ICT-mediated Community Coaching to Improve Physical Activity

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Abstract: It is commonly known that physical activity is important to maintain health and prevent diseases. Many physical activity interventions have been developed to motivate people to be more physically active. Existing ICT-based interventions provide system-to-human feedback as a motivational strategy to be more physically active. In this paper we propose the ICT-mediated Community Coaching functionality as a novel motivational strategy based on human-to-human feedback where we transform the physical activity into a social activity. This paper presents the requirement elicitation, the design and implementation, and the evaluation of the Community Coaching system for physical activity.

1 INTRODUCTION

Physical activity is important to maintain health and prevent chronic diseases. Physical inactivity is the fourth leading risk factor for global mortality. Increasing levels of physical inactivity are seen worldwide. Globally, 1 in 3 adults is not active enough (WHO, 2014).

To stimulate people to become more active, many interventions have been developed. The first ideas emerged in the early seventies which encourage people to fill in certain questionnaires. These questionnaires aimed at getting more insights in the daily activity pattern so that people become more aware of how they behave. However, since the introduction of various measurement devices, it could be done faster and more accurate which was seen as a big step forward. Common device to monitor daily activity are step counters. Only wearing such a device can already increase the daily number of steps made (Bravata et al., 2007).

Nowadays it is often used in combination with a smartphone since it allows people to continuously access their activity data and to receive appropriate feedback any time needed. Additionally, recent ICT-based interventions use persuasive technologies in order to help people to be regularly physically active. UbiFit (Consolvo et al., 2008) and ActiveLifestyle (Silveira et al., 2012) are examples of systems using persuasive technology in order to change physical activity behaviours.

Although many of these interventions have shown to be successful (Bravata et al., 2007), a drop of use is noticed after a relatively short period (Tabak, 2014). One of the reasons could be because of the "one size fits all" approach, meaning that not much attention is paid to personal preferences and environment factors (op den Akker et al., 2011). In case feedback is given at any arbitrary time and not personalized, people will perceive the feedback given as annoying and not as really supportive (op den Akker et al., 2011). This feedback is based on system-to-human interactions. Additionally, these system-to-human systems are limited in terms of provision of social support, they are focusing on the appraisal support.

Social support from family and friends has been consistently and positively related to regular physical activity. Various studies showed a positive relationship between social support and physical health outcomes (Uchino, 2006). These interventions are based on face-to-face meetings and recently implemented in e-coaching systems (Kamphorst et al., 2014). Social networks and virtual communities are also used in physical activity support to provide mainly the emotional and informational support (some examples are WebMD (WebMD, 2005), PatientsLikeMe (PatientsLikeMe, 2004) and MedHelp (MedHelp, 1994)).

From existing solutions to support in physical activity and enhancing compliance we are missing a more intelligent system that is more cleaver in maintaining and mediating between humans in order to provide a human-to-human feedback.

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To enhance compliance on long-term using virtual community and help in being physically active, this research aim is to improve the provision of feedback by the introduction of the ICT-mediated Community Coaching functionality. The functionality activates the immediate social environment and use it instead of computer-tailored messages to encourage the users to do more physical activity. The hypothesis is that having to do physical activities together as social activity would have a higher impact on the motivation to be physically active and to enhance the compliance of use of the system. The system tracks the physical activity of the user and whenever he/she is not complying to the daily recommended level of physical activity, it would notify who are close by and available in the social environment and ask them to invite him/her for a social activity involving physical activity. These notifications are the main communication stream in the system.

To further work out the idea, we elaborated a scenario in order to make explicit the ideas of the Community Coaching system. The scenario describes the various activities performed by the users of the system with the Community Coaching. Based on scenario we elaborated a questionnaire to get input from people to elicit important functionalities that can be used and useful for potential users. Based on the resulting requirements, a design could be made which makes clear the functional architecture of the system and its interface.

Previously, we developed the virtual community TogetherActive (Elloumi et al., 2015) and we will use it as platform for the Community Coaching system. Based on prioritization of functionalities, we implemented the part of the system and integrated it in the TogetherActive system. The Community Coaching can be generalized to any physical activity platform where other kind of social support can be provided.

To evaluate the system, a study with real users was performed. The study took 11 days in total. At the end of the period all participants were asked to fill in a questionnaire, with the focus on the system usability and usefulness. Additionally, the system logs were used and analyzed to investigate the real system use.

This paper is organized as follow. Section 2 presents the Community Coaching system requirement elicitation and design. Section 3 describes Community Coaching implementation and integration in the TogetherActive system. The evaluation protocol and the results are presented in section 4. Finally, section 5 is a conclusion and discussion about the present paper, where we present lessons learned and recommendations for future.

2 COMMUNITY COACHING DESIGN

2.1 Requirements Elicitation

In order to get the requirements of the new system, the scenario-based approach was used. We started by writing a scenario describing the various activities that can be performed by the users of the system. Since we have no basic reference of what the system and potential users may need, we used the scenario in order to make explicit the ideas of the Community Coaching system. Based on scenario we build a questionnaire to get input from people to elicit important functionalities that can be used and useful for potential users.

The following is a part from the scenario.

> *Oscar is 26 years old. He is PhD at the University Twente.* **(...)** *Due to his sedentary lifestyle, he doesn't get the minimum amount of thirty minutes moderate activity a day. However, especially for him it is very important because overweight is a serious problem in his family and he is not adverse of eating croquettes during the lunch break.*
>
> *On advice of the Health and Safety Consultant of the University, he is now using TogetherActive. It offers the social support needed to get motivated to be physically active. This system is a physical activity support system based on a physical activity monitoring sensor and a virtual community.* **(...)** *He is able to see his daily physical activity goal (set by the Health and Safety Consultant to 10000 steps a day), his progress and accomplishments over time. He belongs to a virtual group (suggested by the Health and Safety Consultant), where they share common goals and they have to accomplish them together and compete against other groups. Those group members are able to track each other activity's level.* **(...)**
>
> *To get motivated and be able to accomplish daily personal and group goals, there is a social feedback component built in (Community Coaching). This means that feedback is given by people instead of the ordinary computer-tailored feedback. Those are group members or people he invited but not wearing the sensor. Although these people are not able to track their activity level, they can help support him to be active. To ensure that everyone involved will participate actively to the support process*

a competition element is built in. For each of the 'Helpers' Oscar has to assign a certain role, which can be a friend, colleague or family member for example, depending on the area/group he should be active in. Oscar invited to the system Emma, Peter and Amy as his colleagues and Lucy, Sam and David as his family members. Additionally, to each of the different areas, Oscar has to add a certain number of activities appropriate for that specific location. He added among others a five-minute walk, Frisbee and Petanque for office activities and running and dog walking for free time activities. Once into use, the list can be completed by the other people concerned. Because Peter is a really big fan of FC Twente, he adds playing football to the list.

During a normal working day, ***(...)*** *arriving at the office he changes his status to 'at work'. In this way the system knows who to contact when necessary.* ***(...)*** *At 10:00 he still didn't come off his chair and the system didn't notice any difference in physical activity level. Therefore, the system sends a notification via the mobile application to all group members and Helpers who have been recognized as being a colleague of Oscar (i.e. Emma and persons on the same group/circle). In this notification they are asked to accept the invitation and choose one out of a number of different activities to perform with Oscar.*

Because the weather is very sunny, Oscar's colleague Emma decides to propose to play a Frisbee game outside with Oscar. After she selected the activity 'Frisbee', the invitation is automatically forwarded to Oscar. Once Oscar has accepted the activity a chat screen is automatically opened to discuss time and place of the meeting. To avoid that Oscar receives a lot of invitations, the notifications become invisible after someone has accepted it. Oscar is typing that he has to finish one thing and that they will meet in ten minutes at the entrance of the building. To provide others the possibility to join the activity, Oscar has to fill in when and where the activity will take place (meeting point) in order to display it on a list online. Next to the future activities, also current and completed activities are shown, to keep others informed about their status in the competition.

Half an hour after the planned activity, the system checks whether the activity has actually taken place by comparing the data from the sensor with the estimated effort for the activity. This value is based on three factors, namely the duration, time and intensity of the activity. If the system approves the activity, all participants get the number of points worth it. The one who initiated the activity receives some bonus points. Also points can be earned each time a person is adding an activity to the list. In this way, every month an award is presented to the best supportive activity buddy, called '#1-SupBud'. **(...)**

The questionnaire consisted of 26 questions. Part of the questions was about functionalities in the situation of being Oscar and in the situation of being Emma (according to the scenario). The last four questions were aimed to get some general background information about the respondents.

In total 60 people replied to the questionnaire of which 28 men and 32 women and the majority (82%) was younger than thirty-years-old. The total duration for both reading the scenario and filling in the questionnaire was estimated to be 10-15 minutes.

Based on the results of the questionnaire, the following roles and concepts within the Community Coaching system were introduced:

- Main User: user of the system that needs help to be physically active.
- Helper: user of the system that supports the Main User in being physically active.
- Support group: A support group is composed by Helpers of the Main User. The support group can be a family group, a friends' group, or a colleagues' group or even peers.
- Notification: Message sent to either the Main User or Helper.
- Activity: It represents the main communication content between the Main User and Helpers and it is represented in lively actions planned and performed to increase physical activity level. Each activity has an activity type.

Additionally, based on the results of the questionnaire, we defined the following main requirements:

- **Notify the Main User' Inactivity**
  To get the Main User's number of steps, the system should synchronize the physical activity data to the portal first. If the physical activity data is below the recommended level, and the Main User's agenda allows, the system send notifications to the Helpers nearby.
- **Manage Activities**
  To arrange an activity between a Main User and a Helper, the system should provide a functionality

to start up activities easily and quickly. Furthermore it should be possible for other Helpers to participate to a planned activity (enrolling). The systems sends notifications whenever actions are performed (activity created, activity accepted, and enrollment to activity).

- **Manage Competition**
  In order to motivate the support groups, a competition between support group and between Helpers should be created. A reward would be given depending on the outcome of the competition.
- **Manage Support Groups**
  Main Users have the ability to manage their support groups. They should have the opportunity to approve or deny access to their personal physical activity data (personal or group access).
- **Manage Activity Types**
  The system should allow the users (Main Users or Helpers) to create their own activity types. Activity types created by Helpers should be approved by the Main User.
- **Manage Reward Types**
  The system should allow the users (Main Users or Helpers) to create their own reward types. Reward types created by Helpers should be approved by the Main User.

2.2 Functional Architecture

The architecture of the TogetherActive portal is based on the concepts of a Service Oriented Architecture.

Figure 1 shows the functional architecture of the Community Coaching. Portlets are divided into Main User portlet, Helper portlets, or shared portlets. Portlets may use services. Services are either Main User services or Helper Services.

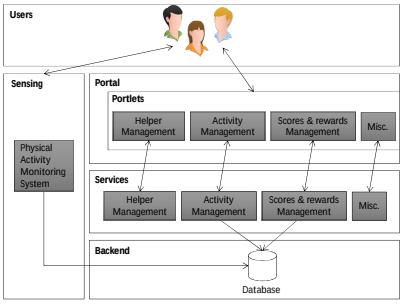

Figure 1: Community Coaching Functional Architecture.

2.2.1 Web Portal and Portlets

The Community Coaching portal is composed of a set of pages hosting one or more portlets. These are categorized into Main User pages and Helper pages. Each portal page contains one or more portlets. The organization of the portlets within the pages is shown in Figure 2.

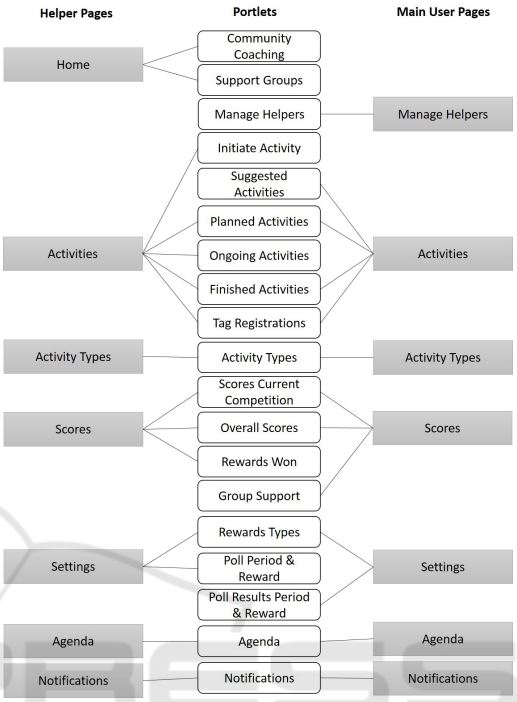

Figure 2: Community Coaching Portal Pages and Portlets.

Based on the requirements of the Community Coaching, we designed the following set of portlets:

- Helper Management Portlets:
  - Community Coaching portlet gives a short introduction about the Community Coaching system
  - Support Groups portlet gives an overview of the Main Users helping and to introduce other Helpers in the group
  - Manage Helpers portlet allows the Main User to manage the members in his support group
- Activity Management Portlets:
  - Initiate Activity portlet allows the Helpers to invite a Main User for an activity, without receiving a notification first
  - Planned Activities portlet gives an overview of the planned activities for that day and to allow Helpers to enroll to activities that were not initiated by themselves
  - Ongoing Activities portlet gives an overview of the activities currently going on
  - Finished Activities portlet gives an overview of all the completed activities.

  - Tag Registrations portlet gives an overview of all the tag registrations for the current day. When an activity is finished, the Main User tags (example with NFC tag) the joined Helper as a confirmation
  - Activity Types portlet checks the list of activity types and to allow the users the update the list
- Competition Management Portlets:
  - Scores Current Competition portlet informs the Helpers about their position in the competition and the scores of their competitors
  - Overall Scores portlet gives an overview of the number of rewards won versus the total number of activities performed
  - Rewards Won portlet reminds the Helper to his success
  - Group Support portlet shows the Main User what group of relations give the most support
  - Reward Types portlet checks the variety of reward types in a certain support group and to allow the users to create new ones
  - Poll Reward and Period portlet gives Helpers the opportunity to give their preference with respect to the reward type and the period of the competition
  - Poll Results Reward and Period portlet keeps the Main User informed about his Helper's votes
- Miscellaneous Portlets:
  - Agenda portlet allows people to put their meetings and busy time to avoid that they get overwhelmed with notifications. The system takes into account Main User and Helper's agendas
  - Notification portlet gives an overview about received notifications

2.2.2 Services

In order to support those portlets, we need database services. The information model in Figure 3 represents the conceptual classes that are used to implement the services.

- Helper management services are responsible for the management of Helpers
- Activity management services are services responsible for the management of activities and activity types
- Scores and rewards management services are services responsible for the management of scores, rewards and rewards types
- Miscellaneous services are services responsible for the management of agenda and notifications

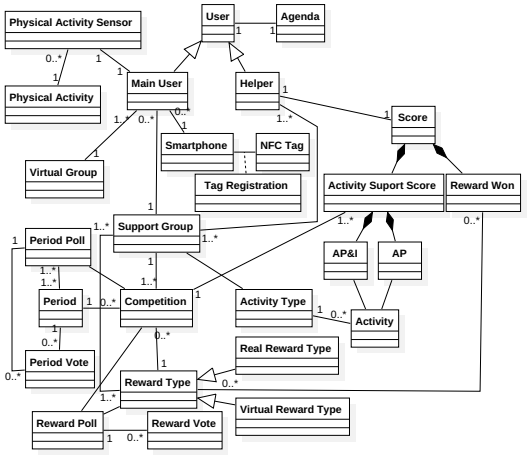

Figure 3: Community Coaching Informational Model.

3 COMMUNITY COACHING IMPLEMENTATION

3.1 TogetherActive Overview

The TogetherActive system (Elloumi et al., 2015) is a virtual community system that provides social support (emotional, informational, instrumental and appraisal) to people on their daily physical activities. It supports them in order to get physically active and to maintain an appropriate level of physical activity. The TogetherActive system (Figure 4) is composed by a physical activity sensor and a portal. The data collected by the sensor is synchronized and used by the portal. The portal is accessible from an internet-connected device.

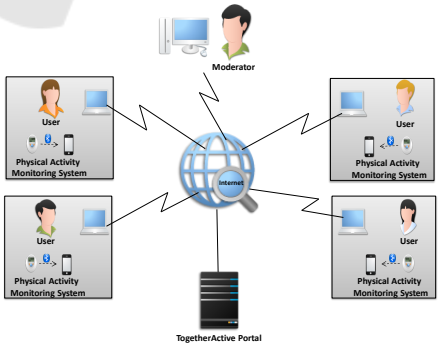

Figure 4: TogetherActive Architecture Overview.

3.2 Community Coaching Implementation and Integration

The Community Coaching system was implemented using Liferay (Liferay, 2000). This decision was

made based on the fact that the Community Coaching system will be integrated in TogetherActive system (which is already implemented in Liferay). Due to the time constraints before starting the evaluation of the system, we prioritized some portlets to implement and simplified or replaced some other portlets.

The Poll Reward & Period portlet and the Poll Results Reward & Period portlet were omitted in the implementation.

The following additional portlets were designed and implemented:

- Set Sub-Goals portlet to replace the agenda portlet. It allows the Main User to set sub-goals. A sub-goal is characterized by a number of steps to reach by a certain time of the day (example reaching 2000 Steps by 10:00 am). The system checks the Main User's level of physical activity reached during the time of the sub-goals. If the Main User didn't achieve the amount of physical activity set in sub-goals, the system sends notifications to the support groups (Helpers). Three sub-goals are set by default, but the Main User can update the 3 sub-goals (time and number of steps).
- Validate Participation portlet replaces the Tag registration portlet. Instead of using and NFC-like system by the end of the performed activities to validate the participation, this portlet allows the Main User to approve or reject the real participation by simple check-box functionality.

The notification portlet was simplified to be a service of notifications sent via emails. In order to receive notifications Main Users and Helpers have to use the email address that they check often, or the one that gets synchronized to their smartphones. Three types of notifications were created:

- Activity invitation notification: it is sent whenever the Main User is not meeting his physical activity sub-goals (with a maximum of 3 notifications per day)
- Activity suggestion notification: it is sent whenever a Helper suggests an activity to the Main User, as an activity invitation notification received or as an initiative from the Helper
- Activity acceptance notification: it is sent to the Helper whenever the Main User accepts his/her proposed activity

To integrate the Community Coaching system in the current TogetherActive system, the Main User pages described in the section 2 are integrated as child-pages (Figure 5).

Figure 5: Integration of Community Coaching System in TogetherActiveSystem.

4 COMMUNITY COACHING EVALUATION

4.1 Evaluation Protocol

In order to evaluate the prototype, usability and usefulness studies were planned. A study with Main Users and Helpers for 11 days was designed in order to use the system. Within the study we recruited the Main Users, and each participant was asked to invite at least two Helpers from their social network. The participants and their potential Helpers were asked to use their personal emails in order to be able to receive the notifications. The study was approved by the University Ethical Committee. Participants (Main Users) were recruited from the university via Facebook, emails and flyers. Recruited participants received full information about the system.

One day before the start of the study, all participants were invited for a short introduction meeting. They were asked to sign the informed consent and a borrowing agreement for the sensor. During this meeting, information was provided about what people could do on the portal and how to wear/connect the Fitbit sensor (Fitbit, 2007). Each participant was asked to invite at least two Helpers from their network. The participants got their own portal access credentials and were informed how to give their Helpers access to the portal. The remaining part of the day was intended to get familiar with the system and to invite their Helpers.

At the end of the study period all Main User participants were asked to fill in questionnaire. The questionnaire consisted of three parts. The first part of the questionnaire was aimed to get some general information about the participants and their backgrounds. Background related topics were the use of social networking, use of apps for health purposes,and physical activity stages of change. The second part of the questionnaire was aimed at the system usability. To measure usability, the Computer System Usability Questionnaire (CSUQ) was used (Lewis, 1995) which is based on a 7-point likert-scale, starting from strongly

agree (value 1) to strongly disagree (value 7). The third part of the questionnaire was about the usefulness of the system, with the focus on the Community Coaching aspect on the portal. For measuring the usefulness of the system, no appropriate, standardized questionnaire was found from literature. Therefore, a new questionnaire (for Main User and for Helpers, see Appendix) was conducted with some input from the Technology Acceptance Model (that is focusing on the usefulness of a system device for office workers (Davis, 1989)). Similarly to the usability questionnaire, the usefulness questionnaire is based on a 7-point likert-scale as the usability questionnaire. As a final outcome of the study, we looked into the real use of the system.

4.2 Participants

We recruited 10 participants (7 males and 3 females) aged between 18 and 30 and were studying or working at the University of Twente. Participants were recruited from the University of Twente. Inclusion criterion to participate in the study was that participants should have some time for using the physical activity monitoring system and using the portal.

4.3 Results

For the analysis of the questionnaires, two of the ten Main User subjects were excluded. The reason was insufficient system use: one did actually never log in and the other wore the sensor for just one day. The remaining 8 subjects were three women and five men. Six participants were using social networks (like Facebook) for more than 4 years now, and 50% of the subjects spend around 5 hours a week on social networking. Two of them already used social network for health or well-being purposes, and six of them used apps on their phones for health or well-being purposes (informational and/or exercising and schedule compliance). Based on the question on stage of change, we found that the six subjects were in the maintenance stage, which means that they have been sufficiently active for the last six months. One of the subjects was in the precontemplation stage and one in the contemplation. People in these stages are both insufficiently active but the difference is that people in the contemplation stage do think about to become more active.

The number of Helpers that filled in the questionnaire was four: two belonged to Support Group 2, one to Support Group 7 and one to Support Group 9. Because the low number of interactions they had with the system and because Helper 7 did not receive notifications.

4.3.1 Usability Study Results

Following the guidelines from Lewis (Lewis, 1995), the results from system usability (Table 1) are summarized into the 4 factors reported as mean values: overall system usability (OVERALL), system usefulness (SYSUSE), information quality (INFOQUAL) and interface quality (INTERQUAL). The table also includes the results from the previous study on the TogetherActive portal without the Community Coaching component(Elloumi et al., 2015).

Table 1: Usability Results.

Score	Main User	Helper	Previous Study
OVERALL	4.3	4.6	3.8
SYSUSE	4.7	4.6	3.9
INFOQUAL	4	4.7	3.8
INTERQUAL	4.2	4.3	3.5

The overall score for the Main User was 4.3 and most outcomes are around 4 which indicates that it is slightly negative. Some Main Users mentioned that it was hard to find the different features and that the interface could be done more intuitive. Two other Main Users noted that they were too busy to consider the system more closely. One person mentioned that the user manual was not sufficient enough. Although the Helper portal contains less pages and portlets, the overall score for the usability is even higher, namely 4.6. Because just two of the four Helper respondents used the possibly to add some extra comments, it is difficult to figure out the items that need to be improved. Furthermore, the given comments were very generic, so not much information can be obtained.

4.3.2 Usefulness Study Results

For the usefulness study, 8 Main Users and 4 Helpers replied to the related usefulness questionnaire (Appendix). The average scores for both Main Users and Helpers are shown in Appendix.

The overall score of usefulness for the Main User is 3.4 which is less than average (4.0). Main Users agree on (based on the questions 2, 5-6, 8-9 and 17):

- having the possibility to allow their Helpers to see their data
- allowing Helpers to invite them for an activity when they don't meet their physical activity goal
- allowing other Helpers to join a planned activity
- knowing who is supporting them the best and which support group is supporting them the best

- the Community Coaching is useful.

Main Users are neutral regarding (based on questions 4, 10-11 and 13-15 with the highest score between 4.0 and 4.9):

- creating their own activity type as a motivation to perform that activity
- Community Coaching helps them to reach the daily goal 10000 steps and reduce their sedentary behaviour
- feeling of having someone always looking after them
- the system is meeting their needs

Additionally, the overall score of usefulness for the Helper is 4.2 which is neutral. Helpers agree on (based on questions 1, 3, 4, 6-7, 11-12 and 14):

- helping the Main User to be more physically active
- creating new activity types and that it increases their motivation to do that activity
- winning real reward that are decided by Main User as being best supporter
- knowing scores from other Helpers in the same support group

The Helpers don't agree about the fact Community Coaching could be useful(last question with a score of 5.0). Giving the limited number of Helpers that replied to the questionnaire, we cannot make a conclusion about the results.

In conclusion, the outcome from the usefulness study, especially from the Main Users, is showing that Community Coaching system is a promising feedback modality to be included in the virtual community.

4.3.3 System Use Results

In order to get more insights about the real use of the system and validate the usability and usefulness results, we checked from the portal logs the involvement of Helpers in the portal, the actions made (such as creating activity types, activities and rewards types) and the visits to the portal.

As part of the protocol, the Helper acquisition procedure was fully managed by the Main Users, we could only observe from the system logs how this it realized. We categorized Helpers into: invited, registered and real. If the Helpers logged in the system for a first time they are categorized as Registered Helper, and if they did more actions in the system, they considered as real Helpers.

Although we can see in Table 2 we can see that 41 Helpers were invited, only 13 Helpers registered, and 8 were real Helpers. From another side, we cannot make sure that it is not the recruited Main Users who used the system as Helpers, since they were the one in charge of the recruitment of Helpers.

Having a closer look on those real Helpers, we noticed that 3 Helpers used fake email addresses so no notifications were sent to them. Thus the setting of Helpers didn't meet expectations and not all Main Users experienced all proposed functionalities and expected added value from the Helpers.

Table 2: The number of invited, registered and real Helpers for the different Main Users.

Main User	Invited Helpers	Registered Helpers	Real Helper
MU2	3	2	0
MU3	3	2	2
MU4	5	1	1
MU5	3	0	0
MU6	3	2	1
MU7	3	1	0
MU8	3	0	0
MU9	3	2	1
MU10	10	3	3
Total	41	13	8

For the 11 days of the study, Helpers were supposed to receive max 33 notifications (type Activity invitation notification) in case that their associated Helper doesn't comply to the 3 daily physical activity sub-goals. Figure 6 represents the total number of activity invitation notifications sent to the Helpers during the period of the study. It shows that in average 22 notifications for activity invitations were sent to the Helpers.

Four Helpers from the real Helpers suggested an activity to their Main Users and two did accept the invitation for the activity. Additionally, one Main User and two Helpers created activity types (4 activity types were created). For the rewards types, only 3 Main Users created reward types; 1 virtual and 2 reals. Regarding the portal visits by the Main User and Helpers, the majority of Main Users accessed the portal more than 1 day and the majority of Helpers accessed the portal only one time in only one day.

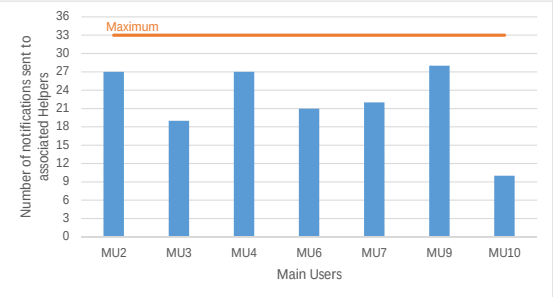

Figure 6: Total number of activity invitation notifications.

5 DISCUSSION AND CONCLUSION

Within this work, we presented a novel way to enhance the compliance and overcome drop experienced in (Tabak, 2014). The proposed ICT-mediated Community Coaching functionality turn the physical activity into social activity, and stimulate the social collaboration to enhance the motivation for physical activity. In this paper we presented the requirements elicitation, design, implementation and evaluation of the Community Coaching system. The Community Coaching system was integrated within the TogetherActive system. To evaluate the system, a study was performed including ten Main Users. Each participant had to recruit his own Helpers. The study was over 11 days. At the end of the period all participants were asked to fill in a questionnaire, with the focus on the system usability and usefulness. Also a system use analysis was performed, to get insights in the real use of the system.

The scenario and the associated questionnaire as a requirement elicitation method gave a good and clear idea about what are the requirements of such a new functionality. We could design the main requirements, and implemented them or part of them (updated versions). In order to generalize to different target groups we should be careful and do an extra investigation because the respondents for the questionnaire were in average young, students or working in the university and healthy.

Regarding the usability study, the Community Coaching system can be improved. Extending the TogetherActive system with the Community Coaching component could have increased the complexity of the full system and affected the usability outcomes of the Main User and Helpers especially with the INFOQUAL and INTERQUAL factors. Results show that there is room for improvements. The focus should be on the integration of the existing portal, to ensure they are more in line with each other. Because the TogetherActive system is designed/implemented in Liferay, the portlets can be easily reused on other pages of the portal and tuned according to the need. Other points to focusing on are the intuitiveness of the system and the look and feel.

Another usability study protocol would be better invested such as the task-oriented usability testing (Wharton et al., 1994) or the walk-through approach. A list of key tasks and sub-tasks within the system should be undertaken in order to achieve the goal of evaluating significant aspects and key functionalities of the system. Example of a task is to invite for an activity. During the study, notifications (for activity invitation) are the main communication stream that goes between the support group and the Main User, but as a reply for these notifications the number of activities that were suggested or accomplished was really low based. If Helpers don't try at least one time during a study to invite to an activity, the vision to the system and its usefulness would be biased. This would be overcome with the different usability protocol.

Regarding the usefulness study, the outcomes, especially from the Main Users, are showing that Community Coaching system is a promising functionality to be included in the virtual community and can be generalized to any physical activity platform where social support can be provided. The outcomes of the Main Users are higher than that of the Helpers. Although the content of the questionnaire was not exactly the same, we consider that Helpers value the usefulness lower than Main Users. Because the outcomes of the first questionnaire pointed out that still 40% of the Helpers was not willing to help the Main User, this is not a very remarkable result. It could be that the Helpers did participate because of the social pressure (because they were asked by a friend for example) rather than being interested in it. Other causes for the low score could be because the Helpers were insufficiently informed about the purpose of the system or because they didn't read the Helper manual on the portal. Furthermore, the current protocol didn't give the chance to Helper to get a physical activity monitoring system. It would enhance their awareness and gives them more motivation if they can also monitor themselves to invite Main Users for activities. Additionally, although the usefulness questionnaire was adapted from the Technology Acceptance Model, it was not validated. This should be done in future experiment with the use of Cronbach Alpha for example, and with the use of the current results in order to validate it.

The hypothesis of this research is that such approach is more motivating and therefore enhances the compliance on long-term as it transforms physical activity into a social activity. Although the outcomes of the system usability and system use were neutral, most subjects liked the idea of Community Coaching (from the usefulness results). Therefore, it is recommended to further investigate on this topic. Extra recommendations should be integrated in a newer version of the system. First, the protocol of inviting Helpers should be more supervised. This supervision will make sure that all invited Helpers are real Helpers. Second, for a short-length study, Helpers should get a similar introduction meeting to the Main Users or all Helpers should come together with their

Main Users for the introduction meeting. Finally, the email setting should be supervised, to avoid similar problems with this study, where some Helpers didn't change the default email address or used a fake email address.

Another suggestion would be to change the target group, in which the benefit for such a system is higher. The change of target group should be handled from the requirement elicitation process till the evaluation protocol. One possible target group is people with chronic condition given the increased awareness and evidences about the importance of physical activity for prevention and treatment (Lin et al., 2006; Middelweerd, 2014; Kreuter and Strecher, 1996). Another target group could be the elderly people, known by feeling lonely (Huitt, 2004) and their physical activity level gets influenced by their loneliness (van Weering et al., 2009).

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APPENDIX

Main User Usefulness Questionnaire	Score
1. I like to invite Helpers to help me	3.6
2. I like to have the possibility to allow my Helpers to see my data	1.9
3. I like to create new activity types myself	3.1
4. Adding new activity type increases my motivation to perform that activity	4.4
5. I like that Helpers can invite me for an activity	2.7
6. I like that Helpers can enroll to a planned activity	2.4
7. I like to create new reward types myself	3.1
8. I like to know how is supporting me the best	2.9
9. I like to see what relation group (family, friends, etc.) are the best supporters	2.9
10. Community Coaching helps me reaching the goal of 10000 steps	4.1
11. Community Coaching reduces the time spent sitting consecutive	4.2
12. Community Coaching increases my awareness of physical activity	3.4
13. Community Coaching helps me to better manage daily physical activity	4.4
14. The system makes me feel like someone continuously looking over my shoulder	4
15. The system meets my needs	4.9
16. The system does everything I would expect it to do	3.5
17. Overall, Community Coaching is useful	3

Helper Usefulness Questionnaire	Score
1. I like to help the Main User being more active	3.7
2. I like to have/get data access of the Main User	4.2
3. I like to create new activity types myself	4
4. Adding new activity types increases my motivation to perform that activity	4
5. I like to get a system notification when the Main User is inactive	5.2
6. I like to suggest an activity to the Main User	3.7
7. I like to have the possibility to enroll to a planned activity	3.2
8. I like to be in a competition with other Helpers	4.2
9. The competition motivates me to perform activities	5.2
10. I like to win a virtual reward, decided by the Main User	4.2
11. I like to win a real reward, decided by the Main User	3.2
12. I like to know the scores of other Helpers in the group	3.5
13. The system increases my awareness of physical activity	4.5
14. The system helps me to better manage daily physical activity	4
15. The system lowers the threshold to perform activities with others	4.7
16. The system does everything I would expect it to do	4.2
17. Overall, Community Coaching is useful	5