
Article:
Grindell, C. orcid.org/0000-0003-0671-1498, Mawson, S., Gerrish, K. et al. (2 more authors) (2018) Exploring the acceptability and usability of a novel social innovation to encourage physical activity: The iStep prototype. Health and Social Care in the Community. ISSN 0966-0410

https://doi.org/10.1111/hsc.12656

Exploring the acceptability and usability of a novel social innovation to encourage physical activity: The *iStep* prototype.

ABSTRACT

This study explored the acceptability and usability of the *iStep* prototype a novel social innovation to encourage intergenerational physical activity to help reduce obesity levels in older age. Obesity is a major public health issue and physical inactivity is one of many factors that influence this, especially in childhood and later life. *iStep* (a pedometer and interactive website) sought to increase physical activity levels across the life course through intergenerational partnerships participating in walking challenges together. This was a qualitative mixed methods study involving 130 participants from two different settings. Pupils and teachers from a local secondary school (n=120) tested the *iStep* prototype over two separate two week periods. Pupil and teacher partnerships engaged in a walking challenge using pedometers and the website platform. In addition 10 retirement age women were involved in a modified co-operative evaluation of the prototype. Two focus groups with pupils (n=9 and n=20), semi-structured interviews with teachers (n= 5) and one dyadic interview (pupil/teacher) were undertaken. Data were analysed using an iterative thematic approach. Five themes were identified: perceptions of the technology, attitudes towards the walking challenge, attitudes to the intergenerational partnership, competition versus collaboration and promoting physical activity. The pedometer was a useful motivational tool which raised awareness of physical activity levels. The website was thought to be simple and easy to use.

Walking was deemed inclusive and accessible to all age groups and setting a target goal was considered beneficial. Engaging in physical activity with a partner was regarded as a good way to provide support and encouragement. Overall this early prototype evaluation showed that *iStep* has potential to be an innovative and engaging way to encourage increased physical activity across generations. It may positively contribute towards reducing obesity levels in older age but outcomes that effectively measure this need to be incorporated in any future *iStep* testing.

What is already known about this topic:

- Healthier aging is a global priority
- Maintaining and increasing physical activity levels across the life course is important to help reduce disability and obesity in later life.
- Innovations that support behaviour change are important to tackle public health priorities.

What this paper adds:

- Utilising a novel but simple technology can encourage physical activity in both younger and older generations.
- Intergenerational partnerships can provide support and encouragement to increase physical activity levels across the life course.

Key words:

Physical activity, social innovation, intergenerational

Introduction

Obesity is a major global public health issue and a significant risk factor for disease and disability in later life. It is known to contribute to conditions such as diabetes, hypertension, coronary heart disease, and osteo-arthritis, which can have significant effects in reducing longevity and causing activity limitation (Department of Health & H M Government, 2011; Foresight, 2007; Yumuk et al, 2015; World Health Organization, 2013 & 2017).

It is widely accepted that appropriate responses to the global challenge of rising levels of obesity include public health interventions at population and environmental levels, as well as behaviour change interventions directed at the personal and clinical levels of preventing and treating obesity in at risk individuals (World Health Organisation, 2013). In this regard calorie restriction and increased exercise levels are the main targets for behaviour change (Yumuk et al, 2015).

However around two thirds of the adult European population do not meet the levels of physical activity (PA) required to gain its numerous health benefits and rising levels of inactivity are directly related to increasing obesity levels (Scholes &Mindell, 2012; Sjöström, Oja, Hagströmer, Smith, & Bauman, 2006). Inactivity and the associated problems it causes account for growing costs in health care, with lower levels of PA in childhood and later life contributing to higher risks of morbidity and mortality (Department of Health & H M Government, 2011; Sallis, 2011; World Health Organisation, 2010).

It is therefore a matter of global importance to find ways to help people to maintain or increase PA levels over the life course in line with international recommendations, to prevent disabling consequences in later life and improve population health (National Institute for Health and Care Excellence, 2016; Department of Health & H M Government, 2011).

The achievement of behaviour change, to increase activity levels thereby reducing the potential development of obesity across the life course, is an important and legitimate focus for innovative technologies. Therefore, social innovations enhanced by information and communication technologies (ICT) which increase PA levels have a potential to affect the health span and lifespan of people of all ages.

This study is part of a larger programme of work InnovAge that was funded as part of the European Commission's Seventh Framework programme and explored how social innovations might support healthy and active ageing and contribute to the EU Horizon 2020 goal of extending healthy life years.

The social innovation

iStep (intergenerational support to encourage physical activity) is the prototype design solution developed by the research team (from Sheffield Hallam University and the University of Sheffield). It aims to target behaviour change related to PA because of its potential (as part of a package of behaviour change interventions) to impact on health outcomes related to obesity across the life course. The research team implemented the concept of the six stages of social

innovation, applying a hybrid of health and social sciences and user-centred design methods to develop the prototype, as per stages 2 and 3 of the social innovation process (Murray, Caulier-grice & Mulgan, 2010; Mawson et al., 2014)**.** See figure 1.

Figure 1:

Preliminary work undertaken by the research team to inform the development of the prototype included, a systematic review of intergenerational interventions targeting obesity, qualitative interviews that explored older women's perspectives of PA throughout their life course and a number of participatory user-centred design workshops. This work concluded that the innovation should be personalised, engaging and allow for individual capabilities. It should also incorporate every day activities and encourage sociability (European Commission: CORDIS: Projects and Results Service 2016) as lack of social contact in later life can negatively influence mental and physical health (Coutin & Knapp, 2017).

The participatory workshop participants indicated that grandchildren were a strong motivator for staying active, for example, being able to play with them or by wanting to be part of their lives for longer. They also suggested that health issues were a barrier to physical activity and their General Practitioner recommended walking as an inclusive way of keeping active (European Commission: CORDIS: Projects and Results Service, 2016).

However, there is little evidence for intergenerational interventions that include older adults and none focus on the intergenerational influence up the generations (European Commission: CORDIS: Projects and Results Service, 2016).

The *iStep* prototype therefore seeks to promote intergenerational PA by allowing children and an older adult to pair up and work together towards a shared walking goal. Each participant is given a pedometer and a specific walking challenge and logs their daily amount of steps on an online platform, see figures 2 and 3. It is envisaged that *iStep* will encourage PA and social interaction and support via the use of the website and the unique intergenerational partnership.

Figures 2 & 3:

This paper describes and reflects on the findings of this formative evaluation of the *iStep* prototype in order to:

1) To explore the usability and acceptability of the *iStep* concept to potential dyads in different contexts

2) To gain an understanding of what factors may influence its uptake.

As the study sits within the developmental stage of the MRC framework for evaluating complex interventions (Craig et al., 2007) it does not test the prototypes effectiveness nor will it include outcomes relating to weight loss.

Methods

Design

The study adopted a pragmatic, iterative process of qualitative data collection and analysis with distinct phases and differing user groups. Semi-structured interviews and focus groups were chosen for the prototype testing carried out in the school environment as participants' experience, perceptions and behaviours towards the prototype were being explored. A modified co-operative evaluation was selected for use with the older women as it was felt this would be a less threatening way of introducing the *iStep* concept to them. Some had indicated a degree of apprehension towards technology during the qualitative interviews they had participated in earlier in the project. Co-operative evaluations are a useful method for prototype development to provide early feedback about redesign in a rapid iterative cycle. (Monk, Wright, Haber & Davenport 1993).

Ethical approval was gained from Sheffield Hallam University Research Ethics committee and The University of Sheffield School of Health and Related Research Ethics Committee for the school setting and older women respectively.

Participants

120 participants (60 pupils and 60 teachers) with an age range 12-60 years, were recruited from a local South Yorkshire school to test the *iStep* prototype. This was a convenience sample directed by the school who were keen for both their teachers and pupils to be involved in a project focusing on PA. Year 7 and 8 pupils were chosen as they had the least academic commitments. Access to all pupils and teachers was enabled via the school's head of physical education (PE) and a teaching assistant (TA).

After testing the *iStep* prototype in the school setting the study team decided to approach the older women who had already participated in the preliminary qualitative work. They represented a group who are known to be less likely to engage in PA (female and older) and therefore would provide a different perspective with regards to the prototypes usability and acceptability. The twelve women were aged 65-80, from low socio-economic groups (index of multiple deprivation 4 and 5) and had differing weight status (Body mass index 22-38). Table 1 highlights the demographics of the participants.

Table 1:

Procedures

Participant information was provided to all participants. This was circulated via the head of PE to all staff and year 7 and 8 pupils. This was sent by post to the older women. Informed consent (including parental consent for pupil participation) was gained for all participants.

The school setting

Teachers and pupils were randomly paired up by the head of PE and had the opportunity to initially meet during a routine school assembly. They were provided with instructions to enable them to sign up to the *iStep* website and set up and use an Omron walking style one 2.1 pedometer (omron-healthcare.com, 2017). They then completed a walking challenge over a 2 week period using the *iStep* technology. This involved wearing the pedometer all day, every day during the challenge and inputting their daily steps onto the website using their own

computer/tablet at a time convenient to them. This occurred in two separate cohorts with 30 pupils and 30 teachers in each (n=120 overall). Pupils and teachers did not physically walk together outside the school environment.

Cohort 1 completed a group collaborative challenge and aimed to walk the equivalent distance in steps of the trans-pennine way (a long distance walk from Liverpool to Hull). The steps of each pupil/teacher pairing contributed to the overall target number of steps.

Cohort 2 completed the same walking challenge but as competitive dyads. Each individual teacher/pupil pairings cumulative steps contributed to the overall target goal. Each dyad could compare their progress with other dyads in their cohort via the website and engage in playful competition if they wished.

After completion of the 2 week walking challenge a selection of pupils took part in 2 focus group interviews (n=20 and n=9 respectively). All pupils who had undertaken the walking challenge were invited to attend. Attendance was dictated by class timetables meaning that numbers varied across the two groups. A PE teacher was present to support author 1 who facilitated these sessions. Semi-structured interviews were carried out with 5 teachers. In addition one pupil/teacher pairing were interviewed together. Interviews were carried out by the first author and took place at the school at a time convenient to pupils and teachers.

The modified co-operative evaluation

In the final phase of the study ten out of the twelve post retirement age women consented to participate. Two declined due to recent ill health.

A modified co-operative evaluation was conducted with each of the ten women by the first author at each participants home. This formative evaluation involved a demonstration of the pedometer and *iStep* website to all ten women. Each participant was then given the opportunity to try the 'live' website. Seven out of the ten women chose to do this and were given specific tasks to perform whilst the researcher observed. A series of debrief questions were then asked relating to their thoughts and experience of viewing/using the prototype. They did not participate in a walking challenge with a younger partner.

All interviews (including the co-operative evaluations) were audio recorded except for the pupil focus groups where flip charts and 'post-it' notes were used to facilitate participant engagement. In addition the researcher made field notes during and immediately after data collection.

Interview schedules were developed by author 1 and verified by authors 2,3 and 5. Separate interview schedules were used for the pupil focus groups, staff semi-structured interviews and dyadic interview. All used open-ended questions that explored participants thoughts, feelings and experience of using the technology (pedometer and website), of the walking challenge, the intergenerational partnership, competition versus collaboration and any suggestions for improvement to the prototype.

A task sheet was devised for the formative co-operative evaluation (Monk et al., 1993). Participants were asked a series of debrief questions by the researcher following the demonstration/use of the *iStep* website. These questions followed a similar format to the other interview schedules. Prompts were included in all the guides to support further exploration if required. The interview guides ensured consistency whilst still allowing the researcher flexibility to explore any emergent accounts from the participants.

Data analysis

This pragmatic approach to evaluating the usability and acceptability of the *iStep* prototype was an iterative process with each phase and its context influencing the way they were executed. Focus group and semi-structured interview data were transcribed, the latter verbatim. The co-operative evaluation audio recordings and observations were transcribed and pertinent points summarised. Anonymity was preserved by removing all names and identifying data. Field notes helped supplement all the data collected and aided in interpretation.
The data was thematically analysed using an inductive, realist approach. This involved a six-phased coding process to establish meaningful patterns. These included: familiarization with the data, producing initial codes, searching for and reviewing themes, defining and naming themes and developing a final report (Braun and Clarke, 2006). Initial codes were discussed and member checked with authors 2,3 and 5 to enhance rigour.

Results

Five themes emerged during the iterative analysis process. Perceptions of the technology, perceptions and attitudes towards the walking challenge, perceptions and attitudes towards the intergenerational partnership, competition versus collaboration and promoting PA.

Perceptions of the technology

Overall the pedometer was seen as a motivating tool by all three groups of participants (pupils, teachers, post-retirement age women). They all liked the idea of monitoring their own steps and thought this stimulated an element of self-motivation and competition. The pedometer also seemed to prompt an increased awareness of PA levels.

'*The actual pedometer acts as motivator as well. You know but seeing it and saying ' I want to get to..' setting yourself individual goals ' I wanna get to this many steps by the end of the day' so 'I'm not going to if I stay in the house I'm going to go for a walk, I'm going to take the dog for a walk' or something like that'* (P5)

The participants thought the *iStep* website was simple and straightforward to use. This was particularly important to some of the post-retirement aged women who were not as confident using technology and initially viewed it negatively. However, the website's simplicity did make it less engaging for some of the

younger users. In the school setting, the pedometer seemed to be the main focus, with the interactive aspects of the technology less well received.

'Well I think you've made it as idiot proof as you possibly can. I think it's very good and quite plain and simple and anybody that is active at using a computer in any way, shape or form I think would be able to activate this. I'd be surprised if they couldn't.' (RW10)

Furthermore the older women objected to some of the language used on the website such as the term 'dyad' instead of 'partner' and 'kudos' instead of 'message'. Some elements relating to page layout and tab functions seemed difficult to navigate such as the view partner steps function. In fact the messaging function was not used at all in cohort 1 or 2 and the data implies that participants were not aware it even existed. Nevertheless when asked all three groups of participants liked the idea of being able to message their partner through the website.

Perceptions and attitudes towards the walking challenge

All participants felt it was important to have a goal to aim for. However it appeared crucial that this goal was realistic and achievable in order to sustain interest and motivation. Some preference was shown towards different activities such as swimming, cycling or the gym, particularly by some of the older teachers and pupils. However some participants and their parents had health concerns that affected their attitude towards walking/PA. Some of the older women did participate in PA to alleviate symptoms such as joint stiffness. Others found joint pain a barrier to being more active. There was also reference to family members being inactive and unhealthy and it was assumed that for these reasons the *iStep* concept would not interest them. Overall walking was

recognised to be accessible to all and a good starting point to encourage people to increase their PA levels.

'I'm just wondering whether I'm physically able to do any of this. I'm not very good (at walking). I've not got much speed at all. You know this is the only thing. You know I do have a lot of pain and it's in my back and it affects my walking.' (RW10)

'I can see that walking is the simplest thing to do and the easiest thing to do with somebody else. You can do it from your front door.' (RW2)

Perceptions and attitudes towards the intergenerational partnership

Taking part in physical PA with a partner was considered to be a good way of providing encouragement and support. Knowing your partner was important to facilitate this. Older women in particular felt it would be a good way of combating social isolation to some degree. In this respect they were more open to unknown partnerships to expand their social networks:

'I can see it would be useful for those people who don't have much contact. It would make you have a bit more contact.'(RW2)

However the intergenerational partnership drew contrasting views across the different stages of the research. Generally the school pupils expressed a preference to be partnered with their friends whereas the adult participants

were more open to the idea of participating with someone younger. Both pupils and the younger teachers were apprehensive about partnering with their parents or grandparents. It was perceived that grandparents would not be able to be active enough. However this was disputed by some of the older women who felt they were more active and motivated than the younger generation of today.

'My grandma would only be able to do about 2000 steps, she wouldn't be able to do it.' (G2- school pupils focus group)

'I could guarantee if it's a much younger partner I'd do more steps than them. Cos they'd give up quicker. Because they're used to sitting about. ' (RW7)

Competition versus collaboration

The *iStep* prototype allows walking challenges to be completed with a partner either competitively or collaboratively. In other words, each individual's steps count independently towards the target goal or the pair's steps are accumulated and count towards it together.

There was an overall feeling from participants that collaboration was a good thing. They all seemed to like the notion of working together as a team to achieve a goal. Distinct differences were however apparent between the three groups with regards to competition. The school pupils clearly enjoyed competing with their friends and the younger PE teachers enjoyed competition with colleagues in their department. Even the older teachers demonstrated some competitive traits despite showing negative feelings towards it as a

concept. By comparison, the older women varied markedly. Some considered themselves competitive, others were not. Despite this, most participants were self-motivated.

'I really enjoyed the competition especially in our department. With the staff, not necessarily the other members of staff, particularly with PE.' (P2)

'Now I would be happy to join in with that (collaboration). I'd be happy to make a commitment to something. But competing I wouldn't be interested you know. Because I feel I would always be the one at the back.' (RW10)

Promoting physical activity

Those who had the opportunity to use the *iStep* prototype felt it had a positive influence on their PA levels in some way. Generally it was important that PA opportunities were easily accessible and could fit into daily routines, such as going to the gym after work, walking to and from the shops. However sustaining enthusiasm to continue using *iStep* over the longer term was a concern. Health promotion, such as healthy eating campaigns were suggested as possible ways of achieving this.

'I think you'd need some impetus to start it. But it would be interesting to see how much you did as a family, how many days it might take you to walk it you know whatever. But like H I don't know how much, how long we would carry that

on for. You know there becomes a point where it's just the same you know you might set a challenge and try to achieve but I don't know.' (P7)

'I think it's a bit like having the 5 a day. I think it's something to aim for. You know and it's there as a goal. Right it's a reminder that you should try to have 5 fruit and veg a day. You should try and walk more. You know I see it as like that really.' (P3)

Clearly further consideration would be needed in any future development of the *iStep* concept with regards to broadening reach and sustainability.

Discussion

The aim of this study was to evaluate the acceptability, usability and uptake of the *iStep* prototype from the dyads perspective. The following discussion is structured around some of the key issues arising from the findings.

The use of technology to support physical activity

The findings indicate that all participants found *iStep* an acceptable and usable technology. The pedometer and website were found to be simple and easy to use. These factors are important when considering longer term compliance to PA interventions, particularly amongst the older population (www.exerciseismedicine.org; Harris et al., 2013; Nied & Franklin, 2002). However, the intention with *iStep* is to engage both the younger and older generation to influence positive attitudes to PA via a life course approach. It has

been suggested that interventions that are suitable for children may not be appropriate for older adults and vice versa (Kang, Marshall, Barreira, & Lee, 2009) and this may explain why some of the school pupils found the website less interesting.

The pedometer and website allowed participants to keep track of their progress and provided objective feedback. Other studies suggest this is important to influence healthier behaviours (Harris et al., 2013; Khan, Weiler, & Blair, 2011; Normansell et al., 2014). Most participants found the pedometer motivating and goal setting useful and these findings are supported in the literature (Harris et al., 2013; Kang et al., 2009; Khan et al., 2011; Normansell et al., 2014) However in some instances the opposite may be true. PA monitoring can be demotivating, particularly if unrealistic or unachievable goals are set (Normansell et al., 2014) and a small proportion of the older participants in this study were worried about this. Positive effects have been seen across all age groups when using pedometers to influence PA levels (Kang et al., 2009).

There are numerous devices available to monitor steps/PA, some more reliable and refined than pedometers. The basic website design could also be superseded by more sophisticated web and app technology. However pedometers are cheap and uncomplicated (Harris et al., 2013; Kang et al., 2009) and the *iStep* prototype was purposefully designed to be simple and user friendly in order to be as inclusive as possible and not to limit reach.

Clearly some alterations to the website are required and mobile app technology needs to be considered in any future iterations of the *iStep* concept.

Walking as the physical activity of choice

Walking is the only option currently on the *iStep* prototype. The findings indicate that having more choice, for example swimming or cycling, may be desirable, to influence uptake and sustainability. However walking is free, it is a means of getting from A to B, is easily incorporated into daily routines, is safe and appropriate, and the most common form of PA used by adults (www.exerciseismedicine.org; Harris et al., 2013). The *iStep* concept aims to reach as many people as possible and walking is transferable across a diverse range of social demographics. This range would be significantly narrowed by incorporating more specific activities such as cycling into the prototype at this stage.

Setting walking challenges of differing lengths that can be carried out over different time scales means potential users have a choice of target goals. These can be selected to suit their existing levels of physical ability. The findings and the literature suggest this is desirable to gain and sustain motivation (Harris et al., 2013; Nied & Franklin, 2002; Normansell et al., 2014; World Health Organisation, 2010).

However despite *iStep* offering varied options some older participants were still concerned about their ability to participate due to physical ailments, in particular musculoskeletal conditions. Health problems have been shown to be a barrier to PA particularly in the elderly (Nied & Franklin, 2002; Normansell et al., 2014). In fact the literature suggests that PA can sometimes exacerbate existing health conditions (Normansell et al., 2014). However it has been reported that

PA can help relieve symptoms such as joint stiffness (Normansell et al., 2014). Similar findings arose in this study. It is important to note that the benefits of PA are thought to far outweigh any perceived health risks and that some activity is considered better than none particularly in those people with low baseline activity levels (Harris et al., 2013; Public Health England, 2014).

Intergenerational partnerships

The use of technology to monitor and facilitate increased PA levels is not a new concept. It is the intergenerational component of *iStep* that makes this innovation distinctive. The literature review carried out in the preliminary stages of this project identified a lack of evidence for the use of intergenerational exchange to promote PA specifically targeted at reducing obesity in older age (European Commission: CORDIS: Projects and Results Service 2016). It was found that most studies focused on the influences of intergenerational exchange and PA on the child rather than up the generations which is *iSteps* intention, a grandparent being influenced by participating with a grandchild for example. However this preliminary evaluation was unable to provide any meaningful insights relating to this. Views regarding the intergenerational partnership were mixed and restricted to teacher pupil partnerships. Future evaluation of *iStep* will need to focus on the intergenerational dimension.

All participants could see the potential benefits of engaging in PA with someone else to provide support and encouragement and this is in line with current recommendations (Normansell et al., 2014). The most recent UK NICE guidance

for obesity prevention and lifestyle weight management (2016) specifically states the importance of families and carer involvement in supporting weight loss management interventions.

Participants suggested not having family nearby and busy lifestyles as potential barriers to engaging with *iStep*. However *iStep* is internet based so intergenerational pairings are not just limited to those who have friends and family close by. *iStep* allows flexibility so users can complete walking challenges either physically together or remotely, communicating via the website thus having the potential to improve social contact. Social isolation particularly in older age is known to have a negative impact on both physical and mental health (Coutin & Knapp, 2017) and some of the older women in this study felt *iStep* had the potential to combat this. Studies have also shown that flexible physical activity interventions, like *iStep,* can potentially facilitate user engagement (Normansell et al., 2014).

The findings from this study provide some limited evidence that through the intergenerational component of the prototype, *iStep* has the potential to effect PA levels and promote healthy behaviours through the life course. It therefore has the potential to reduce the risk of morbidity and mortality from obesity related conditions in older age (World Health Organisation, 2010).

Study limitations

This study posed many limitations. Conducting research within a school setting is challenging. Direct access to pupils and staff was limited and the researcher

relied on one senior member of staff and a TA for recruitment. Gaining informed consent from both pupils and their parents was therefore difficult. Organising interviews and focus groups with pupils and staff was restricted due to school time-tabling and exams.

It is acknowledged that only pupil/teacher partnerships were tested in this study. It had been hoped that pupil/grandparent partnerships could be tested but recruitment for this via the school was unsuccessful. Ethics approval was also gained to approach a well-known national weight management organisation. They unfortunately would not allow us access to their customers. The older women who participated in the co-operative evaluation were unable to test the prototype with younger family members due to project time constraints.

Only one researcher was involved in data collection and initial analysis. Researcher bias was minimised by using a researcher who had not been involved in the earlier developmental stages of the prototype. All codes were checked by other members of the research team during analysis. It is acknowledged that one of the pupil focus groups was large. However having a TA present helped the researcher facilitate this session. The use of flip charts and post-it notes further enhanced pupil engagement.

Finally this study evaluated the usability and acceptability of the *iStep* prototype only. Therefore no baseline data or outcome measures related to effects on BMI were collected.

Conclusion

The findings from initial *iStep* prototype testing show it is an acceptable concept to a range of potential users (both younger and older). The pedometer raised awareness of PA levels and was perceived to be motivational. The website was considered a useful way to monitor progress towards a PA goal. These findings are in line with current guidance (WHO 2010, Public Health England 2014; Yumuk et al., 2015).

iStep also has the potential to provide encouragement and facilitate communication/contact between peers. It therefore may improve sociability and provide motivation to be more active or lose weight (Coutin and Knapp 2017, NICE 2016). Clearly modifications to the website to improve the communication functions are required.

Walking was generally perceived as inclusive and accessible. In order to add diversity and increase uptake, other activities may need to be considered for future *iStep* iterations. These additions may also help sustain engagement and maintain increased activity levels over the longer term. This issue however requires broader consideration.

Finally the unique intergenerational aspect of the *iStep* prototype requires further investigation. Testing so far indicates that the concept is acceptable to provide support and encouragement. However pairings during this evaluation

were only between teachers and pupils. This could explain why the intergenerational aspect elicited mixed opinions.

Despite the limitations of this initial evaluation, the findings are encouraging. They indicate that *iStep* has potential to be an innovative and engaging way to encourage increased physical activity across generations. However in order to demonstrate any positive contribution towards reducing obesity levels in older age further testing of the prototype within stage 3 of the innovation process is required in a range of different settings and using different models of intergenerational collaboration. Evidently outcomes that effectively measure physical activity levels and weight loss need to be incorporated into future testing before sustaining, scaling and spread within the social innovation process (stages 4 and 5) can be considered.

References

Braun V, Clarke V. (2006) Using thematic analysis in psychology. Qualitative research in psychology.3(2), 77-101.

Australian Government. National Health and Medical Research Council. Department of Health, (2013). Summary guide for the management of overweight and obesity in primary care.

Craig P,Dieppe P, Macintyre S, Michie S, Nazareth I & Petticrew M. (2006) Developing and evaluating complex interventions: New guidance. The Medical Research Council.

Catenacci V. A., & Wyatt, H. R. (2007). The role of physical activity in producing and maintaining weight loss. *Nature Clinical Practice Endocrinology & Metabolism*, *3*(7), 518–529.

Coutin E & Knapp M. (2017). Social isolation, loneliness and health in old age: a scoping review. *Health and Social Care in the Community*, *25*(3), 799–812.

Department of Health, & H M Government. (2011). Healthy Lives , Healthy People : A call to action on obesity in England, 51.

European Commission : CORDIS : Projects & Results Service : Final Report Summary - INNOVAGE (Social Innovations Promoting Active and Healthy Ageing). Retrieved from http://cordis.europa.eu/result/rcn/182216_en.html

Exercise Is Medicine: a global health initiative. (2015). Retrieved from http://www.exerciseismedicine.org

Foresight. (2007). Tackling Obesities: Future Choices – Project report - 2nd Edition. *Foresight*, 164.

Harris T, Kerry S. M., Victor C. R., Shah S. M., Iliffe S., Ussher, M., Ekelund UV, Fox-Rusby J, Whincup P, David L, Brewin D, Ibison J, DeWilde S, Limb E, Anokye N, Furness C, Howard E, Dale R & Cook D. G. (2013). PACE-UP (Pedometer and consultation evaluation--UP)--a pedometer-based walking intervention with and without practice nurse support in primary care patients aged 45-75 years: study protocol for a randomised controlled trial. *Trials*, *14*(1), 418.

https://www.omron-healthcare.com/en-gb/products/activitymonitoring.

Intercollegiate Guidelines Network. (2010). Management of Obesity: A clinical guideline.

Janney C, Jakicic JM, Marcus BH & Lang W. (2008). Effect of Exercise on 24-Month Weight Loss Maintenance in Overweight Women. *Archives of Internal Medicine*, *168*, 1550–1559.

Kang M, Marshall S. J, Barreira T. V & Lee J.-O. (2009). Effect of Pedometer-Based Physical Activity Interventions: A Meta-Analysis. *Research Quarterly for Exercise and Sport*, *80*(3), 648–655.

Khan K. M, Weiler R, & Blair S. N. (2011). Prescribing exercise in primary care. *BMJ (Clinical Research Ed.)*, *343*, d4141.

Mawson S, Nasr N, Parker J, Zheng H, Davies R, & Mountain G. (2014). Developing a personalised self-management system for post stroke rehabilitation; utilising a user-centred design methodology. Disability and rehabilitation:Assistive technology,9(6):521-8.

Monk A, Wright P, Haber J & Davenport L. (1993). Improving Your Human Computer Interface: A Practical Technique (Bcs Practitioner).

Moyer VA. (2012). Screening for and Management of Obesity in Adults: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*, *157*, 373–378.

Murray R, Caulier- Grice J & Mulgan G.(2010). *The Open Book of Social Innovation*. The *Young Foundation* (Vol. 30).

National Institute for Health and Care Excellence. (2015). *Preventing excess weight gain. NICE Guideline*. *nice.org.uk/guidance/ng7*.

National Institute of Care and Excellence. (2016) Obesity in adults : prevention and lifestyle weight management programmes.

Nied R. J, & Franklin, B. (2002). Promoting and prescribing exercise for the elderly. *American Family Physician*, *65*(3), 419–428.

Normansell R , Smith J, Victor C, Cook D. G, Kerry S, Iliffe, S, Ussher M, Fox-Rushby J, Whincup P & Harris, T. (2014). Numbers are not the whole story: a qualitative exploration of barriers and facilitators to increased physical activity in a primary care based walking intervention. *BMC Public Health*, *14*(1), 1272.

Public Health England. (2014). Everybody Active, Every Day.

Sallis, R. (2011). Developing healthcare systems to support exercise: exercise as the fifth vital sign. *British Journal of Sports Medicine*, *45*, 473–474.

Saris W, Blair S, van Baak M, Eaton S, Davies P, Di Pietro L, Fogelholm M, Rissanen A, Schoeller D, Tremblay A, Weserterp KR & Wyatt H. (2003). How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. *Obesity Reviews*, *4*, 101–114.

Schoeller D, Shay K & Kushner R. (1997). How much physical activity is needed to minimize weight gain in previously obese women? *American Journal of Clinical Nutrition*, *66*, 551–55.

Scholes S, Mindell J. Physical activity in adults. (2012). The Health and Social Care Information Centre HSE. 1(2):1–49.

Sjöström M, Oja P, Hagströmer M, Smith B. J, & Bauman A. (2006). Health-enhancing physical activity across European Union countries: the Eurobarometer study. *Journal of Public Health*, *14*(5), 291–300.

Tate DF, Jeffery RW, Wing RR & Sherwood NE. (2003). Physical activity and weight loss: does prescribing higher physical activity goals improve outcome? *American Journal of Clinical Nutrition*, *78*, 684–689.

Wadden TA. (1993). Treatment of obesity by moderate and severe caloric restriction. Results of clinical research trials. Annals of Intern Med, 119, 688–693.

Yumuk V, Tsigos C, Fried M, Schindler K, Busetto L, Micic D, Toplak H. 92015) European guidelines for obesity management in adults. Obesity facts. The European journal of obesity;8:402-424

World Health Organisation. (2010). Global recommendations on physical activity for health.

World Health Organization. (2013). WHO | Obesity and overweight. Fact sheet no 311.

Tables and Figures

Fig 1: The social innovation life cycle **(**Murray, Caulier- Grice & Mulgan, 2010)

Fig 2 & 3: The *iStep* website

Table 1: Demographics of the study sample