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A Co-Design Partnership to develop universally designed ICT Applications for people with Intellectual Disability

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Abstract. Co-design has its roots in the Participatory Design techniques developed in Scandinavia in the 1970s. Co-design reflects a fundamental change in the traditional designer-client relationship. A key tenet of co-design is that users, as 'experts' of their own experience, become central to the design process. This reflects the role of the user at the heart of Universal Design. This paper describes an on-going co-design partnership between undergraduate ICT students and Community Partners who support individuals with Intellectual Disabilities. The aim of this work is to develop assistive technology applications and/or products which meet the requirements of the Community Partners. The core development philosophy is Universal Design. The project work forms part of the academic requirements for undergraduate assessment in computing courses and must fully meet the prescribed learning outcomes. The Community Partners initiate the process by outlining preliminary requirements for the Projects using online accessible videos. In partnership with the students they engage and participate in design, development and testing workshops throughout the lifecycle of the project. Some of the necessary preparations and agreements are described, which are required before these co-design partnerships can work for the mutual benefit of all concerned. The experiences and outcomes of completed projects are reflected upon and the potential benefits of promoting Universal Design through co-design partnerships between the ICT developers of the future and the Community Partners are considered. Examples of projects undertaken include Accessible Login and Shopping Assistant..

Keywords. Co-design, Universal Design, Assistive Technology, Community Engagement.

1. Introduction

This paper describes a co-design partnership. In particular, it highlights the necessary preparations and agreements that are required before co-design partnerships can work for the mutual benefit of all concerned. A framework for managing these projects through the various life-cycle phases is proposed.

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The co-design projects referred to here are based on needs derived from the everyday experiences of the Co-Designers. To date, Apps have been developed to various degrees of completion, for a variety of tasks ranging from a Friend Finder app to a Money Management App. The problem of accessible secure password management has been considered. Apps for self-advocacy and for independently requesting referrals for professional services, have also been developed. Screen shots for some of these are shown in Figure 1.

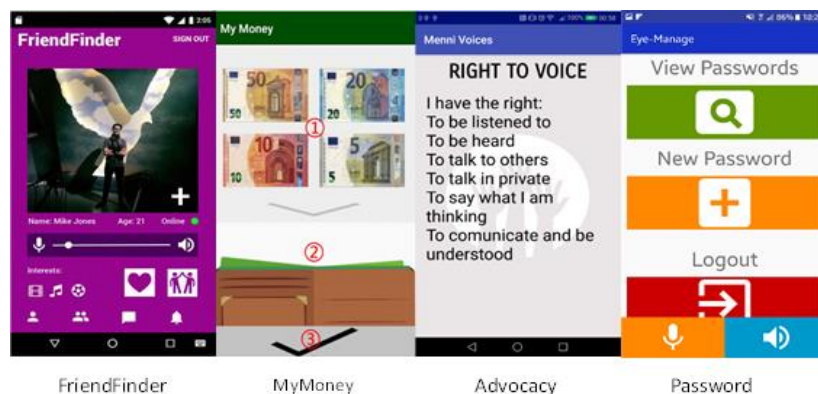


Figure 1 Co Design Apps

2. Motivation of Community Partner in participating in co-design projects

When this process was first discussed, the main motivational drivers for the community partner lay in the need to partner with other organisations in diverse settings and the need to support government directives to integrate more into a local community moving away from institutional settings and moving from a medical to a social model of service provision. The community partners also wanted to learn from the expertise and skill set of different partners to see how it can improve their service provision.

Another motivational driver related to closing the digital divide that exists for the men and women they support. From their experience, the accessibility of mobile devices is opening up new opportunities for all and assistive technology is increasingly facilitating greater independence. An unforeseen benefit of these projects is that it also empowered frontline support staff to up-skill and co-design outside the traditional setting.

While a requirement to learn new digital skills, to become designers and create solutions that can help themselves and others were key motivational factors for the men and women who participated as Co-Designers, a desire to attend college was a primary motivation for them. For many, they may have watched siblings or family members go to college and wanted to have the same opportunity to experience college life. They wanted to meet new people and work with different groups. For many of the individuals, they would have been in school with the same people for over fourteen years. Consequently some of the participants wanted to learn in a different environment, and for some, it resulted in them travelling new routes of learning independently.

3. Motivation for using co-design amongst Computer Science Students

Fostering greater consideration of the user in Software Development, especially Agile methodologies, remains a primary motivation for the academic partners. Agile methodologies are iterative approaches to software development, (Roy 2018, Alt-Simmons 2015). Various commentators have highlighted the waste of abandoned projects, unnecessary reworks, poorly designed systems and the poor economics of badly designed systems, (Spillers 2014, Weinschenk 2011, Charette 2005). They also emphasise how consideration of the user plays a significant role in minimising these problems. As academic providers of Computer Science education we have seen, over many years, students stating that they are using Agile methodologies in their Final Year Projects, (Roy 2018, Alt-Simmons 2015) but with little evidence of any end-user interaction.

A review of Final Year Student projects was undertaken to determine the extent of end-user engagement. The majority used some form of Agile methodology. Whilst approximately half of students acknowledged the concept of end-user engagement in some form, only 10% of students included any reference to, or discourse on, end-user engagement in the concluding chapter which was a key chapter in the report incorporating the Key Findings and Recommendations. This would suggest that students did not attribute any significant importance to end-user engagement despite it being a key component of Agile methodologies. These projects are therefore open to the risks of poor development outcomes due to the lack of user participation. Consequently a key motivational factor is to promote a greater understanding of the User amongst Computer Science Students.

4. Co-Design

In order to refocus our students onto the User, development methodologies which consider the User are required. User Centred Design is one such design philosophy. According to Rogers et al (2012) User Centred Design can be described as an iterative, nonlinear process of designing where the users are the main focus point, which drives the design process. It involves listening to the users, observing them, proposing designs and building prototypes, getting feedback and ultimately validating the products in the light of user expectations.

Participatory Design also advocates user involvement throughout the design process. Its aim is to create systems which are more receptive to human needs, (Clement & van den Besselaar 1993). The difference between the two philosophies is summed up by Sanders (2002) who says that whereas User-Centred Design is design for users, Participatory Design is design with users. Participatory Design methods include design workshops, brainstorming, role-playing scenarios, prototype development, storyboards, and ethnographic techniques such as focus groups, interviews and observation (<http://www.designforusability.org/> & <https://www.usability.gov/>)

Co-design is an umbrella term for participatory, co-creation and open design processes. It has roots in the 1970s participatory design techniques from Scandinavia. C. K. Prahalad and Venkat Ramaswamy (2004) are credited with bringing co-creation/co-design to the minds of those in the business community. They propose: "The meaning of value and the process of value creation are rapidly shifting from a

product and firm-centric view to personalized consumer experiences. Informed, networked, empowered and active consumers are increasingly co-creating value with the firm."

These projects have given our students a unique opportunity to work directly with end-users using a co-design methodology which is much more immersive than the typical interaction one would generally expect to see with Agile methodologies.

5. A framework for Co-designing team projects

Co-design is a complex endeavour with many stakeholders. To make it work requires protocols and agreements which are the basis for our proposed framework. This framework has three distinct phases: a Preparatory phase, a Co-design Team Project phase and a Post Project review phase.

The Preparatory phase addresses the training requirements of the participants. This includes some universal design, co-design and accessibility awareness on the part of the student developers and co-design training on the part of the community participants.

In the Project phase, the Co-Designers, having presented to the students a list of projects which address an everyday need or requirements for the Co-Designer, work with the Students to develop a software system which meets the requirements of one of these projects. Teams of students and Co-Designers are formed and assigned one of the projects. The co-design project is based on experiential learning methods around team development.

Finally in the Post Project phase challenges which arise and issues around the completion of the project are addressed as well as any assessment requirements.

The framework is underpinned by a partnership agreement between the Academic and Community Partner organisations. This agreement defines agreed protocols for: project management, managing expectations, interaction between stakeholder roles, certification, training, co-design process models and activities, intellectual property, ethics, code of conduct and post project work.

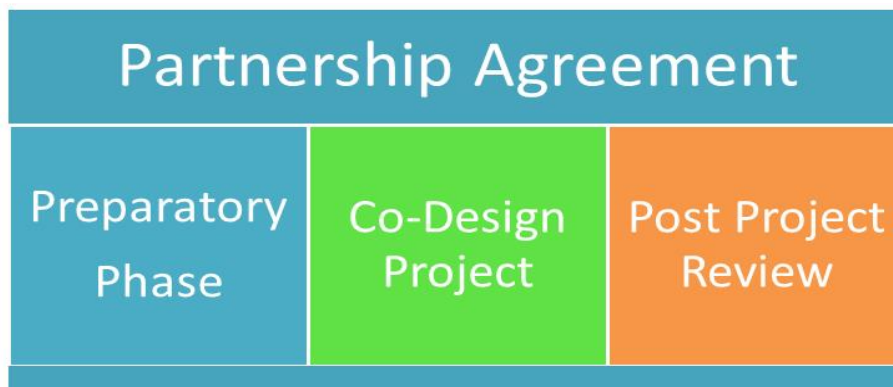


Figure 2 Co-Design Framework

6. Partnership Agreement

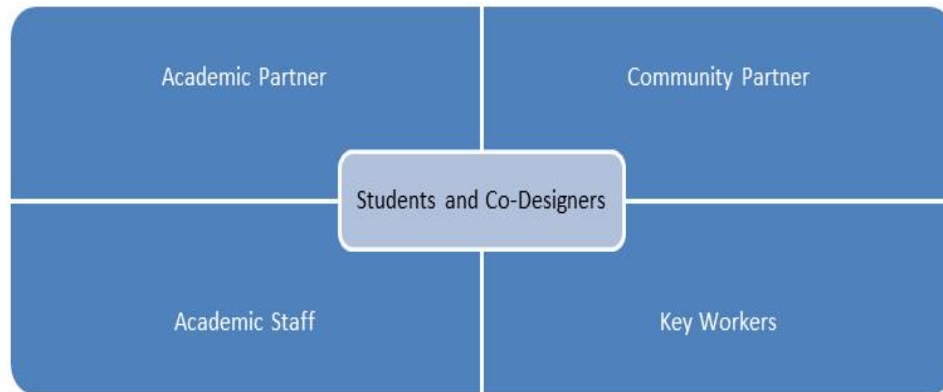


Figure 3 Co-Design Stakeholders

The co-design process involves a complex partnership between an academic institution and a community partner. O'Rourke (2015) recommends that a participatory design framework be beneficent: that is all parties involved in the process should benefit in some way from it. However, to ensure the viability of that objective before the co-design project begins there are certain issues that need to be clarified and agreed and incorporated into a partnership agreement. Key issues to be addressed include:

- **Ownership and Intellectual Property Rights (IPR):** An Agreement must be established in connection with the intellectual property rights with respect to any outcomes of the project. For example all parties, including students, enter into this on the common understanding that any applications and/or products developed will be considered for the common good and made freely available to the wider public in line with Community Engagement programs. This policy will have implications with respect to normal student entitlements as inventors. The students must be informed of the implications of agreeing to participate in these projects at the outset,
- **Project timeline:** An outline of key dates and deliverables,
- **Certification:** Prior agreement on certification for all participants is needed. This might be at the level of Certificates of Participation or higher if suitable certification around co-design has been validated,
- **Preparatory training and orientation:** Participants from both organisations should receive training on aspects Universal Design standards and on Co-Design activities. This orientation should also include a reference to a Code of Conduct which details how both parties will work respectfully in

partnership with each other to the common aim outlined above. It is important to agree beforehand the details of this orientation and training.

- **Roles and responsibilities:** The roles of the various participants need to be clearly specified in advance. Specific roles include: the developers and the Co-Designers, key support workers, Project Co-Ordinators and Project Leaders. For instance the role of the Project Leader is to oversee the development process to ensure all participants are adhering to the principles of the co-design approach and that the project deliverables meet the needs of the Project Clients. Also, the role of the Project Co-Ordinator is to ensure that the academic needs of the students are met at all times,
- **Participation and withdrawal:** In order to ensure that participation in the project is done to the highest ethical standards it is necessary to agree some guidelines in advance. These guidelines have at their heart the principles of Voluntary Informed Consent (Boddy, 2015).
- **Promotional Activities:** Project information may need to be disseminated for promotional purposes using a variety of media outlets, for example, on Web sites. Any materials produced should be respectful of the participants, especially disabled participants (Barnes, 1992).
- **Project review:** At the end of the projects a review meeting should be convened to discuss the project outcomes and to discuss future plans for further development of the applications and/or products.

7. Preparatory Phase

Two activities are undertaken during this phase: Assignment of projects to the teams and Preparatory training.

7.1. Assignment of Projects

The projects originate with the Co-Designers. A list of projects which address an everyday need are presented to the students using a set of videos produced beforehand by the Co-Designers. The Students, working in teams of between three and five members, are required to develop a software system in co-operation with the Co-Designers, which meet the requirements of one of these projects.

Following a short period of analysis the teams of students present a Bid Proposal for their preferred project outlining their team's unique selling points.

Each team is assigned a project which may or may not be their preferred choice. The Project then commences.

7.2. Preparatory Training

Co-design is complex process and it is important that best practise for engaging people with disability in co-design is followed. There are a number of international initiatives which make recommendations in this regard.

One such initiative is Australian Information, Linkages and Capacity Building (ILC) project for people with Disability (<https://www.ndis.gov.au/communities/ilc-home>). The focus of ILC is community inclusion – making sure people with disability are connected into their communities. The National Disability Insurance Scheme (NDIS) (<https://www.ndis.gov.au>), commits to co-design as a way of achieving the aims of the ILC (NDIA 2015).

The NDIA role of co-design is mirrored in the Huddle Design group's report (Sutton Long et al 2016). The main principles of co-design which Huddle recommends are to be person-centred, creative, collaborative and courageous. In order to achieve these goals some preparatory training is necessary to build awareness of appropriate and respectful means of engagement between co-design participants as espoused in the agreed Code of Conduct.

Pre-project training should be based on appropriate learning outcomes which impact the success of the project. Some training or workshops in the methods, activities and processes of co-design such as wire-framing prototypes would be valuable. Similarly an introduction to general accessible design principles such as those of universal design would be very useful. This training should continue throughout the project with weekly sessions addressing the issues for the next stages of the project.

In order for our (Community Partner) participants to feel confident and to be empowered as active Co-designers they first need to understand the design process. Prior to working with the students they learn about the five stages of Design Thinking; Empathy, Define, Ideate, Prototype and Test, in a manner that is meaningful for them. The preparatory work includes a training session to outline problems that mobile technology could solve, another session on how to be a good team member and the importance of listening skills, communication and brainstorming.

They also learn how digital projects work and the rules of co-creation with the aim to unlock their creative skills. They test the theory of Design thinking by designing smart wearable clothes to encourage the participants to believe and to demonstrate that they can generate ideas and that they are inherently creative.

8. Co-Design Project Phase

In this phase the co-design project is run through its lifecycle. The projects undertaken are run in the context of the School of Computing's Undergraduate Team Project Module (<https://www.dit.ie/catalogue/Modules/Details/CMPU3045>), which is run in the penultimate year of our Computer Science programmes. Therefore from the students' perspective the minimum expected outcome from the co-design project is that the academic requirements of the Team project module are met. It requires the students to collaborate and organise themselves into small teams to take a software application through its life cycle. They are expected to demonstrate presentation and communication skills, contribute meaningfully as a co-designer and to show evaluation and review skills.

8.1. First Meeting

Typically the co-design aspects of the project commence with the first meeting between students and the Community Partner participants. It is really important in co-design for the participants to get to know each other. This can be facilitated with techniques like introductory exercises or conversation starters. Examples include a warm up challenge to determine the best use for a paper cup.

The purpose of this first meeting is to determine the user requirements for the project. The background to the project ideas must be considered. Who are the users and why is this project important to them? In what context will the app be used? Requirements might be elicited through a formal discussion, through a presentation followed by a question and answer session or a round table discussion.

8.2. First Co-Design Iteration

Once requirements are established the first co-design iteration takes place. In relation to the projects previously undertaken this iteration typically has lasted three weeks. Each team spends the first part of the iteration developing an initial design, following co-design activities including paper based drawings, brainstorming, reviewing existing products, basic prototyping and feedback sessions.

This initial design is reviewed and feedback provided. Next a prototype App based on the initial design is implemented by the student developers. It is then presented to the Co-Designers who evaluate the product and provide feedback. This knowledge informs the activities of the second co-design iteration and a detailed Project Plan for the second co-design iteration is developed.

8.3. Second Co-Design Iteration

The second Co-Design Iteration also lasts about three weeks and again it goes through the stages of Implementation, Testing and Evaluation. The Co-Designers are involved on a weekly basis. At the end of this process the App is presented for final evaluation and the final deliverable is produced.

Throughout the project the teams document different aspects of the project. This documentation includes: team meeting records, a User Manual, Design artefacts, Planning and Testing strategies and working versions of the code and dataset. The documentation is kept in a portfolio which forms part of the submission for assessment. Individual team members also keep a diary in which their own project experiences and contributions are recorded. The Application and supporting documentation are forwarded for assessment.

9. Post Project Phase

The first significant activity undertaken in this phase is Student Assessment. This involves two components: team assessment and individual assessment. As well as the submitted portfolio, teams are also required to present and demonstrate their projects. The presentation offers a summary of the project lifecycle phases reflecting on key

aspects of the process including: working in a team, the processes of co-design and the experiences of working with users.

Individual assessments also take place. Some of this is based on the Student Reflective Diaries which are submitted throughout the project and which recount an individual's experiences and contribution to the overall process. Every student is also interviewed by their project supervisor.

At the end of the project an award ceremony takes place where certificates of participation are awarded to all participants. These are commissioned from the DIT Students Learning with Communities office as recognition of the contribution of those who took part in the co-design activities. This is separate from the academic assessment for the students.

Another key activity in the co-design framework is the post project review meeting. This gives an opportunity for all stakeholders to reflect and review the project. Plans for the following year should be set out and a schedule of follow-up meetings agreed. A key issue to address is to determine the status of the projects.

In software development there are many reasons why projects may be incomplete and fail to realise the goals of the project. While the proposed project framework incorporates many components of successful IT projects, for example user involvement, proper planning and realistic expectations (Standish 1994), the projects may not be completed because the project lifecycle may take place over a very short time period as was the case with the projects undertaken. The continuation of the projects should be addressed as part of the partnership agreement.

Another key issue to be addressed is the possibility of someone wishing to continue work on the project outside of the partnership which might have implications for IPR and licensing. Without agreement on IPR and potential revenue distribution conflicts could arise especially if the product is a commercial prospect.

10. Review of Student Participant Experiences.

Students who have participated in some past co-design projects were asked to complete a questionnaire anonymously to reflect their views on their experiences working on a co-design Team Project.

In general the feedback from the students is very positive. Not only did the students see improvements in their own personal skills, both hard and soft, they also appreciated the importance of working closely with clients within the context of a team and the benefits these projects brought to the clients and the wider community.

The majority of students agreed that working on co-design projects changed their view of the role end-users in application development and that they would give more consideration to end-user needs and engagement in their final year project. They felt that their teams would benefit from additional training early on in the project life cycle in the areas of end-user introduction/interaction and preparation of design documentation. They also felt that team performance would improve if team members were chosen with similar skill sets in the area of software development.

Because they felt that they got better feedback from the users when presented with designs and prototypes they recommended allocating more time to the Design and Implementation phases.

More User introduction/interaction, Better Team Selection, Provision of Cloud services, Design Documentation preparation and Android Development Skills would in the opinion of the students benefit the process.

11. Feedback from the Community Partner on their experiences with the Co-Design projects

To date, these co-design projects have been beneficial on many levels for the Community Partner in their service provision. The men and women supported by the Community Partner got an opportunity to work with the computer science students to co-design projects creating solutions to some of their everyday challenges.

These projects helped to: break down the digital divide that exists for people with higher support needs; promote greater awareness among the public of the skills that the men and women possess and challenged pre-conceptions held by many in society. They got to experience mainstream college life, some of them for the first time. By going to the college one day a week for twelve weeks, it promoted the possibilities of access to further education building capacity and up-skilling in areas necessary for them to succeed in college.

The partnership helped to build the confidence, skills and experience of the men and women and support staff. They allowed the Community Partner staff and the men and women they support to engage with a new group of people who they usually would not work with under regular service provision. They learned and excelled at working with new teams, learning new skills in a change to the traditional learning/work environment of most service providers.

While the Community Partners found the engagement with students and college staff to be a very positive experience, managing expectations can be a challenge. There are some issues with regards the skill set of the computer science students and their ability to deliver to the expectations of the men and women who will use the products. As these projects have been running for three years, we need to find a sustainable solution to how these prototypes can be rolled out to others and released for use by other people who could benefit from the digital solutions.

12. Summary and Conclusions

In summary the co-design projects have been a valuable addition to the Computer Science undergraduate programs. Both students and Co-Designers have indicated that they find the exercise worthwhile. A strong partnership between the academic and Community Partner has developed underpinned by the partnership agreement.

A framework for delivering co-design projects, while evolving, is an advanced state of development. Greater consideration of the user has impacted in a good way on final year projects in computer science.

While the successes have been many, there are still some issues to attend to especially project completion. Can we learn from other models of academic Industry /community partnership such as those identified by the HubLinked Knowledge

Alliance project (<http://www.hublinked.eu/>)? Are there ways to record and certify the Co-Designers learning in a formal way as part of these projects?

The consolidation and development of the co-design process will no doubt embrace these challenges going forward.

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