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Using a bespoke situated digital kiosk to encourage user participation in healthcare environment design

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ABSTRACT

Involving users through participation in healthcare service and environment design is growing. Existing approaches and toolkits for practitioners and researchers are often paper based involving workshops and other more traditional design approaches such as paper prototyping. The advent of digital technology provides the opportunity to explore new platforms for user participation. This paper presents results from three studies that used a bespoke situated user participation digital kiosk, engaging 33 users in investigating healthcare environment design. The studies, from primary and secondary care settings, allowed participant feedback on each environment and proved a novel, engaging *"21st century"* way to participate in the appraisal of the design process. The results point toward this as an exciting and growing area of research in developing not just a new method of user participation but also the technology that supports it. Limitations were noted in terms of data validity and engagement with the device. To guide the development of user participation using similar situated digital devices, key lessons and reflections are presented.

1. Introduction

Improving patient and staff experience of healthcare services and environments has become commonplace in both research and policy (Bate and Robert, 2006, 2007; Hasvold and Scholl, 2011; Span et al., 2013; Couter et al., 2009). These improvements have involved different stakeholders in on-going discourse about personal experiences of healthcare as well as how services and environments might be improved. This is important since healthcare environments have a profound impact on patients, staff and visitors, with positive design contributing to enhanced physical and psychological status as well as productivity (Dalke et al., 2006; Ulrich, 1991; Devlin and Arneill, 2003).

1.1. User participation

Involving the user through participatory methods such as participatory design/ergonomics, co-design, experience-based design, cooperative design, and action research aim to remove traditional barriers between researchers, designers and users in the design of systems, environments and technology. These methodologies generally evaluate people's tacit knowledge for understanding experiences and developing artefacts, systems, or new ways of working (Spinuzzi, 2005) within a specific context (Halloran et al., 2009). Vink et al. (2008) remark that is through these processes that the context (through understanding a group's norms, language and concerns of the different actors) is therefore critical to successful design interventions.

Participatory ergonomics (PE) is an approach which promotes improved design ideas and solutions, and contributes to systemic outcomes of value to both organizations and individuals (Wilson et al., 1997). PE approaches provide tools (use of paper prototyping, work groups, simulations) for people to articulate their tacit knowledge, which is otherwise inaccessible - in a similar vein to participatory design (Hall-Andersen and Broberg, 2014; Broberg et al., 2011; Spinuzzi, 2005). Such methods provide successful and balanced discourse between members involved in the PE process. This builds trust and bidirectional communication between

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the researcher or designer and participants (Dearden and Rizvi, 2008).

There is however, scope to develop digital tools to facilitate PE to mediate dialogues between the researcher/designer-participant and participant-participant in contexts that may be difficult to get these actors together, for example healthcare. Barriers for conducting research in healthcare include issues of manpower shortages, family commitments, shift patterns, and research activity compromising work (Loke et al., 2014). Therefore, digital facilitation of the participation process provides a way to negotiate these problems and potentially engage with a greater range of hospital users. We call this approach 'situated user participation'; the act of involving a user of an environment in the design process mediated through a digital device (Fig. 1). Such a device locates itself as a boundary object in the design process. It is used as a means of transferring and sustaining knowledge when stakeholders are dispersed, and acts as a design object to enable participants to design with, not just comment on (Hall-Andersen and Broberg, 2014; Broberg et al., 2011). This is depicted in Fig. 1.

1.2. Digital technology and user participation

Several studies demonstrate the effectiveness of digital technology for involving users in a similar manner with application ranging from political voting (Taylor et al., 2012), civic engagement (Hosio et al., 2012) through to assessment of nutritional values in food (Reitberger et al., 2014). In this last example, a situated display along with its mobile application allowed a more informed choice about people's shopping to create healthier buying habits. These applications demonstrate how situated devices are playing a larger role in the world around us – even when grocery shopping. Reitberger et al. (2007) remarks there are a multitude of displays providing touch-points and information. Using situated devices to encourage discussion and participation on a topic is not new in healthcare. DiRocco and Day (2011) used a computer kiosk for patients to give immediate electronic feedback on service provider information about patient experiences. The overall response rate from the digital feedback was 50% (1923/3850) compared to their existing response rates of around 19% per quarter for paper based postal surveys.

In the appraisal and improvement of healthcare environment design this is of particular importance. If a device is situated within the environment in question people can use the context of their surroundings to inform their comments; they are in the 'here and now' of the space. However, little work has looked at using situated devices in healthcare to appraise and develop these environments. The approach offers significant potential as participatory methodologies are tied to technological and organizational developments (Halskov and Hansen, 2014). This may not only complement the existing approaches of, for example Experience Based Design (NHS, 2013), but may be used to shed new light on how the physical healthcare environment is experienced with this information to be used by estates managers and designers.

1.3. Aim

A bespoke situated participation digital tool was developed as part of a large-scale research project investigating participation in healthcare environment design. The aim of the device, termed digital kiosk, was to increase the ease of user participation in the appraisal, design, and development of healthcare environments. The research question underpinning the work was defined as: 'how do users interact with and perceive a bespoke situated digital device to encourage participatory design of healthcare environments?' The paper answers this by reporting on three studies describing users' perceptions and interaction with the developed kiosk. To guide the development of user participation using similar situated digital devices, key lessons and reflections are presented.

1.4. Research design

Investigating the use of the kiosk involved three steps:

I. Development of the computer kiosk: This section provides the rationale and development process of the kiosk.
II. In use: This section details three studies in which the kiosk was used. This includes the evaluation of an emergency department, the development of design recommendations for a new Wellbeing Centre within a large UK hospital, and the appraisal of a health centre environment.
III. Discussion of use: This section describes user's perceptions of the kiosk and also insights relating to its use based on the results of the three studies.

2. Development of the computer kiosk

The purpose of the computer kiosk was to act as a tool to gather data from participants. As discussed, existing methods used within participatory design require a facilitator to be present, so the kiosk

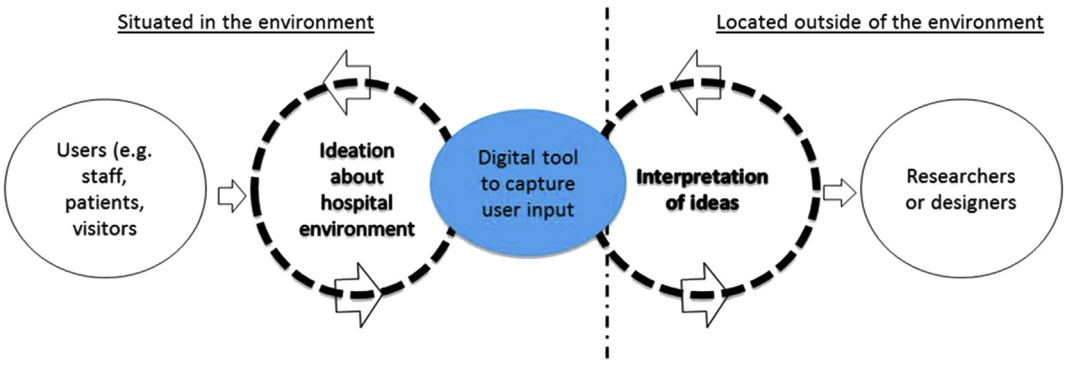


Fig. 1. The location of the digital tool as a boundary object in user participation process.

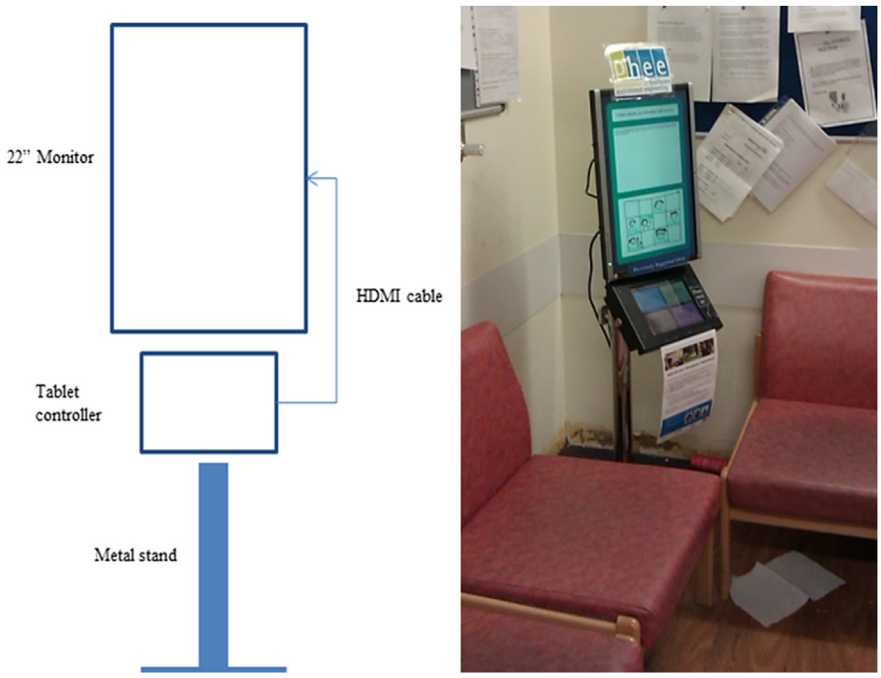


Fig. 2. Technical set up of the kiosk (left) with kiosk in use (right).

mitigated this. A more detailed discussion of the development is detailed in Marshall et al. (2011). The kiosk used a tablet computer connected to a large screen (see Fig. 2). The tablet used a bespoke software application to present different tasks of the environment to users (see Fig. 3 and Appendix A). This sense-making was an important feature, as participatory methods are a social process in which participants communicate, co-operate and negotiate with each other (Steen et al., 2013). Although Steen et al. (2013) referred to workshop type events, by presenting the views of others it was hoped that this would encourage mediated discourse amongst participants.

The kiosk was developed using initial sketch and paper prototyping within the research team to explore and define what information the kiosk would be required to show. Effectiveness across a broad range of research projects was necessary. During this time, different screen layouts were tested to accommodate the wish for images and text to play roles in producing and mediating tasks. Cardboard prototypes were created to ensure that the physical design of the kiosk was able to cater for a variety of users.

Participants responded to questions using the tablet controller. Importantly, the questions, detailed as challenges revealed bespoke tasks created to investigate each case study. Other respondents' comments were displayed on the larger screen once they had been completed. Participants were able to view other participant contributions on the monitor screen and then contribute their own views rather than reworking these existing descriptions.

3. Part A. In use

The kiosk was used in three studies each investigating different aspects of healthcare environments. Across all studies the role of the user (patient, staff and visitor) of the healthcare environment was to give their thoughts (written and drawn) on improving and developing the environment. This data was used to create research findings to provide guidelines for design briefs for use by project partners (hospital trusts and design agencies).

3.1. Sample characteristics

The studies achieved a desired level of sample accuracy in terms of types of users involved rather than one of sample size. This form of purposive sampling used the premise that the number of people involved in the research is less important than the criteria used to select them (e.g. users of healthcare environments) (Wilmot, 2005). Therefore, the sample represented users of healthcare spaces rather than estates managers, designers or architects who may interpret data from the kiosk.

3.1.1. Analysis

Thematic analysis was used to draw out inductive reasoning (see Elo and Kyngäs, 2008) around the use of the kiosk from verbal, pictorial and written data. Interview sessions in study 3 were recorded on a Dictaphone and transcribed verbatim. Detailed notes were written up and included in the analysis to help contextualise the narrative of the transcripts. Across all studies (1–3), coding was conducted using NVIVO 10 software with analysis led by authors JM and SP. Triangulating these sources together pulled out key themes regarding the use of the kiosk. Each study is described below with results presented followed by a detailed discussion.

3.2. Study 1: emergency department staff room development

The broad aims of the study were to capture staff perspective towards an Emergency Department (ED) environment within a UK NHS hospital. Results were used to provide guidelines for improvements to the environment, which had been highlighted as causing stress. Here the kiosk was used for healthcare staff to

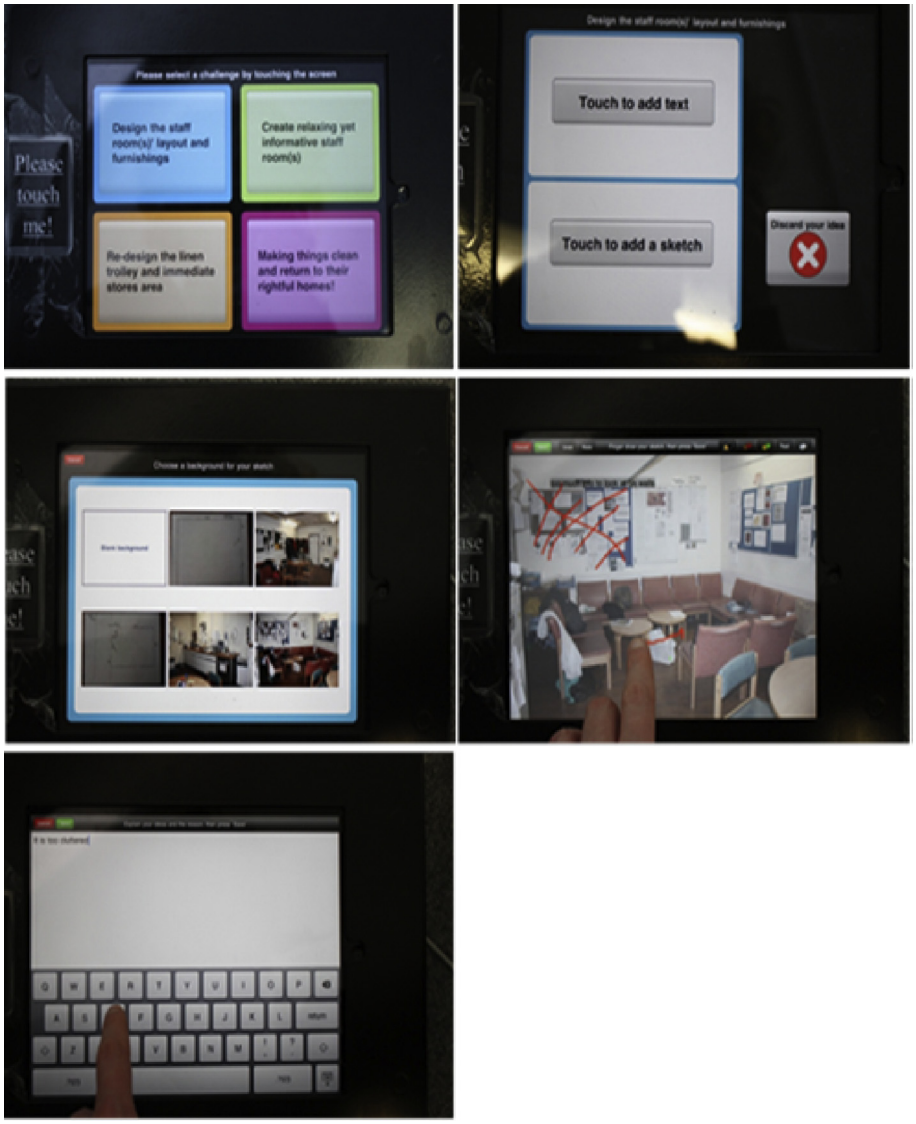


Fig. 3. Application screen layout and sequence (full details in Appendix A).

engage in the appraisal and redesign whilst in the staff room, with an objective of the study to understand participant interactions with the kiosk through the inputs provided.

3.2.1. Procedure

The kiosk consisted of four tasks for participants to complete (full details in Appendix B) including:

Improving the staff-room layout.
Making the staff-room relaxing and informative.
Improving trolley and immediate stores.
Placing items in a clean and correct place.

Participants were asked to give ideas as to how the environment could be improved through annotating images and giving written descriptions as per the kiosk format. The kiosk was located in the staff common room within the ED department.

3.2.2. Sample

A total of n = 15 healthcare professionals voluntarily took part (ranging from nurses, healthcare assistants and doctors) who had access to the staff room.

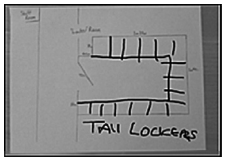
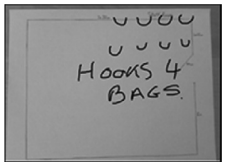
3.2.3. Summary results

A total of 58 units of data were obtained. Twenty-two units were unusable with inputs unrelated to the tasks thus 36 units of data were used for analysis. Participants were able to use the interface to show how the environment could be improved, through the removal of a feature or the introduction of a design feature. This visual representation enabled both the participants and the researchers to understand how these may influence the environment (in terms of aesthetic) and the relative complexity of any design alterations. Results are presented in Table 1:

3.2.4. Practical implications

Results formed the basis of a design recommendation guide

Table 1
Data obtained from study 1 Emergency Department staff-room.

Tasks	Themes extracted	Data
Improving the staff room layout	Social elements	
	Removing clutter	
	Use of whole space	
Making the staff room relaxing and informative	Name boards	
	Tidy spaces	
Improving the linen trolley and immediate stores	Storage space	
Placing items in a clean and correct place	Storage space and facilities	

given to the ED for improving the staff common and storerooms. Data collected formed the user centred evidence for suggesting these along with displaying the relative complexity of the alterations. The study showed that participants were able to interact with the kiosk and provided data for the broader aim. Indeed, 62% of the data obtained was usable (defined as being related to the task posed by the kiosk). This proved an encouraging start to using the kiosk as a participatory tool.

3.3. Study 2: Wellbeing Centre

The aim of study 2 was to gather views on the design of a future Wellbeing Centre within a large NHS hospital. The kiosk assisted with this task to encourage input from a broad range of potential users to this future facility.

3.3.1. Procedure

2The kiosk was used to gather views from users of the hospital towards the new centre. This focused on three design areas (the physical design of the proposed Centre; the atmosphere of the Centre; seating used in the Centre) see Appendix C. These views supplemented design workshops occurring at the same time. All questions used images to supplement written descriptions. Participants were given multiple-choice answers with options for free comments. The kiosk was positioned within the physiotherapy waiting areas for a weeklong period each at separate times. This was located adjacent to the future Wellbeing Centre. To capture additional information, a paper version of the kiosk capturing the same information was positioned in these locations on the alternate times to the kiosk. This allowed for a comparison to be made by the research team regarding which method was most effective (measured through number of usable responses).

3.3.2. Sample

A total of 11 participants voluntarily interacted with the kiosk. These were patients/visitors/staff attending the wards although the exact breakdown is unknown due to the anonymous nature of using the kiosk and the variety of users in the space.

3.3.3. Summary results

This process captured similar themes to that of the data extracted within the design workshops (see Payne et al., 2015), which suggest that the tasks and kiosk obtained valid data. A total of 25 units of data were obtained. Not all responses were related to the task with some inputting unusable data through random text input (n = 10). Others used the device to voice opinions not related to the tasks but to service aspects of the hospital; "*I missed 1 appointment in the past year at physiotherapy department and was dismissed*". Therefore, of the data collected 60% was usable. Results are listed in Table 2.

3.3.4. Practical implications

The kiosk provided support to the project findings in developing a design brief (see Payne et al., 2015). This was used by a healthcare environment design agency to interpret empirical findings to create evidence based design concepts for the design of the Wellbeing Centre. The kiosk proved more effective in capturing feedback than the paper versions. The paper version yielded n = 5 units of data of which 100% was usable. However this was recorded from n = 1 participant. In contrast the kiosk recorded 60% of usable data from n = 11 participants. Use of the kiosk was comparable to the results of study 1. It was therefore apparent that deeper insights into participant interactions with the kiosk were needed in order to explore reasons for unusable data.

3.4. Study 3: evaluating a health centre environment

This study aimed to capture healthcare professional and public response to the physical design of a primary health centre environment, specifically lighting, colour, green space, aesthetic and function defined from a prior questionnaire survey. Interviews were used to understand perceptions towards using the kiosk when carrying out these tasks, thus expanding the findings from study 1 and 2.

Table 2
Results obtained by the kiosk in study 2 Wellbeing Centre.

Tasks	Themes extracted	Data
The physical design of the proposed Centre	Private and open areas.	Confidentiality please, have opaque panels to keep light but not allow patients to be seen Privacy please Cubicles don't share info by being open plan A combination of openness and a more private area without being entirely closed off
The atmosphere of the Centre	Homely atmosphere. Natural light	Homely combines a substantial chair with lightness - the right-hand photo shows seating that looks much too flimsy to be comfortable or to last, for long
Seating used in the Centre	Comfortable seating (reflecting and contributing to the homely atmosphere). Armrests to aid sitting and improve inclusivity.	Casual chairs are nicer I like the look of modern but the seating is not really comfortable for older people or people who need an armrest to be able to get out of a chair easily Armrests really important for older people and anyone with arthritis to be able to get up easily

Table 3
Semi structured interview schedule.

Task	Description
Tasks	Participants complete appraisal of environment (light, colour, green space, aesthetic and function) each task on each different method (Kiosk, paper questionnaire, work boards) noting down strengths/weaknesses.
Gathering insights 1	Open discussion about the methods, which was preferred and which was least preferred. Reasons for this.
Gathering insights 2	What mediating factors the methods have to accommodate given work duties (e.g. time, locations, and interest?).
Improvement criteria	How would you improve the methods – key criteria?

Table 4
Sample from study 3.

Age range	Gender	Occupation	Perceived comfort with new technology	Interview number
55–60	Male	General Practice doctor	Comfortable	Int1
20–25	Female	Doctoral research student	Very comfortable	Int 2
20–25	Male	Student	Very comfortable	Int 2
20–25	Female	Doctoral research student	Very comfortable	Int 2
41–45	Female	Knowledge transfer specialist	Comfortable	Int 2
31–35	Female	Healthcare Infection Researcher	Uncomfortable	Int 3
26–30	Female	Infection control nurse	Very comfortable	Int 3

3.4.1. Procedure

Interview sessions lasted an average of 38 min (range 22 min). A semi-structured interview (Table 3) outline was followed to direct users to interact with the kiosk and complete four tasks (see appendix C). Staff completed a questionnaire survey regarding their working environment and highlighted these as aspects to improve. The three interview sessions were held within quiet rooms at a location convenient to participants, using a combination of one to one and group interview formats in order to accommodate participant availability.

3.4.2. Sample

A total of n = 7 participants (GP, nurse, health researcher; n = 4 members of public) were recruited to take part (Table 4).

3.4.3. Summary results

Table 5 provides a summary of design improvements to the health centre, suggested by participants. The introduction of green space indoors was favoured along with the tidying of clutter on desk space. Interestingly, variety of colour was not desired with only green from planting or small sections of wall painting being suggested. In this study participants used sketching and written comments on the images to express their design ideas and concepts.

3.4.4. Practical implications

Results were used in conjunction with a questionnaire survey of staff evaluating the environment. From triangulating the data, much like study 1, a design brief for improvements was suggested. The most feasible approach for introducing the design alterations was in the staff room of the centre. A detailed report was provided to give insights from participants and ideas for improvements. The kiosk allowed a range of users to evaluate the centre of the environment. Importantly, the kiosk elicited sketching feedback from participants and so the impact of design alterations could be seen visually.

4. Part B: perception of use

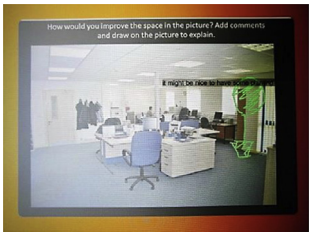
Study 3 collected perceptions towards using the kiosk (Table 6). Two key themes emerged from the data: perceptive insights and information type. These themes revealed strengths, weaknesses and opportunities of the kiosk. As a result they provide a framework for learning and we discuss these in more detail below and draw upon the results of studies 1 and 2.

4.1. Perceptive insights

4.1.1. Initial impressions

Participants successfully interacted across all studies with the

Table 5
Results obtained from study 3 health centre environment.

Tasks	Themes extracted	Data
Lighting	Clean lighting providing adequate contrast.	 
Colour	Neutral colours preferred	
Green Space Indoors	Use of green space and wall paint to provide *"splash"* green space indoors	
Aesthetics and Function	Hide clutter and improve lighting. Introduce green space indoors.	 

kiosk by contributing to the set tasks in an appropriate manner utilising text and drawings. This suggests that the mediation of the tasks by the kiosk was achieved - the language of participation was appropriate. This was evident through both sketches and annotations. Participants reported being attracted to the kiosk with it looking; *"21st Century" (S3i1GP)*. Two comments stated that if positioned in a healthcare waiting area the participant would *"go up to it and see what it was (S3i2public)"* reflecting the increase in comments in study 2. Indeed, *"its a little bit more exciting (S3i3nurse)"* than in comparison to paper-based methods.

Table 6
Insights provided by evaluation of kiosk.

High level theme	Medium level theme	Frequency of comments
Perceptive Insights	Initial impressions	12
	Privacy	11
Information Type	Language	8
	Understanding	25

Study 2 goes someway to support this with more responses obtained from the kiosk (n = 21) when compared to the paper equivalent version (n = 5) that was also used to collect data. Indeed, as one healthcare professional commented; *"it looks modern and not stuck in the dark ages on a scruffy bit of paper". (S3i1GP)*.

The kiosk gave an impression of informality, a positive aspect in terms of attraction to the kiosk with comments of *"friendly"*[1]

- *If I was in a GP practice I would use that [kiosk] because for me personally I am attracted by technology. I want to find out how it works. Press all those buttons (S3i2public).*
- *I prefer to do it this way [kiosk] than I did in the book [paper questionnaire] (S1i3nurse).*
- *I like this, it's more 'notey'. (S3i3researcher).*

This more 'notey' style was evident in study 1 with marks and sketches used to highlight how to improve the space (refer to Tables 3 and 5). The ability to annotate images proved positive as it enabled an interactive nature to tasks. This changed the way participants expressed their views in a descriptive text format, to a more *"notey"* style incorporating both text and sketching. As one participant reflected, "*I didn't write as much on this [kiosk] (S1i2)*" as this participant made notes instead. Participants remarked that incorporating sketch and text was positive although it was acknowledged that the level of detail within responses might differ, as discussed below.

The kiosk encouraged users to explore the device and complete tasks. With the growing use of digital communication devices, these may encourage participation as people maybe more familiar using such devices. When discussing learning in the mobile age, Sharples et al. (2006) comment that texting is seen as an informal activity and so we might suggest that tasks presented on tablet devices may also have a sense of informality associated to them. In support, unusable data observed in study 1 and 2 was generated by misuse of the interface (inputting crude text/images) rather than writing/drawing in the wrong section of the interface (usability errors). Similar observations are reported by Taylor et al. (2012) and Hosio et al. (2012) both of whom note that some participants interact with situated devices without fully considering the task in hand. Although this informality is a positive attribute on one hand, this may influence the validity of data as some participants may perceive tasks as an informal 'game'.

The effect of this notion was apparent as participants noted how they completed different tasks in different ways which may influence validity of findings.

- *I feel like [when using] the tablet I would go and mess about because I know whatever I do on it's not sort of permanent but if I do it on the paper that is permanent everyone is going to see it. (S1i2public).*

[1] Coding of participant quotations is as follows, S = study number; i = interview number; public, GP, researcher or nurse denotes participant demographic.

- *I didn't write as much on this [kiosk] So the level of information in the work booklet [paper questionnaire] is probably better than the level of information you would get out of me this way [kiosk]. (S1i3nurse).*

The tension between quality and quantity of data is raised here. Paper objects may encourage more descriptive answers and so the level of detail provided by, for example the work booklet, may be in more of a narrative description. On the contrary the tablet interface may encourage suggestions to be more visual (sketches) and so the volume of written description is not as necessary. This is of importance as situated devices, if to be used as the main form of user participation, must retain a level of integrity in order to obtain valid data. One participant implicitly indicated this: *"I'm just having a little think and play here [on the kiosk]" (S3i2public).* In contrast paper based methods were seen as a place to put *"serious answers"* (*S3i2public*).

- *I'd play with the kiosk and maybe answer here. Because it takes about 3 min to explore so initially you are sketching randomly to find out how it works then you might put in a serious answer. But here [paper work boards] we know [how it works] so we would put serious answer". (S3i2public)*

4.1.2. Privacy

A positive attribute to the kiosk was the preservation of participant anonymity. This is an important factor as when working in a small healthcare team *"handwriting is quite distinguishable … so you would know who had written what" (S3i3nurse).* Anonymity was particularly valuable in study 1 and 2 as it may have allowed participants to contribute with a greater sense of security (as data is stored electronically). This attribute may attract participants and increase confidence in using situated devices according to Hosio et al. (2012). This may account for the higher number of responses captured in study 2.

4.2. Information type

Information and language presented on the kiosk was not always clearly understood. For example, the word 'challenge' on the front page of the Application caused particular comment *"challenge? What does that mean?" (S3i2public)* with one healthcare profession stating *"what does challenge mean? I don't want a challenge!" (S3i1GP).* This may have been due to the perception of *"no proper instructions at the beginning" (S3i2public).* However, it was noted that one nurse taking part worked the system well; "[**How did you find using the kiosk?**] *I thought it was quite easy to use!" (S3i3nurse).* Observations noted that this participant read all the on screen instructions before moving on to the next screen. Although stating that they were confident with new technology, the participant said *"there is always a back button!" (S3i3nurse).* This highlights how different attitudes to technology may affect patterns of use. In discussion of the best way to balance interaction with cognitive load, Oviatt (2006) argues that leverage from users' experience, knowledge, and engrained behavioural patterns, as well as adapting to users' behaviour and preferences offers one reasoned approach to achieve optimum use of technology. Other participants may use an intuitive approach to interacting with the system rather than reading the instructions. One aspect that was not fully understood by participants was the bidirectional feedback that the kiosk gave in terms of presenting ideas from others along with their own.

It's great that you can see other people's inputs and suggestions it gives it more of a collaborative element but it wasn't obvious that is what it was showing us (S3i2public).
The two screens are confusing (S3i1GP).

This was important since a key factor to the process of participatory activities is to feed off one another in a dialogue around idea generation, in order to develop more fruitful solutions to problems.

5. Lessons learned and future research

PE is the adaptation of the environment to the human (ergonomics) together with the proper persons in question (participants) (Vink et al., 2008). Because of the emergence of new domains within which participatory-based methods are used, new tools and methods for researching and designing will emerge (Sanders et al., 2010). In developing these tools, challenges will present themselves. After a description of the use of participatory design within the healthcare setting, Halskov and Hansen (2014) comment that the diversity of application demonstrates the challenge that researchers face. It is therefore unsurprising that in the development of new methodological tools both challenges and opportunities arise. This is particularly pertinent since there are few guidelines to define optimal stakeholder involvement in the different steps of a participatory design process (Vink et al., 2008). As a result developing platforms for participatory approaches when actors are dispersed is an emergent field. Implications on this developed from the presented work are discussed below.

5.1. Mediating participation

The kiosk highlighted that mediating participation without the presence of a human facilitator is challenging. In participatory design, and PE, participants need to find a shared language through which they can interact (Dearden and Rizvi, 2008). Because of this, situated devices need to provide bidirectional feedback, representing researcher/designer-participant and participant-participant dialogues. Indeed, Barcellini et al (2015) comment that reflexive activities in participatory processes enhance the learning of the stakeholders, which feeds into ideation and design outcomes. Taylor et al. (2012) noted this as a particular drawback of their situated system because user feedback during the study indicated that feedback between stakeholders was insufficient. The presented kiosk provided this function but participants failed to fully recognise the dialogue that was forming from the information presented on the monitor screen, as discussed in the results. Therefore, in order for a successful situated device, this central premise of facilitation needs to be managed. For example, using explicit prompts such as "see what others think" may help direct this mediation. Doing so may develop a facilitated language of communication which participants understand and so produce rich insights into the topic under investigation. Citing Atlee (2003, p231), Sanoff (2006) suggests that consensus around a topic comes about as a result of agreed-to outcomes achieved through real dialogue where differences are explored (2003, p238). Through shared discovery, where people listen to each other and identify points of agreement and disagreement, a process of co-sensing is achieved.

Creating positive perceptions of situated user-participation through this mediated dialogue is an important consideration in healthcare. Indeed one participant (member of public) expressed in study 2 "*I can't believe* [there is] *money to spare for putting these expensive computers to ask the public what they think!".* Therefore, developing the technology to suit contexts and users is a further

challenge as behaviours and demographics around these situated devices differ (Taylor et al., 2012; DiRocco and Day., 2011).

5.2. Challenges for situated devices and user participation

In order to explore and develop the use of situated devices in healthcare, several concepts developed from this work are suggested. Firstly, an interesting perspective to emerge from study 3 was the notion of informality to using the kiosk. As discussed this has benefits as it may mean that individuals may be more willing to participate thereby drawing upon and attracting a broad sample of participants. Indeed, Morrison and Dearden (2013) comment that in healthcare, meaningful participation requires attention to the specific method of engagement so that it allows the public to express experiential knowledge in familiar ways. Caution is needed however. The perceived informal nature of situated devices may also influence the validity of data obtained. Taylor et al. (2012) argue that credibility of data obtained from situated devices is a major challenge. This is particularly important since the role of participation is to design based on experience and so these captured experiences need to be valid in order to ensure the adequacy of subsequent designs.

Although the kiosk was developed with the notion that it would be used to understand healthcare environments, the relationship between the individual and situated devices in healthcare is a complex one primarily due to the challenges already cited by Loke et al. (2014) (manpower shortages, family commitments, shift patterns). Comments by healthcare professionals stated that paper approaches in study 3 although more *"formal (S3i2public)"* allowed participants to fit activities it into their day more easily of which usability is key for effective and efficient use. Additionally, engagement in the research using these devices should have a clear benefit for the user. One healthcare professional remarked these devices might *"contribute to continual professional development, or improve knowledge of standards and regulation (S3i1GP)"*. This may be a feasible notion as technology has the ability to present an array of information to the participant obtained from a variety of sources.

Validity of answers was a key point raised across all studies. Validity is a difficult construct to measure, particularly when using qualitative methods, as opposed to quantitative data aiming to avoid type I or type II errors (Long and Johnson, 2000). Hammersley (1992) suggests an account is true if it accurately reflects the phenomenon under investigation (Long and Johnson, 2000). Therefore, the informality to the kiosk and its relationship to data validity may be a significant area to explore. Unusable data collected suggests that people may *"have a little play (S3i2public)"* with this type of device. Indeed, Luck (2003) comments that generalisation and extrapolation of user preference to a broader population, should be approached with caution when using participatory approaches due to the limited sample that can be obtained and the sometimes narrow scope of projects. Because of this, creating a sense of integrity is an important challenge. The lack of personal facilitation about the research may mean that the nature of the device is not fully understood and so contributions are not considered in the same way as when involved in group discussions. However, drawing again on Morrison and Dearden (2013) if specific language used by participants is preserved by tasks (e.g. through situated user-participation devices) such methods implicitly establish phenomenological experiences as valid and relevant. Therefore, achieving a facilitated discussion through the situated device may help ensure validity and lead to designs that enhance future healthcare environments.

5.3. Study limitations

The three studies were effective in helping to understand how the developed situated user participation device was used. The results provide lessons learned but the detailed nuances of use are by no means conclusive. Evaluation should take place using a variety of situated devices to understand if the themes extracted here transcend a sole device. It is acknowledged that a more formal evaluation at the study sites would have been desirable but ultimately outside the specific aim of each study project. Nevertheless triangulation of the data showed common themes, which go some way to develop learnings for future research of situated user participation devices for healthcare and the role they play in PE. The initial themes presented provide a platform to warrant more detailed exploration.

6. Final remarks

The situated kiosk had both successes and limitations. For participation in environment design it provided a platform with which to interact with users of the space drawing upon an open call to gather their heuristic understanding of the environment around them. As a design tool it enabled data to be obtained that contributed to conceptual ideas and improvements thereby forming an effective boundary object in the participatory process. Indeed, it proved to be adept by being elastic enough to create tasks relevant to each study yet retain the core characteristics across these different contexts. This was a particular success given the variety of healthcare environments within which the device could be situated. Although limitations were highlighted these revealed complexities of the user participation process that were not apparent on the outset. Designing a situated user participation tool is far more complex than producing a usable interface. The challenge lies in creating a tool, which implicitly creates a shared and common language mediated and facilitated by the device. The authors feel there is great value in exploring the concepts of mediated language, facilitation, informality and validity around devices acting as boundary objects in the participatory process. This provides an exciting and growing area of research in developing not just a new method of user participation in healthcare (and beyond) but also the technology that supports it.

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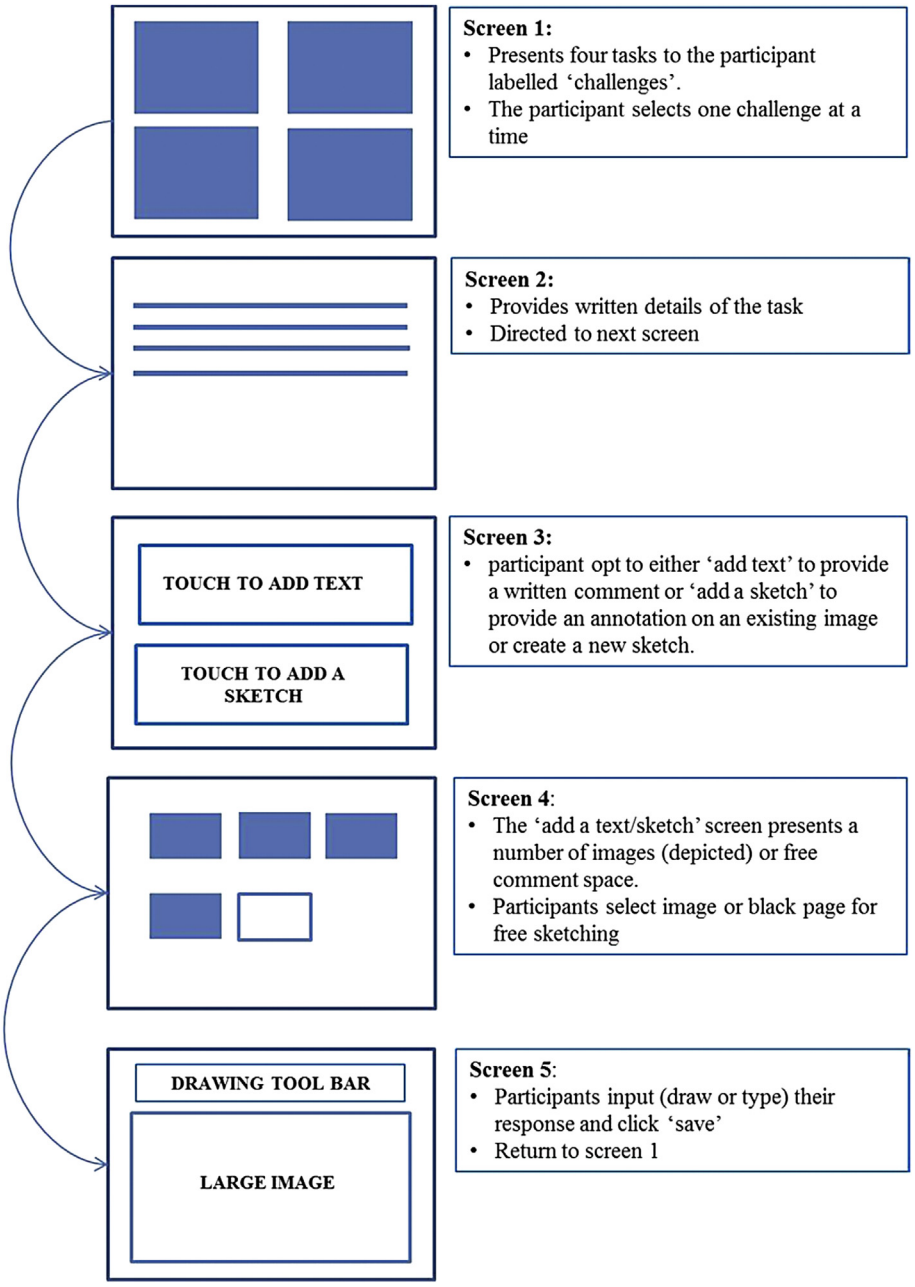
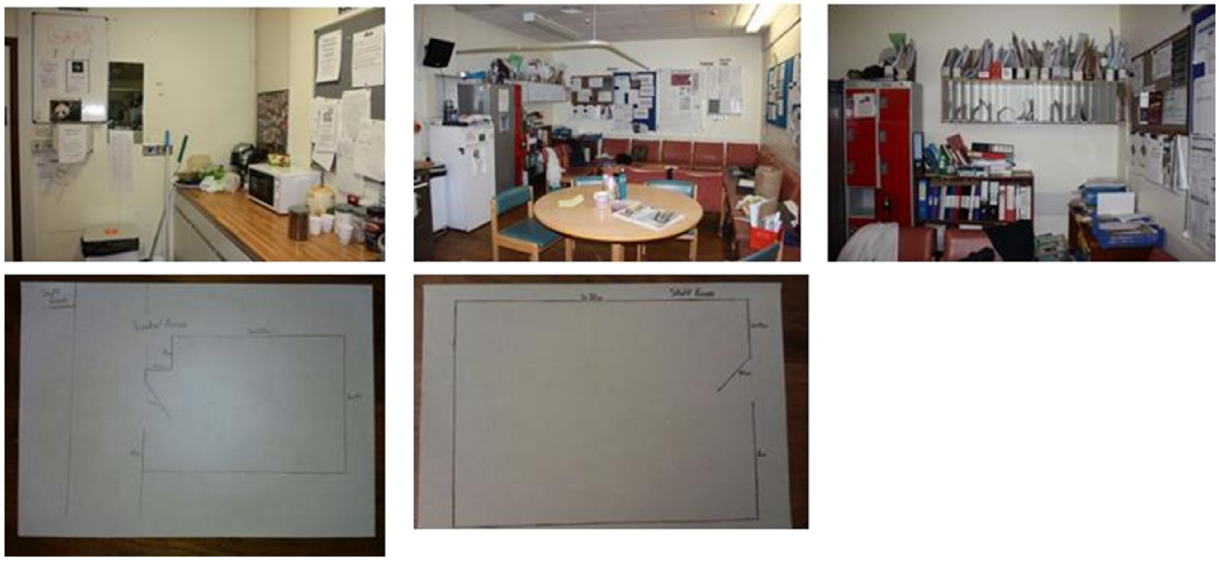
Appendix A. Flow chart of application layout.



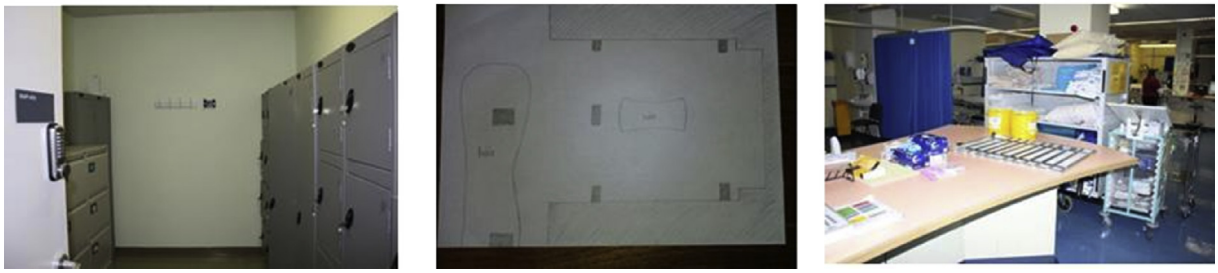
Appendix B. Study 1: Emergency Department staff room development: Images used for each challenge

Challenge - improving the staff room layout

Challenge - making the staff room relaxing and informative



Challenge - improving trolley and immediate stores



Challenge - placing items in a clean and correct place

Appendix C. Study 2: Wellbeing Centre: Images used to create challenges

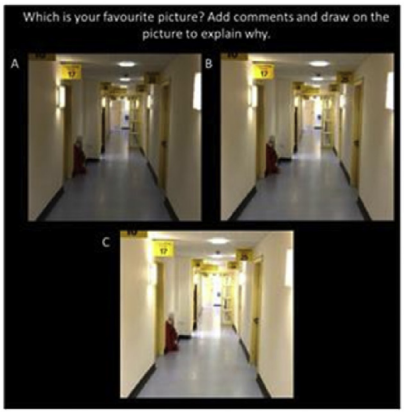
Challenge - the physical design of the proposed Centre (from top right clockwise, image 1,2,3,4

Challenge - the atmosphere of the Centre

Challenge - seating used in the Centre

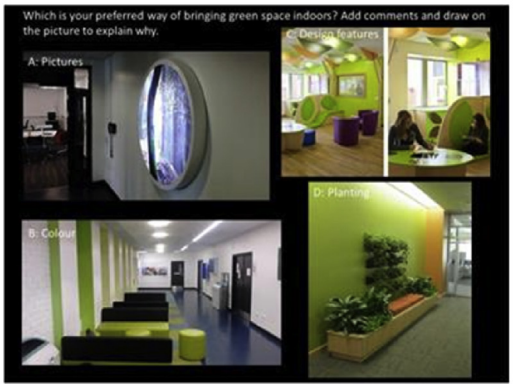
Appendix D. Study 3: Evaluating a health centre environment: Images used to create challenges

Challenge - Lighting

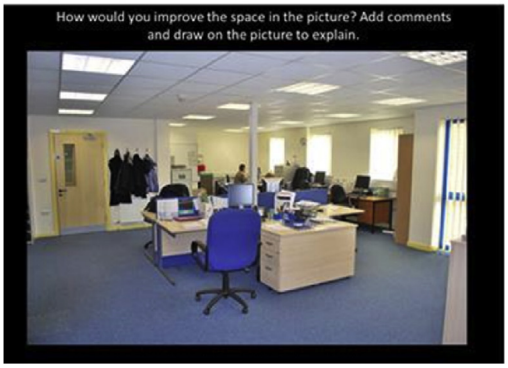


Challenge - Colour

Challenge – Green space indoors



Challenge – Aesthetic and function (image 1 left, image 2 right)



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