“WE WANT TO ADD TO THEIR LIVES, NOT TAKE AWAY…”

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ABSTRACT

Using mobile devices is a common activity across a wide range of ages, from the very young to the elderly. However, the recent rise of applications to be used on mobile devices (apps) has not been as strongly anticipated by the older generation (60+) as it has been by younger people. Are apps specifically designed for the elderly even available? If so, do they help make growing old seem more attractive and inviting?

Undergraduate design programs typically focus on creating employable “problem-solvers” rather than “solution finders”. At the institution where the authors are based, steps had been taken to attempt to address this via the introduction of a multidisciplinary approach known as the POOL model. While this approach had brought various benefits to the students involved, such as greater understanding of teamwork and other diverse disciplines, many of the students’ project outcomes lacked a focus on the end user. The design thinking process and DTRS brief therefore became an opportunity to address this issue and to build student empathy with the users or target audience.

This research paper provides a rationale for the introduction of the design thinking process into an undergraduate learning environment, then describes how a team of twenty approached the design of a product for a mobile device that makes growing old seem more attractive and inviting. The process outcomes and commercial validity of the developed products are considered, including reflections on the extent to which the design thinking process led to a greater sense of empathy amongst the student designers.

INTRODUCTION

Design thinking is described as a “human-centred innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis, which ultimately influences innovation and business strategy” [1], [2]. This process, best known in the academic environment from the d.school of the Hasso Plattner Institute of Design at Stanford University and the University of Potsdam, has become increasingly popular

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in higher education. In addition to increasing attention at the higher education level, the *Design Thinking Toolkit for Educators* [3], released by the design and innovation consulting firm IDEO, intends to involve primary and secondary teachers and their students in this process towards creating a more desirable future. Design thinking is, however, mostly applied in universities at the postgraduate level, in order to foster innovative thinking and collaborative interdisciplinarity to "effectively meet the demands of an increasingly complex world within which design is practiced" [4]. This could be due to the fact that undergraduate design programs typically focus on creating employable "problem-solvers" rather than "solution finders".

Given the benefits and outcomes that the design thinking process provides, be this as an innovation strategy or the power to have an impact on society [18], the researchers felt it timely to consider how this process might be introduced at the undergraduate level rather than wait until students reach postgraduate study. This is particularly the case when most designers at the researchers' institution enter the industry as soon as they have obtained their undergraduate qualification. The move into this area was also considered appropriate, given to date, the design students had experienced an innovative learning and teaching approach referred to as the POOL model [7], [8], [9], in order to help them become a T-shaped person [10], [11], [12], otherwise described as a specialist with an interdisciplinary mindset. Through the POOL model process they had become accustomed to complex teamwork projects and how to respond to a brief or problem using multiple inputs and ideas, with expertise exchange across university, industry and community sectors. Hence, students had experienced approaching a problem within the context of the use or system to which it belonged [54]. Within this approach however, the traditional design problem-solving method was not always entirely successful, with some projects lacking focus on the end user.

1.1 Generation "ME" – a rationale for introducing the design thinking process

As part of their undergraduate degree training, design students at the School of Creative Arts at James Cook University participate in a POOL model learning process, such as in second year where the design students collaborate with students from IT, journalism and photomedia to create complex web sites. These collaborations within and beyond the creative arts have generated positive learning outcomes for students, such as the development of enhanced interpersonal skills (e.g teamwork, communication) as well as an understanding of other disciplines, in that they learn that their contributions are inextricably linked and necessary as a whole when approaching problems. While these benefits are in evidence, it has emerged that there has been a relative lack of deep consideration of the end user through this process, arguably due to the fact that there is a significant investment of time in the POOL model process in helping students to work together effectively and efficiently to achieve the end result. Indeed much of their time is spent on "making the team work", especially as "[p]hilosophies underlying their respective disciplines regarding modes of creativity are often at odds with one another" [13].

There could be other reasons, indeed a recently published article "The Rise of 'Me' and the Fall of 'Us'" at the Education Insider News Blog suggests that "today's college students are lacking in empathy" [14]. When testing empathy levels, investigators [15] found that the score had dropped by nearly 40 percent over three decades. Indeed the current "Me" generation is argued as showing rising rates of individualism, self-esteem, narcissism and positive self-views, in fact according to some psychologists, "the youth today is so intrinsically self absorbed, rude, exhibiting selfish qualities that it comes as no surprise that they are fast losing the ability to empathize with other people" [16].

Hence would design thinking engage these students more in connecting with the user and imagine the world from a customer or user perspective [1]? Would they "pay close attention to what is visible and articulated, while sensing what is below the surface and unarticulated" [17]? While even design thinking advocates express concern that this process and looking at a few individual

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stakeholders in depth does not necessarily ensure that the bigger picture is considered (it may impede systems-thinking) [55], it was the intrinsically human-centered nature of design thinking [18] that was considered relevant to a comprehensive undergraduate design education. Therefore, while other tools to increase the understanding of the user were reviewed and considered (e.g. universal or inclusive design tools), the decision was made to test the design thinking process with a third year group of design students in response to the DTRS brief.

1.2 Facilitating the design of a mobile device product that surpasses conventional expectations for the elderly

This six-week project was conducted with a cohort of 19 final year design students and their design educator, representing a team of 20 designers. The DTRS brief was introduced to students as follows:

> **The Brief**
> *How can the design of products, spaces, and services make growing old seem more attractive and inviting?*
> 11% of the world's 6.9 billion people are over 60. By the year 2050 that figure will have doubled to 22%. If we are to support a growing number of older people we need to produce products, spaces, and services that allow them to stay healthy and well in and around their own home. You are asked to design a product or service for older people that surpasses conventional expectations. Your product or service will run on an iPad in the form of an application (app).
>
> **Steps involved in this assignment:**
> 1. Introduction to design thinking process
> 2. Research in a group of two designers and creation of a persona
> 3. Workshop: learn how to prototype with Flash Catalyst
> 4. Brainstorming in teams: outcome product or service
> 5. Design product or service
> 6. Prototype, user test and change if required
> 7. Document
> 8. Present and submit

The project was structured around the six steps of the design thinking process: understand, observe, synthesise, ideate, prototype, iterate. Figure 1 outlines the project structure and process, with key points of the process aligned to required student activities, including whether the students worked in groups of two, in teams of six to seven designers or as an individual at different stages. While there is the potential for the design process to be organic and/or reactionary and students were encouraged to move forwards and backwards between stages, in this case it was allocated across the first six weeks of the 13-week teaching semester hence had inbuilt milestone points that kept the process moving in sequence.

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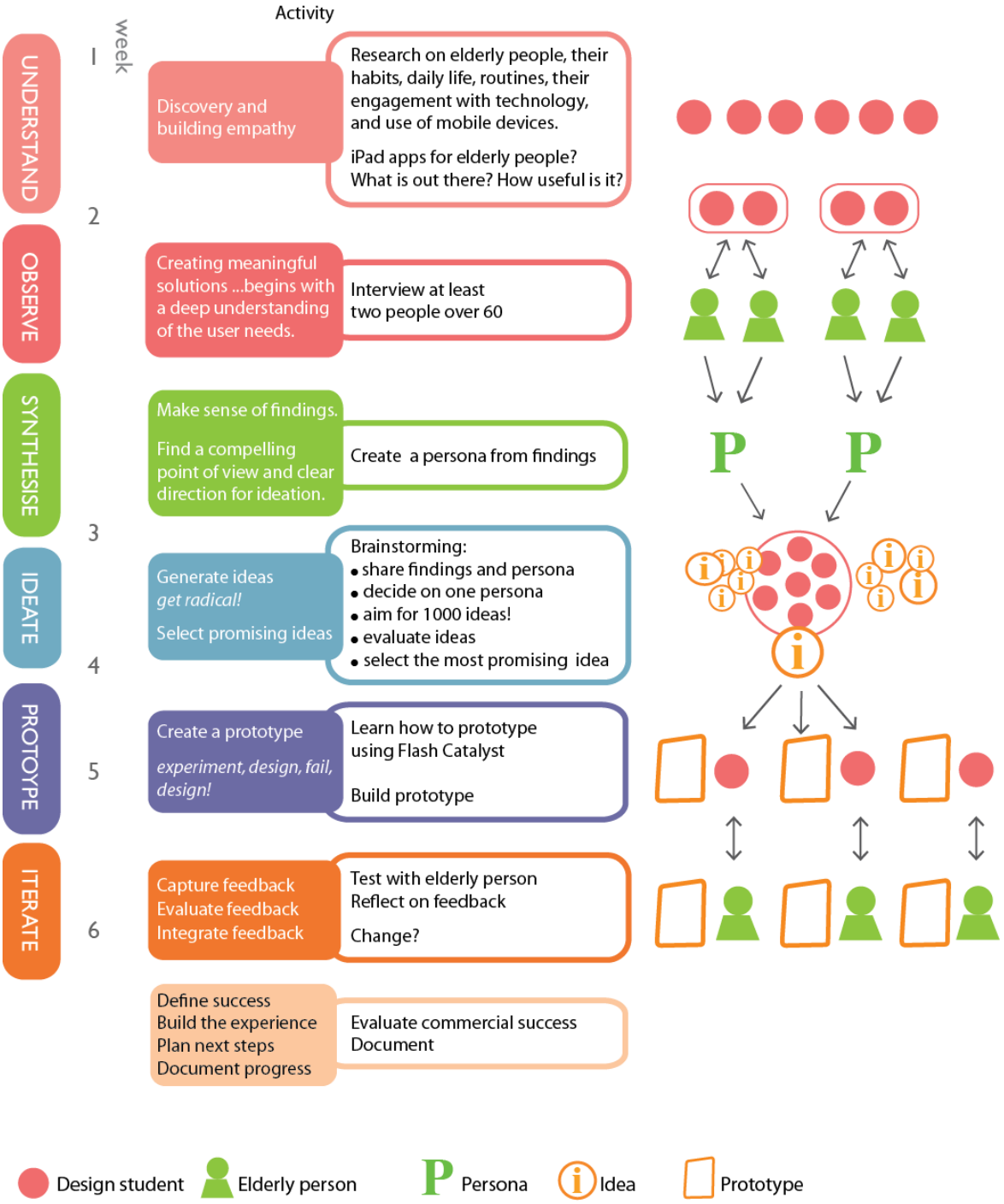

Figure 1. The design thinking process and project steps: apps for the elderly

UNDERSTAND: WHEN "WE" BECOME THE ELDERLY IN 2050

After introducing the brief the design team launched instantly into a discussion about what "older people" means in term of age and definition. A brief Internet query confirmed the students' thinking that most "developed world countries have accepted the chronological age of 65 years as a definition of 'elderly' or older person …" [19]. In the end, the design team decided to use the term "elderly", feeling more comfortable with this compared to "older people". It was also

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discussed in the early phases to look for data on the elderly in general, and then more specifically on the elderly in Australia. This included looking for the extent of iPad use amongst this demographic as well as the identification of existing iPad apps for this group.

What was interesting is the fact that during initial discussions it became apparent that the "elderly" seemed very old and distant to the majority of the design team and therefore the topic was not greeted with enthusiasm at first. An interesting twist was presented by one designer who raised the issue of how old each member of the design team would be in 2050. The result, startling for many, was that most team members would be between 59 and 65 years old at that time. This immediately led to a greater level of interest in that the design team felt that they were potentially developing this app for themselves. Equipped with this adjusted attitude, each member of the team subsequently set out to conduct background research, with the results summarised in the following sections: an ageing population, the elderly and technology, existing apps for the elderly, and designing for the elderly.

2.1 An ageing population

Globally, an increase in life expectancy and a decrease in fertility have led to a rise in the median age of the population, in fact the proportion of people over the age of 60 is increasing more rapidly than any other age group. According to the World Health Organization there will be 1.2 billion people over the age of 60 by 2025 and 2 billion people over the age of 60 by 2050 [20]. In most countries life expectancy for females is greater than that of their male counterparts, and this is reflected in "the higher ratio of women versus men in older age groups" [20]. In terms of the Australian context specifically, longevity continues to increase with "life expectancy at birth being 75.9 years for males and 81.5 years for females during 1996-98" [21]. The shift in the median age of the population is becoming also noticeable in Australia, with this forecast shift between 1990 and 2050 outlined in Figure 2 below.

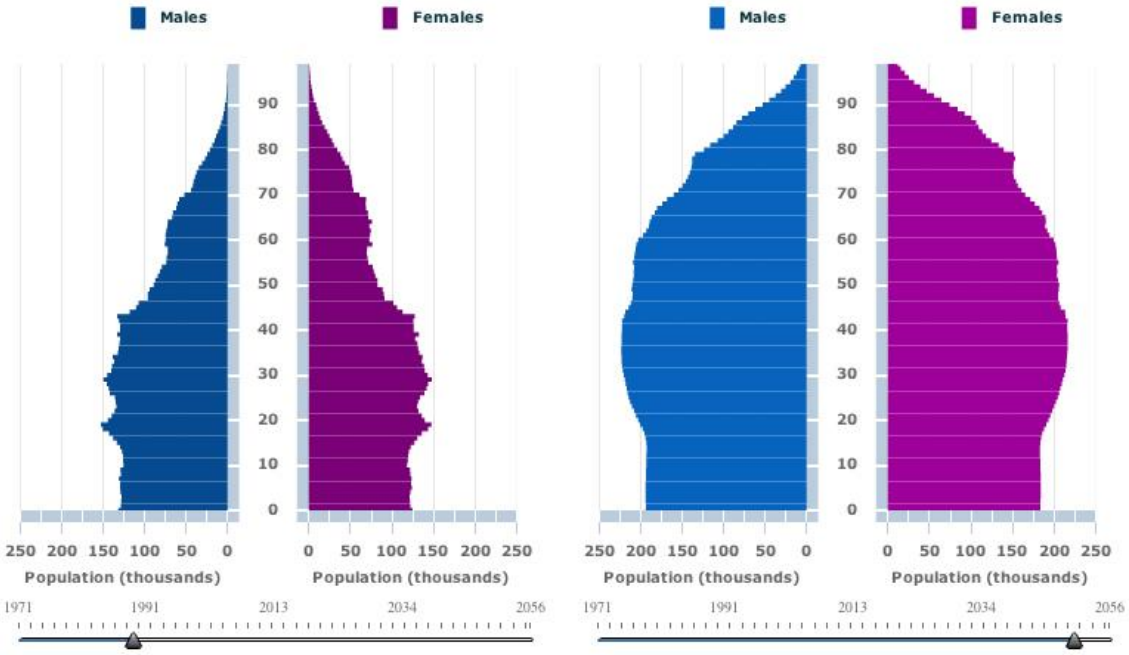

Figure 2. *Estimated age structure in 1990 and 2050 in Australia [41]*

While an increase in life expectancy represents, on the one hand, a major achievement for the 21st Century in terms of science and medicine, an ageing population presents a number of other social and economic implications for the future. Caring for an ageing population places a strain on social support systems and health care systems. In order to support this ageing population it is therefore

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necessary to design products, spaces and services that allow them to stay healthy and well. It is also important that the interface design of such products, spaces and services for the older population are designed appropriately, to suit their needs and interests, but also to cater to their physical limitations or access to technology.

The literature provides insights into the issues of relevance to a designer aiming to respond to the needs of an ageing population. For example, the World Health Organization argues that quality of life for the elderly is dependent on physical, social and mental well being [20]. Griffin and McKenna add that leisure activities are important after retirement from the workforce because they are closely linked to life satisfaction [22]. In relation to post-work activities, elderly men are more likely to pursue "more instrumental solitary interests" whereas elderly women are more likely to engage in "social and interactive interests" [23]. Research by the Intel Corporation into the attitudes of the elderly population across the United States and Europe has revealed four consistent needs and values: the desire to stay engaged and have a sense of purpose, the need to stay socially connected, the importance of maintaining independence and a denial of the challenges associated with ageing [24].

In the Australian context, the over 55 bracket has "25% of the country's disposable income and nearly 40% of its total wealth" [25]. Further, this is even predicted to increase over time [26]. Given the relative wealth and prosperity of this age group, many older Australians have the opportunity and flexibility to engage in more enjoyable and fulfilling experiences such as travel, hence become a member of the 'grey nomad' sector [27]. The 'grey nomads' are retirees who typically travel without a particular schedule or date to return to their normal place of residence. No longer remaining in their homes, 'grey nomads' are challenging the conventions of retirement, given their transient lifestyle and interest in meeting people [28].

2.2 The elderly and technology

In the literature there are frequent references to a generation (born 1946 -1965) known as "baby boomers" [29], who to a large extent are considered to be "technically savvy with high spending power" [30]. With a number of baby boomers beginning to retire and enter the over 60s market today, new marketing opportunities are beginning to unfold. For example, Turner found that baby boomers in the USA are as likely to own a mobile phone or to use the Internet as are members of generation X and Y [29]. In addition, as more and more baby boomers reach retirement, their use of technology is expected to rise, for example in Australia the number of adults over the age of 65 who access the Internet for email, chat sites and general browsing has more than doubled since 1999. [31]. According to Brandon [32], in reference to a study by the Pew Research Centre [53], the fastest growing number of social networking site users are baby boomers and seniors (i.e. the elderly). And while young adults still remain the greatest users of social media, "almost half (47 percent) of adults aged 50 to 64 now use social networking sites" [32].

Jaquette endorses the view that many baby boomers and seniors have embraced technology in order to engage in communications and stay connected with family and friends, be this through sites such as MySpace, Facebook and EONS, the latter where they can "learn about and discuss topics such as retirement plans, dating or even the post-retirement job market" [33]. While new technologies therefore offer a number of opportunities in terms of access to information, communication and social networking, there are also challenges associated with this access, with a number of elderly people reluctant to engage with technology. While this may be due to a lack of experience with computers, Milne argues that problems with motor control and poor vision can also create difficulty for older technology users [34]. Desktop computers, for example lack portability, laptops are heavy and may be difficult to use, while the small format of the iPhone is likely to present challenges for the elderly particularly in terms of vision. However, the recently released iPad is one new technology that may be highly suited to the older population and even the disabled [35].

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The size and weight of the iPad potentially make this device highly suitable for the elderly, in addition to the simplicity of a touchscreen and user functionalities. Senior Technology News argue that the capacity of the iPad to provide white on black display, full-screen zoom magnification, voice over screen reader, mono audio and support for playback of closed-caption content make it more accessible for elderly users [36], a view endorsed by both Dodge and Barangan [37], [38]. Cohen even suggests that the iPad's potential to create common ground between the elderly, their children and grandchildren "cannot be understated" [39]. The iPad has life changing potential, indeed Reisinger provides an interesting example of a 99 year old, who found it extremely difficult to engage in her favourite pastimes of reading and writing as a result of suffering from glaucoma. With the ability to enhance the brightness of the iPad display as well as customise the size of the text, this elderly lady is now able to read books and she is even "writing poetry on the tablet" [40].

2.3 Existing apps for the elderly

While there are more apps available for the younger demographic than for the elderly, there are a number of existing apps for the elderly that range from health related to memory enhancing through to entertainment. Flavell cites a number of health and well-being apps, for example self-check health apps and those that support memory and learning [42], the latter particularly useful because "[i]ntellectual skills which may have declined in old age, can be revived with coaching and practice" [43]. Other existing apps for the elderly can be found in the entertainment area include brainteasers, scrabble, Sudoku and Tetris games. Table 1 overviews a sample of apps specifically targeted at the elderly, with the broad area defined in column one, indicative apps described in column two, and then positives and negatives presented in column three, these identified by the design team during the 'understand' phase.

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Table 1. iPad apps specifically designed for the elderly

iPad apps for the elderly	Name and Description	Positives/Negatives
Health Self-Check Health Applications	**MedsLog by Modesitt Software** helps the user to remember which medications to take and when; maintains a log of previous consumption; data can be emailed to doctor.	+ Simple, easy to read layout + Easy to follow design - Lacks some functionality - Some small button features
	iPharmacy by SigmaPhone LLC medication guide; includes valuable information such as usage, dosage, warnings and precautions.	+ Good source of information - Some small button features
	HeartWise by SwEng LLC records and calculates systolic and diastolic blood pressure, etc. The export feature allows data to be sent directly to a doctor for review.	+ Easy and reliable to use - Complex visualization features may be problematic for elderly users
Memory Alzheimer's and Dementia Applications	**Alzheimer's Cards by Tracey Valleau** stimulate memory and help more advanced sufferers to recognise their surroundings.	+ Easy to use - No zoom option
	iKnowYou by Posit Science assists the user to make better associations with names and faces.	+ Easy to use - Only designed for iPhone screen dimensions resulting in smaller button features
Aging at Home	**iDown by NMA, LLC** is especially useful for the elderly who are at risk of falling. If a fall occurs the app sends an instant email or text message to designated recipients.	+ Excellent idea - More development of the accelerometer is required to make the app more reliable
Productivity Aids	**Chronolite – Timer by Treeness, LLC** especially useful for older users allowing them to set labeled timers and reminders.	+ Simple to use - No repeat timer function
Entertainment	**Epicurious Recipes & Shopping List by Conde Nast Digital** search more than 30,000 recipes, create shopping lists, and follow step-by-step recipe instructions.	+ Good source of information - Intrusive pop-up advertising
	iBooks by Apple download and read books; useful for the elderly is the ability to customize the screen brightness, font size, type face to make for easier reading.	+ Ability to customize screen brightness, font size and typeface for easier reading
	ScrapPad by Album tArt LLC scrapbooking app; allows the user to place pictures on a page, add embellishments and text; share your work via email or Facebook.	+ Easy to follow design + Lots of variety for personal creativity - Rotation and resize options are difficult to use - Some small button features

The design team certainly found it somewhat surprising that there is a variety of apps specifically targeted at the elderly available, with some quite innovative in that they assist the elderly in making use of specific technological features of the mobile device, such as the accelerometer of the iPad when used as a fall detector. What the team also found however were a number of issues that would affect the usability of these apps, including complicated visuals and small button features that would make these challenging for the user.

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2.4 Designing for the Elderly

Designing iPad apps for the elderly offers particular challenges for interface designers (e.g. vision, hearing, orientation matter), however recent research has been undertaken which offers insights into how to manage these issues (e.g. Zajicek [44], Hawthorn [45], Leckie [46]). In previous research on speech systems for older people, Zajicek developed a system that enables elderly people to access Web based data using speech input and output. As part of this research, Zajicek developed four guidelines for designers:

1. keep output messages brief, in order that elderly people are not confused or find difficulty in remembering complex information;
2. reduce choice wherever possible, again due to confusion that can arise from attempting to retain all possible options;
3. use mnemonic letters to indicate key press menu selections; and
4. use confirmatory statements where possible to increase user confidence.

Zajicek also recommends the use of memory supporting patterns to overcome the difficulties of remembering aspects of computer interaction [47].

Similarly, Hawthorn [45] identifies a range of recommendations when designing any form of computer interface for the elderly:

- simple layouts that focus on clarity and consistency with simple, relevant graphics;
- use lower frequency tones for sounds to cater for hearing impairments;
- use speech recognition software to cope with slower speech; and
- allow double-click speeds to be slower to cater for poor motor control.

Hawthorn also recognises that delays or distractions are problematic for elderly users with short-term memory problems. Consistent with Zajicek's first guideline [44], Hawthorn suggests the use of short texts or lists rather than paragraphs of text [45]. Finally, Leckie also provides guidance in relation to text, recommending particular fonts (e.g. Helvetica, Arial, size 12-14pt) and increased line spacing [46].

OBSERVE: ELDERLY PEOPLE, THEIR HABITS AND DAILY LIFE ROUTINES…

The background research gave the design team initial insights and a broad understanding into key issues of relevance to the elderly. The next step was to inquire directly about elderly in the local area, in terms of their habits, daily routines, and their engagement with technology and mobile devices. The design team was coached on how to achieve this through the design thinking process, with the design leader's approach reflecting Krieger's view that "you need to understand your audience even better than they understand themselves, but the only way you'll get there is to develop a deep empathy for their habits, beliefs, quirks, workarounds…. by asking as often as you can 'WHY?'"[48]. With this in mind the design team split into pairs, with each pair required to interview at least two people over the age of 60. Interviewees were often friendly neighbours, grandparents and friends of the family, with a total of 33 elderly people (age 60 to 80 years old) interviewed.

The design pairs were subsequently required to prepare summaries of the interviews, with two examples of these provided below in Table 2, with pseudonyms used to protect the anonymity of the interviewees.

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Table 2. Example summaries of interviews with the elderly

	Couple One	**Couple Two**
	Sue (60) + James (62)	Mary (60) + Henry (65)
Relationship	Husband and Wife	Husband and Wife
Employed or Retired	James is self-employed entrepreneur Sue is not employed as such, but is quite involved in her husband's work	Mary is employed full time by Queensland (QLD) Health Henry is recently retired from QLD rail, but occasionally engages in temporary work – renovation/station work etc.
Daily Activities	Both travel extensively for work and pleasure (sometimes up to a couple of times a week). This travel is both domestic and international. Their domestic travel is often undertaken in a caravan. Sue and James often entertain guests from both Australia and overseas. These can be related to their business or just friends. They also try to see their children and grandchildren as often as they can for the weekend. Sue is involved in theatre and other cultural events. James takes daily walks and Sue participates in swimming.	Mary is the only full time maternity matron at her hospital. She also is a diabetic specialist for her ward. She is usually always on call and bases a lot of her free time around work. She often goes to conferences or tours at other hospitals as part of work. When she's not working she likes to shop for herself, her home and her grandchildren. Henry spends a lot of time fishing, building and renovating now that he has retired. Soon he will embark on a 3-month stint at a station outside his town.
Attitude towards Technological Products	This couple is very tech savvy. Both own mobile phones, GPS, computers, laptops, plasma TV, pay TV. Sue has an iPod and even owns an iPad which she uses regularly to check weather and news. The couple uses the Internet to pay bills, write emails and book flights for example, however they prefer using alternative payment options (e.g. BPay) over credit card as they don't feel comfortable providing the details to the "Internet".	This couple also has a lot of gadgets, however Mary takes more interest in technological products than Henry does. Henry has a phone, utilizes the internet, television and GPS (for fishing). Mary also has a phone – it is touch screen and is able to download apps similar to an iPhone. She engages with the Internet (incl. chat and msn), television.

SYNTHESIZE: WHO ARE THESE PEOPLE?

Personas are fabricated models or archetypes of end users and they are often used in the design and development process of interactive work [49]. Personas "help guide the design process by shifting the focus directly to the user. …[which combined] with other tools, such as user testing and marketing analysis, can give the designer valuable insight into the user's needs" [49]. The design team by now had a wealth of information via research and personal interviews. Accordingly, it was decided to synthesize those findings through a creation of a persona, or "a singular icon representative of an entire group" [49]. Using information from the background research and the example of "Sue and James" in Table 2 above, where Sue provided the majority of the information, it was decided to create a persona named "Gladys" which can be seen in Figure 3 below.

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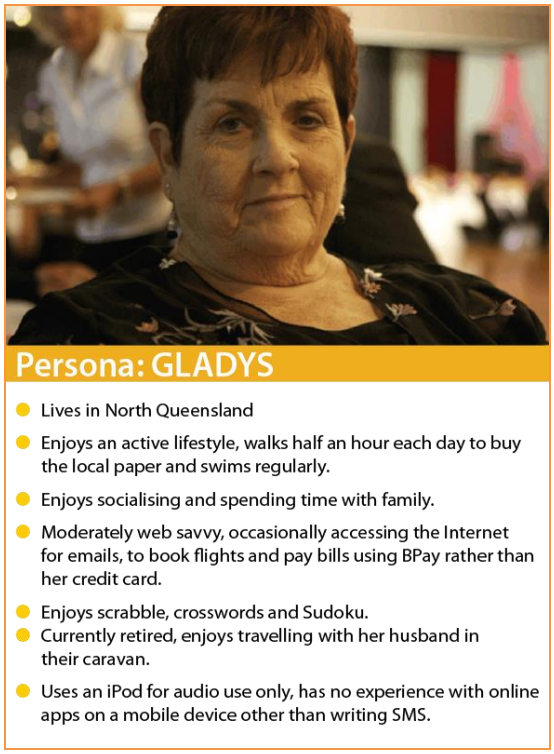

Figure 3. GLADYS–a female persona created through synthesising research findings and conducted interviews with elderly people

Another persona created was “Ted”, a retired 72-year-old male who is mildly familiar with the use of mobile phones and desktop computers, who is seen in Figure 4.

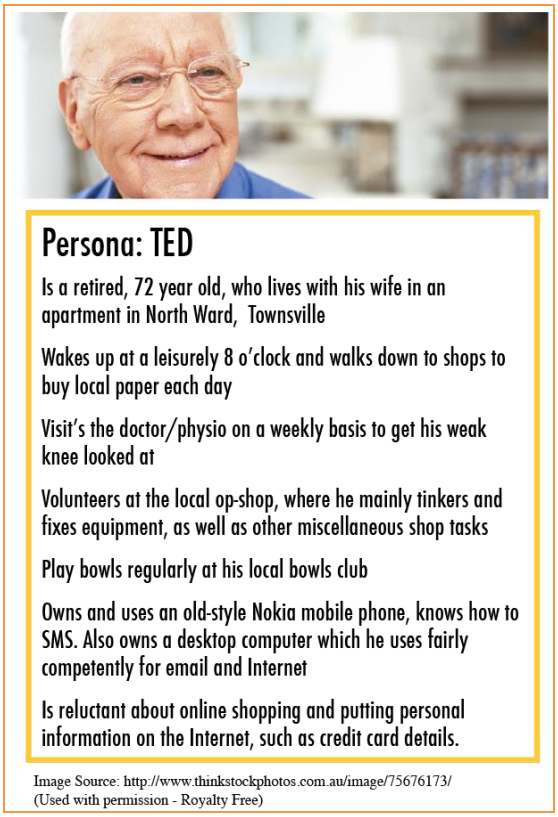

Figure 4. TED – example of a male persona created by the design team

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IDEATE: THINK "WILD" FIRST; "MAKING IT REAL" WILL COME LATER

In the ideation session the design team was split into three smaller teams of six to seven designers. The session was divided into two parts: sharing and brainstorming. During the sharing session, designers talked about their findings and introduced the personas. Each team then elected one persona that they felt was most suitable to brainstorm ideas for. The brainstorming process followed a number of general rules such as: defer judgment, encourage "wild" ideas, stay focused on the topic, one conversation at a time and build on the ideas of others [48], [50]. All ideas generated by the groups were recorded on a whiteboard. One designer in each team was elected as facilitator to keep the discussion flowing in order to encourage the creation of as many ideas as possible. In order to give insights into the ideation stage, section 5.1 below provides an overview of how Design Team 1 approached this aspect of the design thinking process.

5.1 Ideation - Design Team 1

This group spent most of the time discussing how the elderly live. They initially focused on whacky and unique ideas for apps, which included Health Check, Social Networking for Grey Nomads to Virtual Pet Apps. After the initial "brain dump", they moved into the next stage of the brainstorming process which was to prioritize the good ideas from the not-so-good ideas. To achieve this, each member placed a green post-it note next to the ideas they liked and orange post-it notes next to those they disliked. Figure 5 provides a visual of the brainstorming process undertaken by Design Team 1.

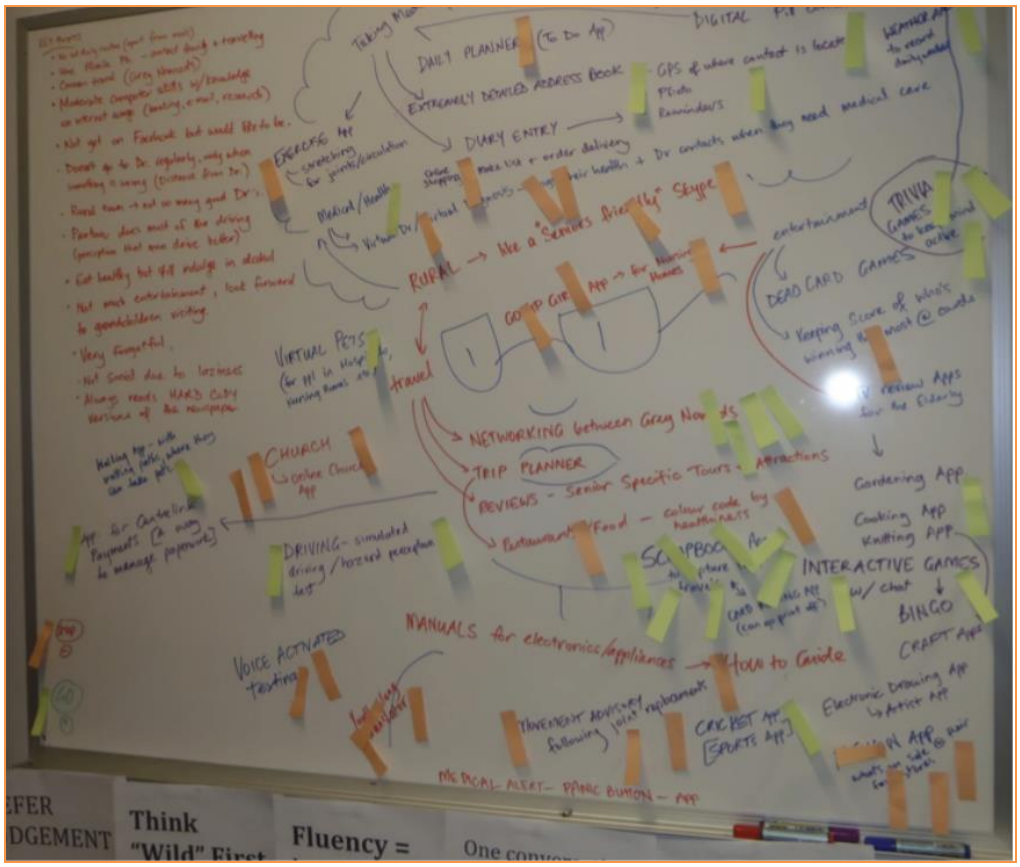

Figure 5. Example of a brainstorming session - Design Team 1

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Design Team 1 then proceeded to transform this brainstorm into a mind map, as presented below in Figure 6.

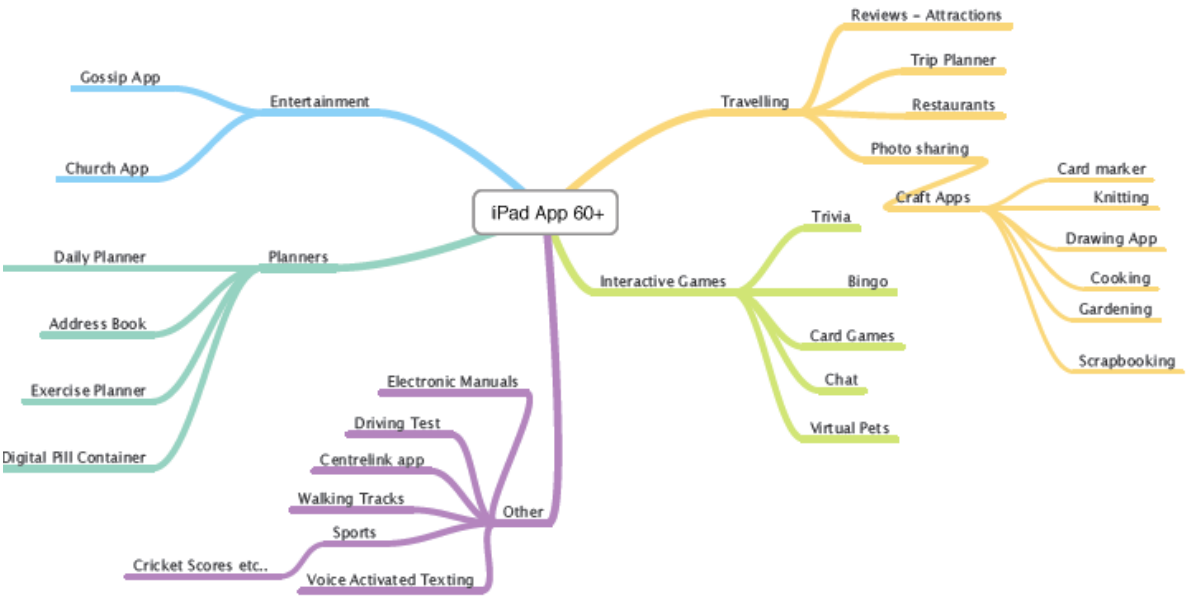

Figure 6. Brainstorming session translated to mind map by Design Team 1 (detail)

After this, Design Team 1 produced a list of “good ideas” and “not so good ideas’ as seen in Table 3 below.

Good Ideas	Not-so-good Ideas
• Scrapbooking/card making app • Social networking app for caravan travellers/Grey Nomads • Gaming apps specifically to keep their mind active [Trivia] • Daily organiser app for when to take medications etc. • Virtual Pet • App to organise paperwork/pension payments • Weather app • Digital pill container • Exercise app with maps of safe walking areas	• Youth translator • Voice activated text messaging app • Electronic manuals/how to app • Sports apps • Church app • Fashion app • Seniors-friendly version of Skype • Daily planner • Restaurant/Food app

Table 3. Outcome of prioritizing process of Design Team 1

The next stage of the brainstorming process was to elect an idea the team wished to develop. The final decision process was guided by shared findings, for example, that elderly people tend to do a lot of travelling and they love to take photos of their trips. As a team it was decided that the most popular and most appropriate idea was the scrapbooking/card-making app. It was argued that by introducing an online scrapbooking application with a capture option (for iPad2), it would be easy for the elderly to take snaps on-the-road and scrapbook them in order to share them with family

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and friends via an easy Internet sharing option, for example email or Facebook. Design Team 1 also discussed the need to create the option for end users to be able to print their creations and for it to be easy to use.

5.2 Sharing results and summary

After finalising their idea each team reported their findings to the rest of the design team. For example, Design Team 1 decided on a scrapbooking/card-making app, Design Team 2 on a virtual gardening app and Design Team 3 on a medication reminder that would include an innovative reminder option for the user's friends and family. During this session it became clear that in all three teams many ideas focused on connectivity and health issues. What is interesting is the view expressed by one designer which represented a consensus reached by all teams at the end of this part of the process: "We don't want to remove any aspects of their routine, and replace them with an app (e.g. getting the paper - this is daily exercise). We want to add to their lives, not take away".

PROTOTYPE: AN IPAD APP FOR THE ELDERLY

After each team had decided on a direction worth pursuing, designers were asked to work individually through the remaining stages of the design thinking process: the prototyping and iteration stage. Although prototyping is a rough and rapid portion of the design process in which the prototype can be a sketch, model, or a cardboard box [51], the designers were nevertheless introduced to interaction design software that allowed them to create a fully interactive prototype without writing code (Adobe Flash Catalyst). The designers however were also advised to be wary of Krieger's experience: "Users look at a lo-fi prototype and see potential; they look at a hi-fi prototype and see problems" [48]. In the end, several of the 19 designers created thoughtful and well-designed apps, with three of these provided in Table 4 below as brief examples.

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Table 4. Examples of design and prototype ideas from Design Teams 1-3

Design Team 1 brainstorming outcome: Scrapbooking/Card-making	
	*GreyNo* Easy to use scrapbooking and card marking app for grey nomads. **app includes:** • Scrapbooking and greeting card feature with layout templates; a library of backgrounds and borders, template greetings; • user can upload photos; • scrapbook and cards can be shared with family and friends via the GreyNomads network or by email.
Design Team 2 brainstorming outcome: Virtual Gardening	
	*iEARTHBOX* Easy to use app for elderly people who enjoy gardening but due to their ageing bodies find it difficult to access a regular garden. **app includes:** - step-by-step guide to creating a raised garden bed, or "earthbox" which would allow the elderly to enjoy the therapeutics associated with gardening without straining their bodies; - images of and information on plants (e.g. need for water, sunlight, what type of soil, etc.).
Design Team 3 brainstorming outcome: Medication Reminder	
 	*PillR* Pill timer designed for the user to easily set up reminders to take their daily medication. **app includes:** - conventional reminder functions (e.g. frequency selection); - 3D-view of medication package and content helping elderly remember what to take (especially useful when prescription changes); this feature is also helpful for people assisting elderly people in taking medication; - sync feature allows sharing a medication schedule with family or friends; they will be notified if a dosage is missed by the user.

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While Table 4 above gives brief insights into the type and functionality of the apps created by the design team, the following sections outline in detail the remaining stages of the design thinking process for the *GreyNo* app, in order to provide more in-depth insights into the process and outcome.

6.1 Design idea and prototype development for *GreyNo* app

Considering the outcome of the brainstorming session of Design Team 1–an app that would be an easy-to-use digital scrapbooking application for the elderly while travelling–it was decided that such an app would be particularly useful for grey nomads. The colours and font (Helvetica) used in the design were selected for their high contrast and legibility respectively, these also designed to cater to any vision impairments the user may suffer from. The scrapbooking and greeting card features of the application were designed with the same pattern or sequence of steps. This was to address any issues the user may have with memory.

The use of pre-designed templates for the scrapbooking and greeting card features of the application would also assist the user by limiting the number of options available. Zajicek suggests that limiting choice where possible will assist the user since the elderly may become confused with longer lists of options or have difficulty in remembering all information [44]. The networking feature of the application links to an existing website for grey nomads [52] where the user can participate in online forums. This networking aspect of the application was included because research suggests that a high number of baby boomers use Facebook for example and older women in particular engage in "social and interactive interests" [23].

In order to give visual insights into this app, which the student named "GreyNo", Figure 7 below provides parts of the storyboards and Figure 8a and 8b shows screen designs and indications for how the user would move and interact.

Figure 7. Storyboard for designing and developing the flow of the GreyNo app (extract only).

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Figure 8a. GreyNo app icon and start screen

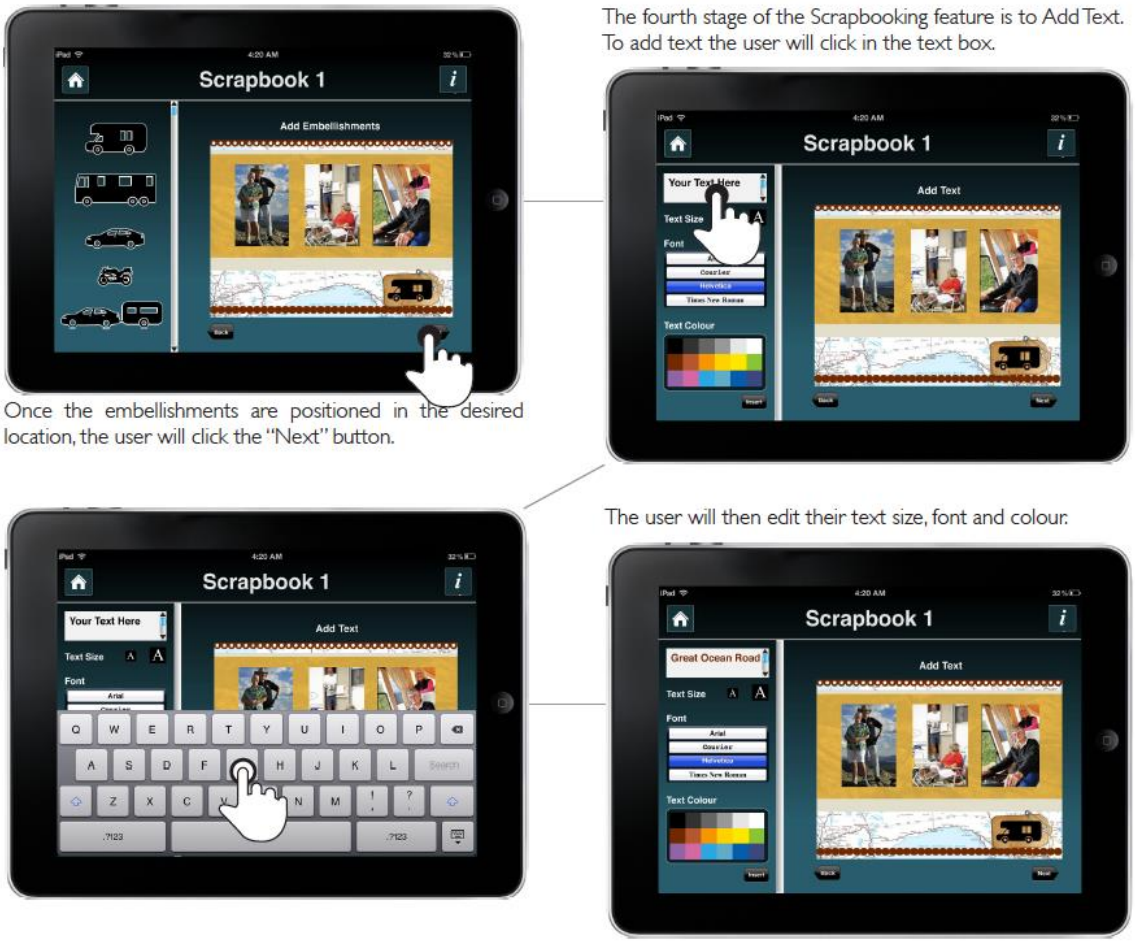

Figure 8b. Screen design indicating interaction of user and flow of GreyNo app (extract only)

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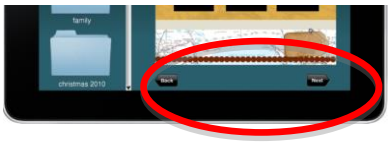
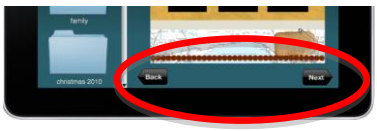
ITERATE: I LIKE, I WISH

Testing is part of an iterative process that provides designers with feedback, to learn what works and what doesn't, and then iterate. This means going back to the prototype and modifying it based on feedback. Krieger recommends an 'I like … I wish' approach to testing during which users point out things they like about the prototype and things they wish were different [48]. This approach was applied by many of the designers during their testing phase while the prototypes at this point were in various forms, ranging from sketches and printed screens to interactive devices. Sections 7.1 below overview the iteration process for the *GreyNo* app.

7.1 Testing *GreyNo* app

User testing was conducted with a 60-year old elderly lady, with screen designs presented for feedback. At this stage the user was asked where she would want to 'click' or touch the iPad to test how intuitive the application would be. The layout of the application proved to be reasonably successful and the user found the overall design to be appealing. However during the testing the user presented some criticisms (e.g. some buttons were too small) and this feedback was used to modify the final design. Table 5 provides examples of the *GreyNo* app designs before testing, the user feedback and resulting changes to the design.

Table 5. Iteration of GreyNo app

Before	Feedback	After
	The user identified that the titles for each stage of the application were too small. This issue was resolved by increasing the font size of each title.	
	The user commented that the "Next", "Back", and "Insert" buttons were too small and may be difficult for older people to see. This issue was resolved by increasing the button size.	
	At times the user became somewhat confused with the sequential operations of the app. To overcome this problem, one step in the sequencing was deemed to be unnecessary and thus removed from the app. Markers at the top right of each screen were added to show how far the users had progressed in each sequential operation.	

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As is indicated above in Table 5, the user testing stage proved to be a valuable opportunity to measure the success and failure of the application's interface and interaction design and to improve the app's design and functionality.

REFLECTIONS ON COMMERCIAL SUCCESS

Although this project did not require of designers to develop the app to be fully functional, part of the reflection process entailed that they evaluate the potential commercial success of the iPad apps. This step was considered important in order to contextualise once more the design process within research findings as well as potential market realities.

8.1 Commercial success of *GreyNo* app

The proportion of people over the age of 60 is increasing more rapidly than any other age group. An application such as *GreyNo*, which is specifically designed for the elderly, could be in high demand in the future. Most notably, the networking capabilities of the app would arguably appeal to both men and women because according to Brandon, the fastest growing numbers of social networking site users are baby boomers and seniors [32]. On the other hand the networking capabilities may be more relevant to elderly women because they are more likely to engage in "social and interactive interests" [23]. Regardless, Jaquette explains that staying connected, sourcing information, communicating with friends and having an alternative form of communication are among the reasons why seniors have embraced this new social media [33]. Hence, it was felt that the networking aspect of this app would be a positive indicator of success. While it would most likely be popular within a niche market, with further development, the designer felt that *GreyNo* had the potential to be a commercial success. However, the application would need to offer more features to make it more relevant to the grey nomads, such as maps, caravan park or camping guides as well as tourist information.

OUTCOME: ENHANCING THE DEVELOPMENT OF EMPATHY IN UNDERGRADUATE DESIGN STUDENTS

The DTRS brief was presented to students in order to test if the intrinsically human-centered nature of the design thinking process might be of value in general but also enhance empathy and help students to focus their design considerations on the customer or user. In order to explore this, students presented a final written reflection which required that they specifically respond to this issue. Although one student did not submit this final reflection, the other eighteen provided insights into the ways in which the process encouraged a greater focus on the end user, with the following five examples indicative of this.

Student 1
I obtained much more of an understanding about my user by undergoing the interviewing in comparison to if we were just given a topic and told to design for it.

Student 2
I did not think the elderly needed an application let alone an iPad to use. But through the researching process, I began to further understand the appeal and use it would bring to a new technological savvy generation in the future.

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Student 3
I believe that meeting with a potential application target group (elderly person) was a good idea. It was good to find out the things that they needed and to try and brainstorm ideas to actually deliver that assistance. I found the project was engaging in the sense that you get out and interview potential clients/customers of your design/application and get the real truth about what they think of the product.

Student 4
Interviewing individuals from the target market group allowed me to fully understand the attitudes and typical activities of a population that is so different to my own.

Student 5
Talking to the elderly also captivated me. I never realised how they lived their lives and how little freedom and mobility they had. It was hard to realise where they were coming from and how life really was for them.

It is clear from the above five examples that exposing students to the end user requires that they develop both knowledge of the process as well as the development of a greater sense of empathy. Further evidence of the value of both the approach as well as the development of empathy within the designer was identified in the findings of a short final survey presented to this same group of students at the end of their semester after which they had completed a different multimedia project. In addition to 88.9% confirming that they enjoyed the initial design thinking approach, 72.2% of the participants also indicated that they were more readily applying the concept of empathy for the end user in their second multimedia design project. This is clear evidence that the project involving the design of an app for the elderly led the majority of students to change the way they approach the design process. While some students did not indicate that it was of influence in their next project, the fact that the majority indicated it was influential is a pleasing result for the researchers and a positive answer to the research question.

CONCLUSION

Overall, the introduction of the design thinking process for a group of third year undergraduate design students was considered successful for two main reasons. Firstly, students developed and displayed enhanced empathy when designing an iPad app for the elderly. Indeed the students, initially challenged by the brief and the process, increasingly enjoyed the process the more they learned about the elderly. Assumptions about the user over time turned into understanding. Understanding created empathy which translated into app designs that showed considerations for the elderly, hence this became a new experience for the students as a consequence of participating in the design thinking process. Secondly, the design thinking process has encouraged a group of young designers to conceptualise the future, to understand a problem before attempting to design a solution, and to undertake a more considered approach to the creation of products and services. While this process was challenging for all involved, the real benefits are likely to emerge in the future, once the students in the design team apply the learning they have obtained through this initial process to their future actions and activities.

Note from author (K.F.)
Being an educator for quite some time and reading students' positive reflections on the design thinking process was very rewarding. I would like to thank all 3rd year students who participated in the design thinking process and in this project.

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