

Participatory Design Resulting in a ‘Do-It-Yourself Home Modification’ Smartphone App

C. Bridge

Abstract While the numbers of Do-It-Yourself (DIY) home modifications have increased, there is little available information that assists people to do their own home modifications. This is in the context that the traditional Australian home has generally been built with little consideration for anyone who may be less agile or who may have any other ability issues. For instance, someone may find themselves no longer able to step into a bath or have difficulty standing up from the toilet and need to make changes to their home to remain independent and safe. Home modifications describe these types of changes in the home typically made in response to loss of ability and are designed to help people to remain independent and safe whilst reducing any risk of injury to their carers and care workers. This paper outlines the participatory design process used to create the smartphone App and reports on its beta testing and final launch.

1 Introduction and Background

Modifications to the home include changes to the structure of the dwelling, e.g. widening doors, adding ramps, providing better accessibility, etc., and the installation of assistive devices inside or outside the dwelling e.g. grabrails, handrails, lifts, etc. Home modifications is a key to being able to ‘*aging in place*’, in other words, living independently at home. To ‘*age in place*’ means that you can remain in your own home rather than being forced to relocate or enter assisted living, or a retirement community, etc. Home modifications assist people with disability and older people to be more independent and may reduce the need for ongoing assistance (<https://www.homemods.info/about>). Population wise, there are more people living alone and most older people and people with impairments of ability have a strong desire to choose where they live.

C. Bridge (✉)
UNSW, Sydney, Australia
e-mail: C.Bridge@unsw.edu.au

This research project aimed to support and enhance life for people with impairments of ability and those who are ageing by production of a Do-It-Yourself (DIY) resource App known as ‘*DIYmodify*’.

The *DIYmodify* project builds from previous research undertaken in 2015–2016 (Bleasdale et al. 2014; Bridge et al. 2016) that explored the phenomena of DIY modifications from a literature, consumer, industry and economic perspective. This scoping research found that there were significant DIY installations of grab rails, handrails, handheld showers, shower infills and small ramp installations undertaken annually by older or disabled people in New South Wales (NSW). The cost offset to health and aged care services of these activities amounted to more than \$15 million dollars based on our analysis of consumer direct sales data from Australia’s largest national hardware chain. The annual savings cited in this initial report were based on product selection, purchase, installation or construction being undertaken by privately funded individuals or their families. The data analysis revealed that the number of people doing their own home modifications comprised a significant and growing market segment within the existing home hardware enterprise.

Where home modifications are made of necessity, for example before being able to return home from hospital, the home modifications are likely to be instigated by a health professional, with often little thought for aesthetics or the emotional impact on the household, family and friends. Additionally government services offering home modification assessment and/or intervention funding often have long waiting lists. Unsurprisingly, given that nearly all wealthy countries have an ageing population doing home modifications without professional input in such circumstances, is a growing trend. However, it is also because there are greater numbers of people deciding that they would like more choice over the quality, appearance, cost and timing of these support types. Additionally, those that undertook DIY home modifications stated that they took pride in the results they achieved and this sense of self-efficacy enhanced their sense of wellbeing and capacity. This is unsurprising as previous research has shown that home modifications can improve quality of life and reduce care (Carnemolla and Bridge 2011, 2016).

Our previous research revealed that while most participants reported a positive experience of the DIY process, most negative aspects of the DIY experience were attributed to a serious lack of information on the process and products available for undertaking DIY home modifications. It was also noted that there were also often issues in communicating the needs of the person to tradespeople who might be undertaking the project on their behalf (Bridge and Barlow 2016). Further, there was rarely any information available either online or at the Point of Sale (POS) in the hardware shop to help them. The process of home modifications empowers people and helps to maintain independence over their lives (McNamarra et al. 2014) and the *DIYmodify* App and its associated factsheets needed to ensure the experience of modifying a home DIY was a safe and positive one.

It was found that DIY participants were likely to have a broad range of skills and information needed from the very basic to the highly technical and thus the resources developed had to be able to cover this knowledge range. The information needed to be tailored so that different groups could access it and it needed to be

available in a variety of formats (Bridge and Barlow 2016). It was considered especially important that appropriate resources be available at Point of Sale (POS).

The five home modification types for including in the initial POS resources were

- grabrails;
- handheld showers;
- level access shower alcoves;
- handrails and
- ramps.

Factsheets were the overall preferred resources for obtaining information by seniors, with websites coming second. Although Apps may still not be the preferred means of resources for seniors, there is a significant number of people who do use their smartphones and who access Apps on a daily basis (Berenguer et al. 2017). The decision to develop a hybrid App gives a wider access across a greater range of resources as smartphones can link to factsheets and additional information. Factsheets then can be printed. Also, information is accessible via a website.

2 Aims and Methods

The primary aim of the participatory design research funded by the NSW government was development of Point of Sales (POS) resources for DIY home modifications. This project set out to develop and curate the resource(s) needed to assist people with impairments of ability of all ages and their carers. It also aimed to facilitate people to be able to make more informed decisions in relation to their needs, skills, home situation and resources, so as to undertake home modifications with confidence and greater autonomy.

This participatory part of the research project reported in this chapter was directed by the following research questions:

1. What are the design requirements for accessible POS resources for undertaking DIY modifications?
2. What type of online formats are required to cover the product decision-making, installation and maintenance processes?
3. What are the required design elements and information content to ensure that the App is effective in assisting consumers to access DIY home modification information?

The overall project used a mixed method research approach where the research tasks were divided into several interlocking tasks:

1. review of existing resources;
2. review of App and smartphone resources;
3. resource review update—home modifications;

4. new resources development and
5. resource design—design of the App and factsheets; and the Participatory Action Research (PAR) was used as a vehicle throughout all of the tasks to review research findings and to inform decision-making.

3 Participatory Action Research Sessions

Participatory Action Research (PAR) seeks to understand and improve the world by changing it. It includes collective, self-reflective inquiry, which researchers and participants undertake iteratively usually in a number of cycles so that together they can understand and improve the practices in which they are involved. The same process is often used for research that seeks to create new computational outputs or objects (Bridge and Carnemolla 2014). Some of the values of PAR are empowerment, support and relationships, learning and social change. PAR affirms that experience can be a basis of knowing and that experiential learning can lead to a legitimate form of knowledge that influences practice (Bostock and Freeman 2003).

Three workshops were undertaken as a part of the POS material development in order to formulate, and provide feedback on development of the *DIYmodify* App. To undertake the project, a team involving researchers, an App developer, and participants with ability impairment and some experience in home modifications, was established.

The participants shared their knowledge, skills, expectations and experiences regarding home modifications and their aspirations for a *DIYmodify* App. The team included three critical key stakeholder groups: home modification policymakers; home hardware and construction industry and people with impairments of ability. The final PAR team included some of the participants from the previous ‘World Café’, a creative group interaction method focused on conversations for leading collaborative dialogue, sharing knowledge and creating possibilities for action that was organised as a part of an initial *DIY* home modification scoping research (Bridge et al. 2016) as well as new invitees from the three key stakeholder groups with an emphasis on end users with impairments.

Involvement in the PAR team was completely voluntary, unpaid and all members committed to the three, two and half hour workshops. All workshops were fully compliant with our Human Ethics Clearance (HC 16578) and involved informed consent for photos, video and audio recording. The workshops comprised 8–11 people: two researchers, an App developer and 6–8 participants. Workshops were audio recorded, and all discussion transcribed. The transcriptions were searched for keywords or synonyms using standard content analysis techniques to clarify and inform all key decisions. A brief overview of the three PAR workshops is detailed so some of the decision-making and tasks undertaken in the *DIYmodify* App development can be better understood.

3.1 Workshop 1—Formulation of the Design Brief for the App

The findings from previous scoping research were presented, although some of the PAR team were already familiar with them having agreed to participate in the most recent work or having already participated in the earlier research. As a preliminary activity, some of PAR participants spoke of the value of DIY projects to themselves and why someone might launch into such a project. They spoke of people doing their own home modification projects due to time, cost and for doing it ‘properly’. For example, *‘Realistically, that’s why they are doing it themselves—to save money’* (Participant 02) and *‘A lot of it is to save time’* and *‘They don’t do post-occupancy checks and if they’re wrong, you’re in a very dangerous position—and you have to get it done again privately.’* (Participant 01)

A DIY matrix adapted from the original Enabler Model (Steinfeld et al. 1979) was presented as a way of illustrating how peoples’ abilities might inform both project selection and an understanding of matching resources and abilities to make undertaking a home modification project in a DIY manner more successful. The matrix in this model focused on DIY tasks and used a self-assessment of ability. It was decided that the App would address ‘abilities’ and through their own self-assessment, a person would be advised if they would be able to complete the required task for example, installing a grabrail or whether they should be advised to seek assistance from a family member or friend or perhaps employ a tradesperson to do this installation for them. While some members of the PAR team were concerned about physical installation risks, it was decided that the physical installation was merely one part of the total project. Final group consensus was that a Task Analysis that ‘advised’ you would be unable to complete the installation task of ‘installing’ a grabrail failed to appropriately acknowledge other options, i.e. included having a relative, friend or neighbour assist with a project. For example, someone might easily accomplish all the pre-installation steps, i.e. choosing which sort of grabrail they needed, deciding which direction it should be installed, and how high it should be installed, etc., for the grabrail home modification type or any of the other of the four home modification types, yet may be unable to physically instal it themselves.

As a team, they felt the App should lead users through the decision-making process using a set of self-reflective questions. For instance, one PAR member said it should commence with *‘What do I need? A grabrail. What do I need it for? What type of grabrail do I need? Then, how do I install it?’* (Participant 03). Another PAR members stated *‘You just need to remember that a grabrail in the bathroom isn’t going to help you get into bed’.* (Participant 02). Following the discussion on the Enabler Model and Task Analysis Matrix (Steinfeld et al. 1979), a brief overview of smartphone App’s, their current vogue and importance was given. After that there was an opportunity to work on an App prototype, using the information gained from the workshop.

It was also identified that there needed to be somewhere in the process the possibility of accessing assistance, perhaps the advice of an occupational therapist,



Fig. 1 Participatory Action team at workshop one, problem-solving the decision framework

a building advisory service or additional help from a tradesperson, as it may not always be the case that the instigator of the home modification project would be completing all of the installation themselves. Figure 1 illustrates the participants of first workshop reflecting on current information summaries.

Key learnings from the first workshop used to inform the next stages of resource development were that:

- resources need to be straightforward, explaining why a particular home modification might be needed and by whom.
- language needed to be direct and clear.
- screens/pages should be uncluttered and should be accessible for people with visual impairment, colour blindness and other types of disability.
- While there was a lot of information that people might need to know, if it is stepped through clearly, it need not be overwhelming.
- there should be links to other sources of information if this will assist people to understand what is needed and would help them throughout the DIY process.

3.2 Workshop 2—Feedback on Initial Framework for the DIYmodify App

By the second workshop, the App programmer had been engaged and progress on the thinking for the App had substantially developed. The PAR team was invited to be involved in the decisions around the icons and language to be used in the App, as well as the logic sequencing for the screens.

A significant chunk of time within the workshop time was spent on brainstorming the name of the App. The names suggested by the PAR members were

developed into a list—and each suggestion was checked for availability. Once checked the short list of available names was forwarded to each PAR team member for them to vote on. ‘*DIYmodify*’ was by far the preferred name. This included all the necessary aspects including ‘Do-It-Yourself’, as well as ‘modification’ and was short enough to be suitable to use as a title under the logo.

The longest discussion however surrounded organising framework or modified Task Analysis that drew on the idea of a matrix integrating environmental variables impacting DIY performance and an ability framework known as the Enabler model (Steinfeld et al. 1979) which was designed to assist decision-making around potential barriers/enablers impacting an individual’s capacity for undertaking the chosen home modification task. Figure 2 illustrates the participants in workshop two wrestling with the best way to lead users through the information so that there was no wrong door and that the information could be kept up to date effectively.

By the end of workshop two, there was still no clear agreement on how to proceed on this issue, yet it was considered an important aspect of the content that would be on the App and it would form the basis of leading a consumer through the App to the relevant solution. A standard technique in PAR is critical reflection of a method often associated with undertaking design activities to improve practice. Its use has been shown to lead to a deeper and more complex understanding of experience and ‘reflection on experience and past actions’ which the process enables draws out understandings that would be otherwise difficult to obtain (Fook 2011). As part of this reflection on the Task Analysis, a paper outlining the possible alternatives to the Task Analysis was forwarded to each PAR member for them to reflect on and provide input on prior to attending workshop three.

Meanwhile the App Developer and the researchers continued on the Information Architecture for the App and the content of the App itself. In this stage of the App



Fig. 2 Participatory action team at workshop discussing the Task Analysis options

development, it was realised that by shifting the thinking away from the task analysis as a ‘deciding factor’ and having it instead as a checklist on the factsheets, many of the issues would be solved.

3.3 Workshop 3—Feedback on the User Interface for the App

By workshop three, as the App was further advanced the PAR team was able to make very explicit decisions on content, including colour and words and information order. Including how the App was operating, e.g. swiping or clicking screens to move forward or back, etc. An issue that continued to be extremely important to the PAR team was that of language, i.e. how it was used, who the App was targeting and therefore, whether the language was appropriate for that specific group. Other issues addressed included:

- The appearance of the App.
- The use of colour.
- A desire for the App to go back one page at a time rather than returning as it did at that time back to opening page and main menu.
- More images were also requested.

The PAR team stated that they found the prototype App to be uncluttered and generally easy to read, despite some content requiring further development. For example, the video segments were considered too long and further editing was requested. The launch and marketing were also discussed. Other issues raised at the PAR workshops included the words and language used throughout, the colours, the name of the App and how the App pages were moved from one page to the next instead of using scrolling or a ‘next’ button). Each decision in the App development was treated in a similar manner with reasoned and considered analysis, a systematic process, time for reflection and development and amendment or further planning for the next cycle, when necessary.

4 Beta Testing

App development typically also involves: alpha testing and beta testing. Initially, alpha testing usually by the people involved in its development such as our PAR team, leads to larger beta testing. In this case, our PAR team were included in both the alpha and beta testing of the App. However, Beta testing involved a much larger and broader audience and tested whether the *DIYmodify* App was working as expected without mistakes on end users smartphones, as well as making sure it is suitable for its intended audience, people with impairments. Beta testing is standard

and is carried out to ensure any glitches in the operating of the App are resolved before forwarding the App to the respective App stores for download.

Originally, the Apple and Android versions of the App were to be developed alongside each other but the App Development team advised that as it can take substantial lead time for an App to be approved for release by the Apple Store that the Apple version of the App be developed first and then the Android version be developed in order to achieve the completion target dates.

Once the Apple version was at a suitable stage for beta testing, a range of people from peak bodies and organisations whose clientele might find an App on home modifications useful, and who had agreed to be ‘beta testers’ and who had Apple operating system phones or iPads were sent a link to the app to test. After the beta testing feedback was received for the Apple version, the Android version of the updated App was sent to those who had an Android device and expressed an interest in the Android beta testing. It was, however, more difficult for people with Androids to access the test App from their Android phones.

Each person contacted was sent a package explaining the process of beta testing. Of those contacted, 42 agreed to be ‘beta testers’ with only four negative responses received and these mostly concerned wanting more items, difficulty with the download or feeling that the DIY option was not for them. For example, one beta user commented that ‘*it would have been good to have other types of ramp addressed, not only the doorway ramp*’ (Beta tester).

Additionally, the last 500 users of the ‘Home Modification Information Clearinghouse’ website were sent invites to test the App in either its Apple or Android form prior to its official launch, with no significant negative responses being received, both the Android and Apple Apps were officially launched on the 16 July 2017. *DIYmodify* has been downloaded 2639 times, with 2373 downloads from the Apple store and 266 from Google play. This appears to indicate that despite both smartphone types having accessibility features, Apple devices appear to be more generally used by people with disability.

5 Conclusions

As originally intended, and with the assistance of our PAR team it appears that the *DIYmodify* App ‘supports consumer decision-making and in-store purchasing’. It addresses issues involved for those who are renting their home, as well as for those whose home is purchased under Strata Title, i.e. a home where permission to modify is required from a body corporate or similar. It explains what to look out for when undertaking the home modification, how to choose, and then maintain and clean the home modification. It does not, however, go into detail on how to physically instal the home modification as existing material is already readily available online to explain how to do this.

The *DIYmodify* App is the world’s first in that, it curates existing resources and knowledge in a novel decision-making frame to provide guided decision-making

for selected home modification products. It was designed with no animation to accommodate those who may have photosensitive epilepsy. It targets a marginalised group—people with impairments of ability, as well as those who are ageing, with the intent of empowering them and recognising that while they may be requiring assistance in some areas of their life, they are essential members of society and that they can be responsible for their decisions in what they want in their home to help with daily life.

The 21 associated evidence-based factsheets developed for and curated by the *DIYmodify* Apps extend the knowledge that was previously available. They include checklists to assist the DIY-er in organising how they will undertake the project and provide letter templates to send to the owner of the property if the user is not the property title owner. For those requiring installation assistance, there is a factsheet on how to ask for a quote on a project, what to tell the tradesperson and what to look for when comparing quotes. These factsheets extend the knowledge base for each of the five home modifications and provide valuable additional information. A more extensive evaluation of the *DIYmodify* Apps was outside the scope of the original POS development reported here but is planned as a part of future extension work yet to be undertaken.

References

- Berenguer A, Goncalves J, Hosio S, Ferreira D, Anagnostopoulos T, Kostakos V (2017) Are smartphones ubiquitous? *IEEE Consum Electron Mag* 6(1):104–110
- Bleasdale M, McNamara N, Zmudzki F, Bridge C (2014) Positioning paper: DIY home modifications: point-of-sale support for people with disability and their carers. Home Modification Information Clearinghouse, UNSW, Sydney, Australia, published 6th August 2014. www.homemods.info. Accessed on 14 Nov 2017
- Bostock J, Freeman J (2003) ‘No limits’: doing participatory action research with young people in Northumberland. *J Community Appl Soc Psychol* 13:464–474
- Bridge C, Barlow G (2016) Co-design of point-of-sale resources for do-it-yourself (DIY) home modification. Presented at the 6th international conference for Universal Design, Nagoya, Japan, 9–11 December 2016
- Bridge C, Carnemolla P (2014) An enabling BIM block library: an online repository to facilitate social inclusion in Australia. *Constr Innov* 14(4):477–492
- Bridge C, Maalsen S, Zmudzki F, O’Neil S, Carnemolla P (2016) DIY home modifications: what information is required at point of sale? Home modification information clearinghouse, UNSW, Sydney, Australia, published 4th April 2016. www.homemods.info. Accessed on 14 Nov 2017
- Carnemolla P, Bridge C (2011) Home modifications and their impact on waged care substitution. Home modification information clearinghouse. UNSW, Sydney, Australia, published. www.homemods.info. Reprinted version accessed on 14 Nov 2017
- Carnemolla PK, Bridge C (2016) Accessible housing and health-related quality of life. *Int J Architectural Res* 10(2):38–50
- Fook J (2011) Developing critical reflection as a research method. In: Higgs J, Titchen A, Horsfall D, Bridges D (eds) *Creative spaces for qualitative researching*. Practice, education, work and society, vol 5. Sense Publishers, Rotterdam

- McNamarra N, Bridge C, Zmudzki F (2014) Consumer choice and DIY home modifications: exploring universally designed housing. Presented at the 5th international conference for Universal Design, Fukushima and Tokyo, Japan, 11–13 November 2014
- Steinfeld E, Schroeder S, Duncan J, Faste R, Chollet D, Bhisop M et al (1979) Access to the built environment: a review of literature. US Dept of Housing and Urban Development, Washington, DC, US