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[3-D-2-04] Design of a gamified mobile application that aims to improve temporary deferred donors' intention to donate blood again

*Roberto Espinoza¹, Luciano Santos¹, Yukiko Mori¹, Tomohiro Kuroda¹ (1. Graduate School of Informatics, Kyoto University)

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The deferral experience – when a prospective donor is not able to donate for some reason – can affect the return rate of participants, especially in the groups of young and first-time donors. Information and Communication Technologies (ICT) could be a tool to support deferred donors, in particular younger ones, who are more familiar with technology. Although previous research has applied ICT to support blood donors in general, there are no previous ICT projects that focus on supporting deferred donors. In this paper, we describe a gamified mobile application, designed based on previous works in the blood donation field, and on the results of a survey about the perspective of Japanese citizens regarding the deferral experience and ICT. Three core objectives were considered: to give relevant information, to allow for casual interaction, and to motivate the use of the future ICT systems or tools. Seven key features were designed for the application, as to integrate the core objectives previously mentioned. They can be labeled as Login Reward, News Post, Discussion Post, Quizzes, Social Poll, User Alarms and Avatar/Character Progress. These features were modeled considering the concepts of extrinsic and intrinsic motivation from the Self-Determination Theory, as it has previous application in the formation of habits and in the encouragement of engagement of the individuals. In future works, the effectiveness of the proposed application could be tested, as to evaluate if it can significantly contribute to improve the intention to donate again of deferred donors.

Design, development, and usability evaluation of an ICT system that aims to support deferred donors

Roberto Espinoza¹, Luciano Santos¹, Yukiko Mori¹, Tomohiro Kuroda¹
Kyoto University¹

Abstract: Previous studies about blood donation have employed strategies that integrate Information and Communication Technologies (ICT) to support prospective donors. However, none of these studies focused on deferred donors. For this research, we reviewed previous works targeting blood donation and deferred donors, and used the results of a survey on the perspective of Japanese citizens regarding deferral and ICT to define three principles for the design of ICT systems that aim to support deferred donors: to give relevant information, to allow interaction, and to motivate prospective users. Based on these principles, an application with gamification features was developed and evaluated for its usability. Results seem to support that such an application is useful and appealing to potential users, and should be available to support the blood donation process.

Keywords: ICT, blood donation, deferred blood donors, gamification, usability.

1. Introduction

Multiple projects and studies in blood donation aimed at improving the recruitment and retention of prospective donors and keeping a consistent supply of blood units. Some recent approaches used *Information and Communication Technology* (ICT) as their strategy, following a trend [1] already present in the fields of Medicine and Health to improve patients' experience.

However, while the new ICT services have been successful in supporting prospective donors, there was little focus on deferred donors, who are people that try to donate blood but for different reasons are not able to finish the process. This group has been associated with a low return rate [2]. In the case of Japan, around 11% of prospective donors get deferred every year (592012 citizens in the year 2020) [3]. Since deferral cases are more frequent in the groups of young and first-time donors [4], reducing this negative outcome becomes a priority for a country with an aging population.

A previous study [5] suggested that the use of *LoveBlood* (a Japanese ICT service for blood donation) can lead to a higher intention to donate again after a deferral. The authors propose that a more specialized service offers more value to the users, encouraging

them to try to donate again in the future, or if not possible, to contribute in other ways to the blood donation process. In that sense, developing a service that could guide prospective donors could be a valuable contribution to blood donation, potentially reducing the number of deferral cases and increasing the return rate of deferred donors.

To design such a system, it was required to understand what recurrent issues and needs do deferred donors have, and how would they be addressed through the design of the system. Furthermore, this proposed design would have to be evaluated to determine if a resulting system would be accepted by potential users.

From that context, in this research we aimed to investigate the following:

- What design considerations should be taken for an ICT system to support deferred donors?
- Will such a system be considered usable and useful?

To do so, a two-step process was performed: first, existing theories of motivation and user experience, as well as the results of previous studies were used to define the design principles of the system. Then, an ICT system was designed and implemented, and an evaluation of its usability was performed.

2. Issues affecting deferred donors

Previous studies highlighted associations of low return rate with issues such as a weak blood donor identity of the participants [6], [7], the lack of knowledge or understanding about their own deferral situation [6], and negative emotions regarding the deferral [6], [8].

A systematic review about the effects of the deferral experience [9] concluded that giving deferred donors the possibility to contribute via alternative activities can improve their return rate. These activities include, among others, talking about blood donation and recruiting new donors. Engaging in such activities can strengthen their blood donor identity, otherwise hindered by the deferral. When such interactions are not available, deferred donors can become as passive in the blood donation process as non-donors.

Previous studies also reported that awareness might have a positive effect in future return of deferred donors [5]. Similarly, communication strategies and updated educational materials could mitigate possible misunderstandings [10]. It could be detrimental to deferred donors and to the blood donation process if they do not fully understand the provided instructions, as they could suffer additional deferrals.

Communication strategies have been used to facilitate calmness during the deferral procedure [9], as giving a more detailed explanation and guidance could allow for better reception of the rejection. Still, deferred donors could require additional reinforcement to their motivation since, according to previous studies [6], [8], a deferral can make donors feel not apt to donate blood and discourage them to try to donate again in the future.

Considering the previous ideas, ICT systems that aim to support deferred donors should adhere to the following principles:

1. *Improve the knowledge of deferred donors.*
2. *Increase the options of interaction for deferred*

donors.

3. *Increase the motivation of deferred donors to regularly engage in activities related to blood donation.*

3. Design and Development of the ICT System

Considering the proposed principles, we followed a design process based on the *Self-Determination Theory* (SDT) [11]. This psychological theory emphasizes the different types and sources of motivation that can impact behavior both in its quality and its dynamic. It states that motivation can vary from being entirely volitional (*Intrinsic Motivation*) to being completely external (*Extrinsic Motivation*).

A common approach to SDT is *Gamification*, which refers to the introduction of gaming elements in non-game contexts [12]. Past studies [13] have suggested that it can be used to improve the motivation and rate of learning, and to promote social interaction. Since the goals of the system include increasing the knowledge of deferred donors and strengthening their blood donor identity, Gamification can be a suitable approach in this context.

Gamification elements can be categorized as *Game Dynamics* and *Game Mechanics*. Game Dynamics refers to the intended user experiences [12], while Game Mechanics refers to the available tools and possible interactions [14].

In regards to the users of the system, it is possible to define *Types of Users* [15], which are categories based on the goals or motivations that drive users into action. The definition can be related to the type of motivation (Intrinsic or Extrinsic) or to other factors.

Types of Users include *Players* (users that engage in activities to receive rewards), *Socialisers* (users that wants to interact and relate to others), *Achievers* (users that seek progression and challenges), *Free Spirits* (users that desire to feel in control) and *Philanthropists* (users that want to help others).

For our proposed design, we defined that the Dynamics would focus more on Intrinsic Motivation since it is the stronger type of motivation, while the Mechanics would focus on Extrinsic Motivation as a way to reinforce the Dynamics. Application features were proposed to consider many different types of users. The sequence of steps used for the design was as follows:

1. Define the type of motivations of focus for the activity (if Intrinsic or Extrinsic).
2. Select which types of users will be driven for each motivation.
3. Select the Game Mechanics and Dynamics, and their interaction (main features).
4. Define additional features necessary to support the system or collect data (support features).

For instance, one of the proposed goals was to promote learning about deferral. A learning activity can be encouraged using both types of motivation. In that case, external factors are related to Players since they look for rewards. On the other hand, the internal factors could appeal to Free Spirits, due to their desire to feel in control, and to Achievers, who seek progression and challenges. There are many possible Mechanics and Dynamics to implement a learning activity, but for this feature we focused on a *Challenge* Dynamic, as it could target the three types of users previously mentioned. Challenge is flexibly offered using difficulty levels, and different prizes (such as points or avatars) are allotted according to the difficulty. In that sense, these two aspects were implemented via a *Quiz Feature*.

Following the same process, the final selection of features for the application was defined as follows:

Main features:

- *Login reward*: Every first time in the day that users access the application, they receive a certain amount of points and some advice or piece of information regarding blood donation deferral. This feature aims to indirectly give knowledge to users, as well as

extrinsically motivate them to regularly access to the app.

- *News Sharing*: News and/or articles about Blood Donation and Deferral are regularly uploaded to the application. Users can comment in any entry and “like” their favorite ones. For regular users, the application shows character/avatar of their selection and their username. This feature aims to engage the Philanthropist and Socialiser users. It creates the Dynamics of *Social Interaction* and *Recognition*.
- *Quizzes*: Users can answer questions about blood donation and deferral 3 times per day. Different levels of difficulty are unlocked according to the level of the user. Points are awarded according to the result of the quiz and the level of difficulty selected. This feature aims to engage the Players, Free Spirits and Achievers.
- *Social Poll*: Once a week, users can vote between different facts related to blood donation deferral. Users are instructed to pick the one that they find the most interesting. At the end of the week, users are notified of the most popular choice, and the ones that selected it can claim a set amount of points. This feature aims to engage the Achievers, the Free Spirits, the Socialisers, and the Players.
- *Posts*: Users can create posts for discussions. The content is evaluated by administrative users and once approved, the posts are shown in the application without the creator’s identification to reduce possible social burdens when asking a question or telling a personal story. Users can “upvote” or “downvote” the available posts, affecting its popularity score. Every week, users that created new posts with the higher scores are awarded a set amount of points. This feature aims to engage the Socialisers, the Free Spirits, the Philanthropists, and the Players.
- *Application Alarms*: Users have the option to activate notifications for news, for discussions, and

for updates in the character store. The aim is that users voluntarily choose to get informed about their topic of interest inside the application, as a sign of their growing interest. This feature aims to engage the Socialisers, the Philanthropists, and the Achievers.

- *Character Store*: Users can acquire different characters, which are updated in a bi-weekly schedule. The store indicates the required level for each character, their price, and the amount collected of each one. Users have the option to focus on upgrading the status of their current collection or to collect all of the available characters. The Character Store aims to appeal to Free Spirits, Players and Achievers.

Support Features:

- *Login Feature*: Registration and access to the application can be done by e-mail or by SNS (for this research, only Facebook was considered)
- *Surveys*: Getting additional information about the user allows for future improvement in both the design and the capability aspects. Surveys allow to acquire both quantitative and qualitative data.
- *Profile*: Users have access to their character collection, review their current level and points available, and access to other settings.

The final design was developed in a mobile application. The resulting system consists of three main screens, which are the *Home Tab*, the *Activity Tab* and the *Profile Tab* as seen in Fig. 1.

The details of each section are as follows:

- *Home Tab*: Presents the features related to both learning and interaction. The available features in this screen are the “News” and the “Posts”. The design also includes the mechanics of “Likes” and “Popularity Score” to motivate the interest and participation of users (*Socializing* and *Recognition* dynamics for Intrinsic Motivation of Philanthropists, Socialisers and Free-Spirits).

- *Activity Tab*: Includes the features that implement Gamification concepts to improve learning. Users can access the Quiz and Social Poll features, which target both Extrinsic and Intrinsic Motivations and use the Game Mechanic of points. Users can also create a discussion post from this screen.
- *Profile Tab*: Presents the information of the user regarding the gamified elements of the application, which are related to the Extrinsic Motivation aspect and the Player Type of User. This section of the application also connects to the Character Store feature (which aims to motivate Player, Achiever and Free Spirit users extrinsically and intrinsically, and to create the dynamics of *Challenge* and *Habit*), and to the “Settings Screen”, which includes the Application Alarms feature.



Fig. 1 Main screens of the application

4. Usability Evaluation

To verify if the application was usable and useful, as well as if it would be well accepted by potential users, a small study was performed with anonymous volunteers recruited on social networks. Participants were asked to install and use the application for a few days, then answer an anonymous online questionnaire.

Prospective participants were required to have an iPhone, be between 20 to 50 years old, and had lived in Japan for the last 2 months. Participants were recruited from June 17th to July 2nd of the year 2021. They could

complete the tests and submit their answers to the survey until July 11th.

Participants received the steps to install the application, a user manual, a list of tasks to fulfill inside the application, and a link to the Google Form for the usability evaluation. Additionally, participants were given a contact e-mail to ask for support in case they had issues during the testing.

The Usability Evaluation consisted of two sections: the SUS questionnaire [16], and a Follow-up question section (with three Likert-scale questions and a couple of free-text questions for the participants to give their comments about the application).

From May 17th to July 2nd, 15 participants were recruited for the usability testing. 13 participants created an account for the application, and 11 participants submitted the final form. Participants ranged in age from 20 to 34. There were 10 male and 1 female participant.

The SUS evaluation of our proposed application, as seen in Fig. 2 showed a final score 70.91 (scale 0 to 100, with 100 being the best usability), which is above the average SUS score of 68 [16]. The highest SUS score received by participants was of 95, while the lowest score was of 30.

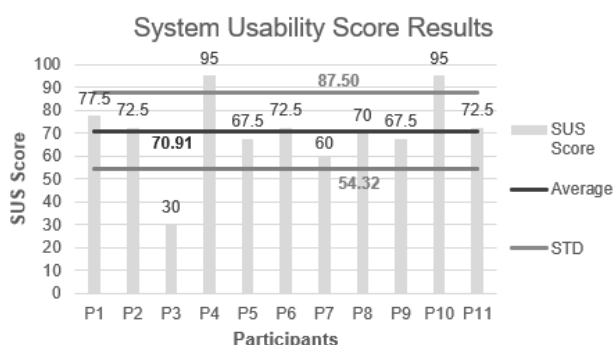


Fig. 2 SUS average score of the application and per user

For the follow-up questions, on average, there was a positive response (greater than 3) from participants to the items: liking the concept of the application (3.82), to be likely to download it (3.55), and to be likely to recommend it to others (3.64).

About the free-text comments of the participants,

they indicated positive feelings regarding sharing and discussing information about blood donation and deferral. Participants also showed positive feelings about having a mobile application about blood donation. Some of them also implied that the concept of the application could help to keep people informed and interested about the situation, and to enhance participation in blood donation.

Based on these results, it is possible to conclude that participants enjoyed the experience of using the application (3.82 in a 5-point Likert scale) and found it acceptable and usable (70.91 SUS score). This leads to believe that following the proposed design considerations can lead to the development of a usable, useful, and helpful system regarding our aim of providing support to deferred donors. Additionally, as participants expressed their positive intention to download the application (3.55) and to recommend it to others (3.64), we can conclude that an application such as the proposed on this research should be available to support deferred donors.

As this was an anonymous and online valuation, the feedback from the participants might not have been as detailed nor as extensive as possible. This limitation reduced the possibility to determine the exact reasons that might have hampered the experience for the participants that gave low scores in the evaluation. In that regard, doing more extensive evaluations might allow us to obtain richer feedback about future improvements, changes and/or opportunities.

5. Conclusion

In this research, we defined the necessary design principles to consider when developing an ICT service to support deferred donors. We proposed a design process taking Gamification as an approach for motivation, implemented and application following that design, and evaluated the usability of the developed application. The results showed that our

application is at an acceptable usability level, and that users liked its concept. This allows us to consider that using the proposed design process can lead to implement other ICT services with a similar usability and usefulness.

For future work, further evaluation regarding the usability of the application will be considered, as to get more specific feedback of possible improvements of the application. We also aim to evaluate the possible effects of the use of such a system in deferred donors' intention to donate or their intention to promote blood donation. Additionally, each of the elements of the application, such as the gamified ones, could be evaluated to determine if they are significant in the goal of creating a positive effect in deferred donors.

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