Co-creation in the Localization of Interactive Systems Designed for Communicating Science to the Public: An Experience Report

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Abstract. This study describes the design iteration in the localization process of Nasa's Eyes on the Earth which was aligned with co-creation. The paper provides insights from an experience report on project-based learning (PBL) conducted in the context of a collegiate course for Human-Computer Interaction (HCI). We will highlight how co-creation and collaborative work on an existing real-world project was aligned with increased levels of students' engagement and markedly improved interaction design in prototypes. The implications of the co-creation and design shift for the education of designers and researchers in HCI will be discussed.

Keywords: Co-creation · Human-computer interaction · Project-based learning

1 Introduction

Recent advances in design research have led to a paradigm shift from a user-centered approach to co-designing with target user populations. These shifts have changed the roles of the designer(s), the researcher(s), and the users in co-creation contexts. The importance of co-creation is to connect with, work with, and enable individuals to generate thoughts and to make ideas cooperatively [1]. In co-creation contexts, designers have been moving progressively closer to the target user populations by engaging with them early in the design process. This is particularly evident in systems design for a diverse group of users such as web platforms designed for communicating science to the public. As a consequence of these changes in the design practice and in the changes in the meaning and value of systems designed for scientific communication for the public, we present an experience report on design methods for the localization of NASA's Eyes on Earth for Arabic-speaking populations.

The paper provides insights from an experience report on project-based learning (PBL) conducted in the context of a collegiate course for Human-Computer Interaction (HCI) at the College of Computer and Information Sciences (CCIS) in Al-Imam Muhammad Ibn Saud Islamic University (IMSIU). The objectives of the HCI course are to apply HCI principles to practical problems and to develop an understanding of universal design in technical systems. PBL models have been applied in HCI education contexts [2] to improve the students' engagement by increasing the degree of interest in learning HCI principles. The key contributions in this particular experience report are design methods for introducing students to iterative prototyping in an ongoing real-world project in collaboration with researchers in an R&D center [3]. The students were undergraduate students who enrolled in an HCI course. They were divided into groups to complete the HCI project in collaboration with researchers at the Center of Excellence for Earth and Space Science at King Abdulaziz City for Science and Technology (KACST), which aims to create a localized prototype of NASA's Eyes on the Earth. Each student contributed to the success of the HCI project as they complete their tasks.

Due to the lack of sources that emphasize the importance of co-creation and collaboration between the designers and the users in the education field, this study empirically explores and highlights how co-creation and collaborative work on an existing real-world project was aligned with increased levels of students' engagement and markedly improved interaction design in prototypes.

The remainder of this paper is structured as follows. In Sect. 2, we describe the design process and how the co-creation is applied in HCI. Section 3 gives a general description of the methodology. In Sect. 4, we discuss the findings of the study based on the information gathered as a result of the methodology. We conclude in Sect. 5 with a summary of insights.

2   Co-creation in the Design Process

Co-creation is an interaction between two or more entities (i.e. designers, students, users, communities) to jointly integrate their respective resources to produce a mutually valued outcome. As co-creation is originally a concept from business literature, most literature describes the interaction between the organizations and the user. However, in the education context, the interaction could be between the researcher and the student [4, 5].

Through co-creation, the involvement of students, lecturers, and researchers into the design process is a powerful means to guarantee the fulfillment of requirements towards functionality, usability, and other factors. Moreover, students' differing knowledge can jointly interact with the researchers to further create more integrated and preferred outcomes [5].

In this particular case, co-creation has been applied in the design process of the localization of NASA's Eyes on Earth for Arabic-speaking populations. A cohort of students enrolled in an HCI course was tasked with prototyping the mobile and web versions of the platform in collaboration with an R&D center leading the localization effort in the region. Students focused on the need to adapt the designs more and more to the human 'end-user' (e.g. the consumer, student, or teacher) and to the specific context

of use or ecology of the localized version of the platform. The student, who has played the role of the designer, has been moving closer to the researcher, who has played the role of the user, throughout the design process. Within this paper, the effects of co-creation approach will be analyzed through the use of survey and focus group methods.

3   Methodology

The HCI course is an elective level course at the Department of Computer Science at IMSIU. It is provided to the students in their senior year after they have several programming and systems design and development courses. The objectives of the HCI course are to apply HCI principles to practical problems and to develop an understanding of universal design in technical systems. The course lectures concentrate on design and theory. Lectures are synchronized with the students' implementation of a real-world project to enhance the classroom learning experience in an introductory HCI course.

A semester-long project was given to the students in the HCI course. The IMSIU lecturers taught the course in two consecutive semesters. Group A and Group B represent the first and the second semesters respectively. In both semesters, the project was a team-based project, each team consisted of 3–4 students. The students applied classroom knowledge in analysis, design, implementation and evaluation on their own projects. Students were required to design and conduct a research investigation about the topic of the project. Project phases were released in four phases, each phase built on the other after receiving feedback from lecturers. The difference between group A and B will be explained below.

Group A worked on the localization of NASA's Eyes on Earth, which is "an interactive computer application that displays the current and future locations of NASA's Earth-observing fleet of satellites and visualizes the data they collect from the Earth in near real-time or from data archives. Thus, it allows users to monitor Earth's vital signs, for example, global surface temperature, sea level, and carbon dioxide concentration. It also allows exploration of the latest Earth events such as sandstorms, wildfires, and hurricanes through geo-located satellite images" [6]. Students were required to develop a localized prototype of NASA's Eyes on the Earth web application or the mobile version 'Earth now'. Moreover, each student had the option of choosing their tools to develop the prototype. The project was as a collaboration between IMSIU and KACST. During the early stages of the project, a workshop was conducted by the researchers at KACST to showcase the wireframes and mockups of the platform, and to help the students in the requirements elicitation process. Moreover, a prize was offered to the winning teams at the end of the course.

On the other hand, group B worked on the Localization of an English website. The project was a typical undergraduate semester-long project. The students were required to develop an Arabic UIs for an English website. Unlike group A, group B project was not in collaboration with an independent entity. Additionally, no monetarily prizes were promised. However, the lecturers explained the project and encouraged the students to do their best, and the project carried the same grade weight as in the previous semester and the same four-phases design process.

3.1 Survey Approach

A survey was distributed at the end of the semester with the intent to solicit students' feelings and attitude towards the course's project. Surveys were distributed and collected electronically via email and anonymity was protected and that was made clear to the students. All surveys were collected after the course's final grades were made available to the students. Hence, no relation with grades can be made which hopefully encourages honest responses. Survey questions were:

1. I was interested in the HCI project more than usual for other courses' projects.
2. I felt enthusiastic about the HCI project more than previous courses' projects.
3. I cared about the results of my HCI project regardless of the grade I get.
4. I felt interested in the results of my HCI project even after the semester ended.
5. I enjoyed being a part of the HCI project.

All questions were required to submit the survey; all were in the form of statements expressing feelings regarding aspects of the project followed by a 5-point scale ranging from 0, representing a strong disagreement with the statement, to 4 representing a strong agreement. The Survey was in Arabic, the mother tongue of all students who took the course.

3.2 Focus Group Approach

This study is also supported by a focus group discussion, which was done by the researchers at KACST on the IMSIU's students. Focus group is a qualitative research method that provides information and an in-depth understanding of feelings that people have about certain topics or concepts. Generally, it consists of 3–9 participants for each group, with a moderator and a moderator assistant. Hughes and DuMont (1993: 776) characterize focus groups as group interviews: "Focus groups are in-depth group interviews employing relatively homogenous groups to provide information around topics specified by the researchers" [7].

During the focus group discussion, researchers adopted the roles of a moderator and an assistant moderator. Each researcher performed a specific role to ensure a smooth progression of the discussion. The moderator is someone who asks questions, takes the lead in the discussion, and creates a comfortable environment for the participants. The assistant moderator role includes observing participants' interactions, taking comprehensive notes and recording the discussion. Seven questions were asked for participants during the focus group discussions:

1. Do you prefer working in a team or individually?
2. Do you prefer working on a fictional project or a real-world project?
3. How familiar are you with King Abdulaziz City for Science and Technology?
4. How did you feel while working on the project?
5. What encouraged you to do this project?
6. What do you think are the pros and cons of this project?
7. How likely would you be to complete the project afterwards?

In this study, the focus group discussion was conducted with two groups. The first group consisted of 3 students from Group A, similarly the second group consisted of 3 students from Group B. Additionally, both discussion groups are homogeneous, the participants share similar characteristics such as gender, age range, and social class background, to permit cross-group comparability. After the focus group discussion, the audiotape was transcripted, and a large amount of data was produced, the data have been chunked into smaller units, and coded by the researcher, these codes are grouped into categories to help the researchers find common themes of the discussion [8].

4   Results and Discussion

4.1   Survey Results

A total of 23 students completed the survey, with 14 respondents from Group A and 9 respondents from Group B. For Group A, a large majority of the students' answers were positive especially in questions 3 and 5 (see Sect. 3.1), almost all of the students strongly agreed with the statements. The responses are indicative of the students' enjoyment in doing the project. The answers of Group B were mostly varied. In question 3, 65% percent of the students strongly agreed with the statement. In contrast, question 4 showed that 55% of the students strongly disagreed with the statement. As a comparison of both groups' answers to question 4, we found that the answers were somewhat contradictory. We believe this is caused by the students' engagement in a "real-world project" versus a "fictional project".

Overall, responses indicated that the majority of students in Group A were more engaged and satisfied with their learning experiences in compared to the students in Group B. Furthermore, the lecturers noted that students' energy in Group A was more vibrant, more attention was given to the project details and definitely more questions were asked. Group A students frequented lecturers' offices more often, asked more questions and showed more interest. Moreover, most of them showed signs of a boost in moral evident in their demeanor in class in general. In contrast, Group B students did not show any abnormalities, they were in comparison more aloof and indifferent toward the project.

4.2   Focus Group Results

The analysis of the focus group discussions revealed four overarching themes, these themes is discussed below:

- **Positivity:** Students in Group A addressed positively the benefits of working in a real-world and team-based project. They were satisfied with the clear project requirements gathered from the researchers. The students used positive words while describing the project such as wonderful, creativity, and innovation. In Group B, students reported positively about the benefits of working in a team-based project. Moreover, they used positive words while describing the project such as impressive.
- **Opportunity:** Students in Group A worked in collaboration with researchers at KACST to improve the interaction design of the localized prototypes. In Group B,

students contributed to the enrichment of Arabic content on the internet through the localization of the English website. Students in both groups gained experience in the designing field which satisfied their current and future interests.

- **Negativity:** Students in Group B preferred to work on a fictional-project rather than working on a real-world project.
- **Challenges:** Students in Group A discussed a range of challenges that impeded their ability to do better such as the need of proper communication with researchers to suggest domain-specific tools, and the tight deadlines for submissions. In Group B, students had no communication with the entity who is responsible for the English website. Also, it was difficult for them to handle tight deadlines for submission.

5   Conclusion

In this study, we presented how co-creation and collaborative work on an existing real-world project was aligned with increased levels of students' engagement and satisfaction with their learning experiences. These approaches have shown a very positive effect on both students and lecturers of the course. The results of the focus groups and the survey adequately validate our hypothesis: a course taught using real-world and co-designed project is as or more educationally effective and enjoyable than a traditional lecture-based course. The findings would benefit HCI educators on how to create an effective collaborative learning environment with a project-based learning approach.

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