. There are patterns describing solutions for problems that occur on many context of design, such as web like Montero et al., (2012); web and mobile device as Welie (2012); Computer Supported Cooperative Work (CSCW) as Clear et al., (2005); ubiquitous computing as Chung et al., (2004); games as Bjork et al., (2003); digital home as Saponas et al., (2006); among others, including more general ones to support on design system as Tidwell (1999).

Investigating these patterns, it is possible to notice that they are not describe the whole problems and solutions observed at six co-authoring system. Because of that, we are formalizing patterns considering these problems and solutions. Our patterns are called proto-patterns because they are still prototype. It is necessary some experiments and validations to confirm they are patterns (Meszaros et al., 1996). Figure 2 illustrates how co-authoring proto-patterns are been formalized.



Figure 2: Steps to formalize co-authoring proto-patterns.

There are four steps: 1) Investigating related works to find strategies and patterns could support on formalization of patterns and co-authoring design; 2) Observing interfaces from six co-authoring system. Technique bottom-up (Saponas et al., 2006; Chung et al., 2004) has been used in order to collect solutions from the interfaces of co-authoring system. To register and organize the

solutions, it was adopted the strategy, through tables, described by Finlay (2012). Each table is related to one problem and each line of it contains an interface of co-authoring system that represents the solution. These interfaces are investigated and the pattern solution is written considering the common solution in all interfaces;

3) Writing each pattern considering the solutions. The co-authoring patterns are been written according patterns that explain how to formalize patterns, describing also required information to express the knowledge and experience, such as name of patterns, problem, context, solution and examples, as illustrated in Figure 3 (Meszaros et al., 1996);

4) Validating the patterns. Currently, these steps were done three times. Because of that, there were three validations: First with designers who did not know co-authoring and, they read the patterns and expressed, through questionnaire, what they understood; Second with expert co-authoring designers, they compared the solutions described on patterns with co-authoring systems that they developed and; Third with designers who did not know about co-authoring and, they needed to design prototypes of co-authoring educational system. This third validation is described in next section.

In this formalization process, seven proto-patterns have been formalized. One of them is described in details below and the others just name and part of solution is described, but there are complete patterns on link [http://lia.dc.ufscar.br/Co-authoring proto-patterns.rar](http://lia.dc.ufscar.br/Co-authoring%20proto-patterns.rar).

<p>Name: Co-authoring option Context: Co-author needs to identify the possibility of inserting information to create the content of system. Problem: How can co-author know of co-authoring option in the beginning of interaction? Force: Co-author does not create the content if s/he could not identify this possibility. Solutions: Displaying co-authoring option in the beginning of interaction. Showing this option using a infinitive verb which express action of creating. Describing the <u>Goal</u> of system on the same interface where there is the option. Reasoning: *Main reason that co-author does not use co-authoring is when s/he does not realize the option. Examples:</p> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px 10px; background-color: #4a86e8; color: white;">Create a game</div> <div style="border: 1px solid black; padding: 2px 10px;">Create</div> </div>

Figure 3: Co-authoring option pattern.

Name: Goal – **Solution:** Displaying the goal of system in one sentence and, defining what Information the co-author needs to insert to create the content of system, considering the goal.

Name: Information – **Solution:** Defining what information will be inserted by co-author; Allowing the insertion of each part of information through Steps.

Name: Steps – **Solution:** Creating one step for each part of information; Displaying Characteristics of steps to support inserting information by co-author.

Name: Characteristics of steps – **Solution:** Displaying What needs to be done on each step. Showing to co-author which step s/he is seeing and, total number of steps.

Name: What needs to be done – **Solution:** Using words to express what co-authors need to do; Showing simple words; Allowing the Reuse of information to be also example about how to insert each information.

Name: Reuse of information – **Solution:** Showing the possibility to use information stored on system, inserted by any co-author.

4 CASE STUDY

In order to observe the use of co-authoring proto-patterns, there had been a case study with 22 undergraduates, from last year of computer science and computer engineering, who attended an optional discipline at university about Human-Computer Interaction (HCI) concepts to design computer systems. Firstly, students filled a pre-questionnaire considering their experience, knowledge and experience about Software Engineering (SE) and HCI. Then, these students were divided in 5 groups – 2 with 5 students and 3 with 4 students.

There were, in each group, one students with 18 months of SE courses and already developed system but did not know HCI concepts; another with 12 months of SE courses but no practical experience neither knowledge about HCI; one student (or two in groups of five) with 12 months of SE courses and 6 months of HCI courses with practical experience in both SE and HCI; one with six months of SE courses and no practical experience neither knowledge about HCI. These 5 groups designed interfaces of an education system considering a scenario that researchers, who have experience on co-authoring, wrote while they were developing a system, i.e., there were all necessary information to plan and draw co-authoring interfaces.

Three steps of the case study are described below. Each step occurred in one day of the discipline during 2 hours. After these steps, each group evaluated the prototype of others considering pattern-based usability inspection method, that supports to analyze if patterns were applied at interfaces (Schmettow et al., 2007). Inspections were done as the last step considering the results from each step. On the other hand, inspection results are shown after each step, in this paper, in order to facilitate the analyse of them.

After each step, there was a post-questionnaire to collect information about difficulties and facilities to design interfaces prototypes, as well as their comments about the use of different strategies, as co-authoring proto-patterns, to design systems. The questionnaire was based on Likert scale, developed to subjectively evaluate user satisfaction through answers as "Very Interesting", "Interesting", "Indifferent", "Uninteresting", "Very Uninteresting" "I cannot opine" (Preece et al., 2002).

First step – Students did interfaces of prototype considering their previous knowledge, i.e., without learn about co-authoring. Considering pre-questionnaire, there were in each group participants who known Requirements Elicitation, Unified Modeling Language (UML), ISO Standards, Agile Methods, Tests, as well as Usability and Accessibility concepts, Heurist Evaluation, User Tests, Brainstorming, Mental Model, among others. Goal of this step – to observe if the groups could reach co-authoring proto-patterns solutions using other strategies. The results of this step are shown at Table 1. It is import to mention that one group missed class in two steps, and then the results of first and second steps represent 4 groups' opinions.

Table 1: Pattern-based usability inspection results.

Proto-patterns thought	Are there all solutions from proto-patterns?
Group A None	No
Group B Reuse	No, it is not possible to see all content of system
Group C Steps	No, there is information that co-author cannot change/insert/delete and; there are a lot of information to insert in each step
Group D Steps	No, there is a lot of information to insert in each step

Second step – Students could change or do new interfaces of prototypes considering Welie's patterns (Welie, 2012). These patterns were chosen because their support on web design and the scenario describes a web educational system, as well as it was observed some patterns that could support co-authoring, as Home Link, Action Button, Form and Booking. Goal of this step – to observe if the groups could reach co-authoring proto-patterns solutions using Welie's patterns and, if students could identify patterns to support on co-authoring design. The results of this step are shown at Table 2 with some students' comments.

Table 2: Post-questionnaire results of second step.

Questions	Students' answers
Easy to understand the patterns	10 Strongly Agree; 8 Agree
There are difficult patterns to understand. Comments	14 Strongly Disagree; 4 Agree. "There are a lot of similar patterns. Sometimes, it is not clear the difference among them, e.g. there are a lot of patterns related to search.
Facility / benefits of using patterns	18 students wrote answers like "Help on thinking process, as well as on choosing and designing of elements interface"; "Increase insights at discussions of group", etc.
Difficulty / disadvantages of using patterns	10 students wrote answers expressing that "It is difficult to choose appropriated patterns".

There is not a table related to pattern-based usability inspection because the data on Table 2 did not change in this step. Welie's patterns supported many improvements on interfaces, such as Search Field, Home Link, among other features that students did not think before. On the other hand, these specific changes do not represent co-authoring proto-patterns solutions.

Third step – Students could change or do new interfaces of prototypes considering Co-authoring proto-patterns. Goal of this step – to observe if the groups could apply co-authoring proto-patterns solutions using the proto-patterns. The results of this step are shown at Table 3 and Table 4.

Table 3: Post-questionnaire results of second step.

Questions	Students' answers
Easy to understand the patterns	15 Strongly Agree; 7 Agree
There are difficult patterns to understand	20 Strongly Disagree; 2 Disagree "I took a feel minutes to observe the difference between Steps and Characteristics of Steps patterns, but it is not difficult."
Facility / benefits of using patterns	22 students wrote answers like "Help on insights"; "From the knowledge of the patterns was easier to create the prototype".
Difficulty / disadvantages of using patterns	None

Table 4: Pattern-based usability inspection results.

	Proto-patterns applied	Are there all solutions from proto-patterns?
Group A	Almost all, excepted Goal and Reuse of Information	No, students considered all solutions from 5 patterns, but they did not take into consideration "Goal" and "Reuse of Information" patterns.
Group B	Almost all, excepted Goal	No, students considered all solutions from 5 patterns, but they did not take into consideration one part of solution from "What needs to be done", because there are instructions using technical language. They did not apply "Goal" pattern.
Group C	All	No, students considered all solutions from 6 patterns, but they did not take into consideration one part of solution from "Characteristics of steps", because it is not possible to change the information 'name of the game' created, the name is defined automatically.
Group D	All	Yes, students considered all solutions from 7 patterns
Group E	All	Yes, students considered all solutions from 7 patterns

5 FINAL CONSIDERATIONS

This paper describes co-authoring proto-patterns to support on designing computer educational system that allows co-authors adequate it considering pedagogical goals and the diversity of students with different profiles, necessities, etc. Through case study was possible to collect some evidences:

First step, the groups could not reach co-authoring proto-patterns solutions using other strategies. Three groups designed interfaces that represent a problem described at a proto-pattern but their solutions did not represent the proto-pattern solution, e.g., two groups divided the process to insert the content of system into steps, but they considered co-authors' tasks to define steps; however the pattern Steps describes to consider each part of information. It helps co-authors know what they have to do on each interface; they can also see appropriated instructions and examples to be reused.

Second step, the groups could not reach co-authoring proto-patterns solutions using Welie's

patterns and, they could not identify patterns to support on co-authoring design easily. The groups were encouraged to write on interfaces the Welie's patterns applied, and two groups wrote 3 patterns from 6 identified by one co-authoring expert as appropriated for co-authoring process. Others patterns, that the groups wrote, supported to improve the interface, e.g., inserting search field, etc., but the groups expressed difficulties to indentify appropriate patterns to apply on interfaces, because there are a lot of them. In this context, we see advantages to cite others designers patterns in co-authoring patterns. This strategy can help on indentifying appropriated patterns easily, as well as while designers use co-authoring patterns, they will be presented to others that can also help them. It is important to highlight that Wizard pattern from Welie describes the same problem than Steps co-authoring proto-pattern. On the other hand, the solutions are different. In the Wizard, the steps are related to parts of task and, in the Steps, the steps are related to parts of information.

Third step, the groups could apply co-authoring solutions using the proto-patterns. Considering the pattern-based inspection, it was possible to observe which solution was or was not applied. The most of proto-patterns solutions were applied but some of them have not been considered on design. For example, Goal pattern was not considered by two groups and Reuse of information by one, as well as the groups B and C did not apply all the solution described in one pattern. Then, these patterns will be revised to be more understandable. On the other hand, the groups knew how to use these solutions at pattern-based usability inspection. For example, group A and B did not apply "Goal" pattern, but at inspection the group B identified that group A had not applied "Goal" pattern and, then B suggested some solutions considering the solution from this pattern. This happening was evidence that the essence of solution is described, but it can be clearer.

As future works, we will explain each proto-pattern for students and they will be encouraged to change or create new interfaces in order to observe if the proto-patterns express the whole information explained by one experienced co-authoring designer. Educators will be invited to evaluate the prototypes. Design patterns will be cited in co-authoring patterns and, other case studies will be done.

These proto-patterns came from educational area but we will investigate if they can be used on designing of systems in different areas like business in order to allow users identify the co-authoring possibility and do that easily.

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