

ENGAGING LARGE CLASS WITH INCLUSIVE DESIGN THROUGH THE USE OF SIMULATION TOOLS AND INTERDISCIPLINARY COLLABORATION

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ABSTRACT

A user-centred approach and interdisciplinary team work are increasingly becoming important in the learning and teaching of design. Whilst it is good practice to introduce relevant theories to design students, it is challenging to organise course projects that involve different disciplines. It is also difficult to help design students appreciate users' real needs if the user population (e.g. people with severe disabilities) is unfamiliar to the students. This paper reports a project that aims to explore how simulation tools can be used in helping students understand users and their contexts of use; and how design students work with volunteering occupational therapy (OT) students in answering a healthcare design brief. The project is a roll-out of a successful pilot study. The student participants were asked to answer a questionnaire before and after the project, and to attend a focus group interview at the end of the project to reflect on their experience. Data were collected regarding the usefulness of the simulation tools, and the benefits of working in an interdisciplinary team. Suggestions were made in learning design through the use of simulation tools and interdisciplinary collaboration.

Keywords: Simulation tools, interdisciplinary collaboration, questionnaires, interviews, healthcare design

1 INTRODUCTION

There is an emerging need for changing designers' mindsets from the now hackneyed 'solution providers' to one of 'user-led innovation' [1]. This requires a design approach that engages users and places them at the heart of the design process, which is often referred to as 'user-centred', 'user focused', 'human-centred', 'empathetic' or 'co-design' [2]. When people with disabilities are involved in the process, the approach is also referred to as inclusive design. Simulation tools (e.g. 'goggles and gloves') are useful in helping designers understand the users, especially in terms of mobility and sensory capabilities. Involving different disciplines in the design process will enable the designer to see the problem from different angles, thus addressing it more holistically. The research reported in this paper aimed to explore how simulation tools can be effectively used in the teaching and learning of design and how design students benefit from collaboration with occupational therapy (OT) students in answering a healthcare innovation design brief.

The research was built on a successful pilot study [3] which involved ten volunteering participants: seven design students, one occupational therapy (OT) student, and two persons with Multiple Sclerosis (MS). The pilot study conducted in 2007 suggested that the students' understanding of the issues relating to design for people with MS significantly increased after their participation in the co-design project. It also suggested that co-design with end users and students from a different discipline could broaden design students' horizons and help them appreciate different viewpoints [3]. All the design students involved in the pilot study suggested incorporating projects of the similar nature into their course work so that more students could benefit from the co-design experience. Consequently funding was sought to support such an initiative. The UK's Higher Education Academy (HEA) offers a small grant through its Engineering Subject Centre's mini-project competition, and it provided financial support to roll out the pilot project in 2009.

2 RESEARCH DESIGN

While the pilot study focused on co-design with people with disabilities, the roll-out project adopted simulation tools in the process. The reason of using simulation tools rather than involving real users in the project was that it would be practically too complicated, if not impossible, to involve real users in a large course project (more than 100 students).

2.1 Research questions

The research questions were:

- How effective are simulation tools in helping students understand users and their context of use?
- Would interdisciplinary collaboration help students better understand the issues associated with a specific design brief?
- What factors are critical in organising interdisciplinary design projects?

2.2 Recruitment of participants

The project was run in a first-year design course through the core design module ‘Design Process 1’. Ethics approval was applied through the School of Engineering and Design, Brunel University. Permission was obtained to involve all the first year design students (112) in the project. The design lecturer distributed the information sheet to the students a week before the commencement of the project. The project also obtained ethics approval from the Brunel School of Health Sciences and Social Care, and an occupational therapy (OT) lecturer circulated a group email to all the first year OT students two weeks before the project, explaining the project and asking whether any of them would be interested in it. The OT students’ participation in the project was on a voluntary basis. Ten OT students expressed interests.

2.3 Questionnaires

Questionnaires were distributed to all the student participants on the 19th Feb, 2009 when the students received the design brief. The volunteering OT students were invited to attend the briefing lecture. The questions included both general ones (Q1-Q4) and specific ones relevant to the design brief (Q5-Q6)– refer to ‘Section 3 Design Brief’.

The same questionnaire was given to the participants again after the project was finished.

2.4 Interviews and feedback questionnaire

Group interviews with design students and OT students (separately as two focus groups) were conducted after the project ended to explore their experience of the project. Individual feedback to the project was also collected through a feedback questionnaire to the design students. The questions included:

- How did you find the project?
- Was anything particularly good? What was the best thing?
- Was anything particularly bad? What was the worst thing?
- Could anything have been done better? Can you suggest any changes for another time?
- Do you particularly remember anything you learned in the project?
- Did you learn anything which surprised you?
- How did you find using simulation tools?
- How did you find working with people studying a different subject?

3 DESIGN BRIEF

It was important to find a design brief that both design and occupational therapy students were interested in and could relate to. The Design Council’s ‘Design Bugs Out’ brief [4] was adopted as it was about healthcare innovation, an area of mutual interest to both design and occupational therapy students.

The design brief was to tackle healthcare associated infections (HCAIs). There were five specific areas to choose from:

- Hand hygiene (new product and/or service or system that improves hand hygiene of hospital staff, patients and visitors.)
- Bedside environment (furniture or a total system)
- Commode (ease of clean, usability, patient experience, comfort and dignity are priorities).

- Patient transport (stretchers, wheelchairs and porters' trolleys)
- Open brief (a piece of equipment, furniture or system which directly or indirectly reduces the spread of common HCAs in the healthcare environment)

4 MODES OF OPERATION

The students worked in groups of seven (6 design students + 1 occupational therapy student), and they could choose any of the five briefs to focus on. Apart from weekly design lectures (2 hours) and tutorials (4 hours), the students were encouraged to organise their own group activities. The design students spent on average 9 hours per week on the project, and the occupational therapy student volunteers were expected to contribute a minimum 4.5 hours during the project period. The key activities in each week were:

- 1st week: team forming, clarification of the task and planning + first questionnaire
- 2nd week: conceptual design
- 3rd week: using simulation tools and building ergonomics rigs
- 4th week: work-in-progress presentation
- 5th week: embodiment design
- 6th week: detail design + second questionnaire + group interview
- 7th week: preparation for submission

The simulation tools introduced to the students included:

- The Cambridge EDC impairment simulators [5] developed by the Cambridge Engineering Design Centre, including goggles and gloves, and reach and stretch restrictors.
- The BT virtual simulators (simulating vision and hearing impairments, available from the inclusive design toolkit www.inclusivedesigntoolkit.com)
- The simulation rooms used for occupational therapy training (Figure 1) and a mock up hospital ward environment specifically built for the project (Figure 2).



Figure 1. Occupational therapy training room



Figure 2. Simulated hospital ward environment

The presentation was the highlight of the project. Each group gave a formal 10 minutes presentation of their design concepts. Guest judges included professional designers involved in the real-world 'Design Bugs Out' competition, representatives from both Schools and the sponsor. Prizes were given to the best three teams (two were selected by the judges and one voted by the students), and all the students received a certificate acknowledging their participation in the project.

5 RESULTS

In total 119 students fully participated in the project (including 111 design students and eight occupational therapy students). The occupational therapy volunteers each was asked to work with more than one design groups to ensure that all the design students had an opportunity to consult occupational therapy in the process.

5.1 Questionnaires

Table 1 compares the design students' responses to the questionnaires they completed before the project started and again after it had finished. Not all the students completed the questionnaires twice, and the data presented in Table 1 are based on 45 respondents who completed both the 1st and the 2nd questionnaires. The qualitative data (e.g. text comments) were converted into quantitative data through assigning a number 1-5 (1: no gain; 2: slight gain; 3: some gain; 4: adequate gain; 5: excellent gain) to indicate the significance of improvements in understanding after completing the project.

Table 1. Comparison of questionnaires 1 and 2

Questions	Questionnaire 1	Questionnaire 2
Q1. What does Design mean to you?	All could address one or several important aspects of Design. 28% of the Design students had no idea about OT before they started the project. The majority had a vague idea (e.g. 'healthcare related job') about OT.	The average gain for Q1 is 2.1, and for Q2 is 2.6, suggesting that design students' understanding of both their own discipline and the OT discipline improved after the project; the latter more significantly.
Q2. What does Occupational Therapy mean to you?		
Q3. What do simulation tools mean to you?	Students' understanding was general and broad, and some mentioned games and computer programmes.	The answers were more specific and examples were given. Many explained why they were used (e.g. as 'ways of experiencing a situation unfamiliar to you')
Q4. What do you think are the benefits of working in an interdisciplinary team with Design and Occupational Therapy students?	The majority of the students were positive towards interdisciplinary team work, expecting to share different perspectives and skills. A few did not answer this question or wrote down "I look forward to finding out."	All suggested that they have benefited from the team work. Many mentioned that OT helped design students to understand the needs of patients and the problems with existing products. The average gain is 3.
Q5. Please identify up to 5 elements that you would consider important in controlling healthcare associated infections within hospitals.	Commonly referred items included: disposable overalls, sterility of wards, limiting visitors, anti-bacteria hand wash and syringe bin for dirty syringes	In addition to items typically mentioned in Questionnaire 1, many students mentioned "awareness of staff", "establishing cleaning routine"; "using right materials" and "nurses and cleaners doing a proper job", suggesting a broader understanding of the issues.
Q6. Can you suggest how any existing hospital equipment or furniture might be improved to better control infections?	14% of the design students did not answer this question. Many proposed ideas such as providing cover, some suggested using high intensity UV light.	All could make some suggestions. Typically "reducing complex parts and joints", adding "cleaning notification", and some mentioned "material innovation".

5.2 Student feedback

The design students' feedback to the project was collected through a focus group interview with eight design students and a feedback questionnaire (61 responses were received). The questions asked were similar in the interview and the questionnaire, but the latter incorporated a set of ranking questions (7: strongly agree +++; 1: strongly disagree ---) on detailed aspects of the project (Table 2)

Table 2 Students' level of agreement regarding the 14 specific aspects of the project

Statements	Average score
Involving external judges makes the project interesting	6.1 (Agree +++)
The 'real world' design brief makes the project interesting	6 (Agree +++)
The competition/prize makes the project interesting	5.7 (Agree++)
I benefited from team working	5.6 (Agree ++)
I appreciated the opportunities to work with occupational therapy students	5.5 (Agree ++)
Ergonomics and rig-building were relevant and useful	5.4 (Agree ++)
It is useful to incorporate peer assessment into the project	5.4 (Agree ++)
Seeing other's work motivated me to improve my work	5.3 (Agree ++)
It is good to have work-in-progress presentations	5.2 (Agree ++)
Branding and semiotics were relevant and useful	5.2 (Agree ++)
The 'Design Bugs Out' resource on Ulink (e-learning platform) proved helpful	4.9 (Agree +)
Visiting the Mary Seacole Building (OT training rooms) proved useful	4.7 (Agree +)
The simulation room (hospital ward) proved useful	4.3 (Agree +)
The simulation toolkit ('goggles and gloves') proved useful	4.1 (Agree +)

Overall the feedback to the project was positive. Quoting students' words, the project is "interesting and challenging". The students liked the "real-world brief", and most enjoyed "working in a team". Some liked the fact that the project was "different to what has been done before", and gave them an opportunity to "test all the skills learnt." In the focus group, "external judges" were specifically mentioned as something that students really valued and welcomed.

In terms of "the best thing", the students mentioned the following:

"Work as a team" (21 mentions, with 2 specially mentioning "working with OT"); "Presentation" (19 mentions, with 6 specially mentioning "presentation to external judges"); "rig building" (12 mentions); "real-world brief" (6 mentions); "simulation" (3 mentions); "winning the prize" (2 mentions); "[learning] branding [theory]" (2 mentions); "learning about problems" (2 mentions).

23% of the respondents did not report any bad aspect of the project. The "worst thing" mentioned in the questionnaire included:

"Presentation" (19 mentions, issues relating to lack of time for preparation, timing – better to be at a later stage of the project); "rig building" (12 mentions, issues relating to timing, venue and organization), "team work"(4 mentions, issues relating to problems with communication, uneven work loads between team members, less motivated team members); "unsure about how much work was needed" (3 mentions); "lack of access to the simulation rooms"(2 mentions).

The suggestions students put forward for future improvements included:

Better management of team work (e.g. introducing register to team meetings, or allowing students to form their own teams); better organization of rig-building (provide better resources, more access to workshops); giving more time for preparation of the presentation and have a break in the presentation day; improvement of the simulation rooms (more access, more relevant products), clarification of project deliverables; and access to more resources (e.g. end users, nurses, and hospitals).

The focus group highlighted the importance of presentation and students found it was really useful to develop public presentation skills early in the course. Some students also acknowledged that "the design process as a group differs from individual design processes."

6 DISCUSSION AND CONCLUSIONS

Back to the research questions:

- How effective are simulation tools in helping students understand users and their context of use? The students' feedback suggested that they found the simulation room and toolkit useful, but not to its full potential in this project. They had limited access to the simulation rooms, and some reported in the focus group that they had "no time to look at the virtual simulation tools"; and "the simulation tools focusing on vision and dexterity impairments are not particularly relevant to the project." To make the simulation more effective, greater access should be given to the students with more relevant simulators. In the focus group, it was suggested that "a tutorial dedicated to the use of the simulation software would help us use the simulation tools more."

- Would interdisciplinary collaboration help students better understand the issues associated with a specific design brief?

All the student participants perceived the value of interdisciplinary collaboration, and actually benefited from such collaboration. Although only eight occupational therapy students participated in the project and their time spent with each group was limited, their input was greatly appreciated. The Design students commented:

“Working alongside occupational therapists was extremely helpful as you are able to understand more fully the needs of the target market, thus allowing the designer to design more accordingly to the specific needs.”

“Both groups of students can look at the situation from different perspectives which make the end product more usable to a wider group of people.”

“They (i.e. occupational therapy student) have greater knowledge and understanding on existing systems and what is required to help and inform the designer.”

“Would have been far harder/taken far longer to discover the issues needing to be resolved without the OT students.”

“You are able to obtain an insight into the design process from a different unique point of view which you may not have considered before.”

“You get a larger skill and knowledge base to work with and can therefore get more ideas and be able to develop them to a better level.”

“Enables you a greater insight into the users’ needs.”

- What factors are critical in organising interdisciplinary design projects?

We found timetable is critical: it has to suit the different disciplines involved. Choosing a project that is appropriate for students with different backgrounds is important. Keeping students motivated is the key (e.g. inviting external judges, offering prizes and certificates). The plan has to be flexible.

To conclude, the simulation tools are useful in helping design students understand the users and their context of use, especially when real users or actual environments are difficult to access. To make effective use of simulation, relevant tools should be introduced with additional training. Design students benefit greatly from working with occupational therapist students, and many regard occupational therapists as an invaluable bridge between the end users and the designers.

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