

# Getting the Most from Working with Higher Education: A review of methods used within a participatory design activity involving KS3 special school pupils and undergraduate and post-graduate industrial design students

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## Abstract

This paper provides education-based researchers and practitioners with the preferred research and design methods used by Higher Education Institute (HEI) students and Key Stage 3 (KS3) pupils applied within a participatory approach to a design activity.

The outcomes were that both pupils and students found informal (unstructured) interview to be effective in creating dialogue alongside meeting in person. Students commented on the friendly environment created by staff within which the pupils felt safe to express themselves. They found the co-design activity in some cases difficult due to communication issues.

Recommendations are that the HEI students would benefit from a thorough literature review of the medical conditions associated with the pupils and their school activities; an initial informal meeting or group activity involving students and pupils would reduce shyness and perform an icebreaking role prior to the initial interview; the use of drawing templates or low resolution sketch models for pupils to draw on or handle and modify to help define a product specification; and, role playing alongside other visual prompts that enable the pupils to visualise the function of the student-proposed designs. Pupils benefited through seeing professional techniques of visual communication and design practices being applied during the collaboration.

## Key words

design and technology, participatory design, research methods, inclusive design, Special School and Higher Education Institution collaboration

## Introduction

A core requirement of all teaching is to enhance engagement of pupils with the subject. One proven way of engaging pupils within design and technology is to introduce activities that involve people and environments external to the school. (Chrisophersen, 2002) One option is to collaborate with a higher education institution (HEI) on the delivery of the curriculum.

HEI design students working directly with pupils exposes both groups to methods of gaining information to make

design decisions and how best to embody the design-decisions into an artefact. The quality of a design solution depends on the quality of information available to make these design decisions. Both groups can gain from the experience of working with others of a different age, gender, life-experience, physical and cognitive ability. Whilst Cohen et al (2007), for example, provide a bibliography of research methods suitable for researchers working within education they do not provide guidance when and where to apply or prioritise these methods within a specific context or group.

This paper provides an insight for researchers and practitioners within education into the preferences for the research and design methods which pupils and students found effective when working together on a design activity. Supporting evidence was provided through the design outcomes produced by students and pupils within curriculum delivery at Key Stage 3 (KS3), alongside anecdotal observations by School and HEI staff.

This work is part of an on-going pedagogic development of a HEI module teaching undergraduate students how to design for people with disabilities and make their products more inclusive. (Torrens, 1998; Torrens, 2000)

The paper will also provide a template of best practice in this form of collaboration through the review of a case study. The template is based on best practice of one of the authors who has over 20 years' experience of designing inclusive products and working with elderly and people living with disabilities. An optimised method for assistive technology (AT) product design is documented in a number of resources (Birkett et al, 1995; Torrens, 1998; Torrens, 2011; Torrens and Black, 2011 and Torrens, 2012)

The study will draw upon the working relationship between a Special School, with Academy status, in general education for children aged 4-19 years old with physical disabilities and learning difficulties and a Design School within a HEI in the United Kingdom (UK). Throughout the paper the School children will be referred to as 'pupils', whilst the University undergraduate and post-graduates will be identified as 'students'. The relationship spanned a ten year period with four iterations of this specific pedagogic activity. The focus of this case study was the

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activities undertaken in the academic years 2011-12 and 2012-13. The activity within the case study will be described along with the recorded outcomes from the activities. A survey conducted with school pupils and HEI students with supporting anecdotal observations from HEI and school staff are reported. The discussion reflects on the recorded findings relating to the efficacy of the approach used. Efficacy in this paper refers to the effectiveness of the combined methods within this participatory approach to elicit needs and aspirations from the pupils by the HEI students. Efficacy also applies to the effectiveness of pedagogy in the form of engagement and reflection on the activity by students and pupils.

## Aim

The aim of this paper is to provide education-based researchers and practitioners with the preferred research and design methods used by HEI and KS3 pupils applied within a participatory approach to a design activity.

## Method

21 HEI students undertook the collaborative design activity in 2011-2012, with a further 8 students in 2012-2013. Three visits in 2011-2012 and four site visits 2012-2013 were used to deliver three forms of research and design methods: interview and observation; co-design; and, client choice/preference via visual presentation of design solutions. The additional site visit in 2012-2013 was introduced to enable HEI students to gain additional empathy with the School environment and discuss the activities of the pupils in the School with teaching staff. For ease of reporting, the initial site visit will not be considered in the description of the method or results; however, it will be considered in the discussion.

A survey conducted with both pupils and students provided evidence of efficacy of the methods applied. In this case, a participatory methodology refers to a mixed methods research approach (Creswell, 2009, Creswell, 2007) within a user-centred design strategy. A by-product of this methodology is that it is inclusive in nature. However, the term 'Inclusive design' is a term used to describe a specific form of design activity, normally associated with those who have physical or cognitive impairment. The design approach presented in this study helps counteract forms of disability that may lead to being handicapped in achieving daily living activities (ADLs). ADLs include washing and personal grooming, sporting and leisure activities, work or school activities.

Christophersen (2002) provides a clear indication of the approach and seven principles applied to this form of design. The aim of achieving at least some of the seven principles underpin the choice of participatory research and design methods, towards a realisation of a final product design. The aim of the students was to reflect on the effectiveness of using the chosen methods to achieve this goal.

## Case study

A design activity was conducted involving Special School pupils and HEI students that followed the School guidelines for external visitors and an approved protocol from the HEI ethics committee. The activity involved site visits to the Special School organised between HEI and School staff.

The two groups involved in the design activity described had been given a design task: to identify the needs and aspirations of individual pupils for new assistive technology (AT) products and realise them through a concept product design. AT products are those which enable the user, where possible, to perform activities of daily living (ADL) comparable with an able-bodied individual.

## Preparation

A two-hour time period was identified that was mutually convenient for both teaching programmes within each Institution for the duration of the activity. The activity was planned to be undertaken over an eight-week period; it involved three site visits with one week gaps between them.

A group size of 25 students was considered the maximum that could be accommodated within the class of between 10 and 20 pupils. Reasons behind this decision included: avoiding pupils feeling intimidated working with a large group of students; optimising the opportunity for students to gain individual pupil insights from limited contact time; and, the two hour time constraint on reviewing and choosing design solutions by a limited number of staff and pupils.

Recording of the activities by HEI staff and students involved some photography as well as written details. All recorded material was vetted by school staff before releasing into the restricted electronic learning environment of the University intranet for use by HEI students. Permission to publish images of pupils and students was obtained before publishing in the public domain.

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Students were given training in questionnaire design; semi-structured interview; and, observational analysis as defined by Cohen et al (2007) and Wilson and Corlett (1995) prior to the start of the activity. They had also been trained in and undertaken some empathic modelling to gain some insights into physical impairment and practice the methods taught. (Torrens, 2000, Torrens and Black, 2011a)

## Research and design activity

Students and pupils had clear objectives for each of the three visits:

- Visit 1) was to gain information about the needs and aspirations of the pupils. What the pupils wanted from products that were not available and how they wanted the products to look; to fit with a pupil's personal style.
- Visit 2) was to undertake co-design activity between the pupil and student. This was to gain some consensus about the balance of attributes within the design.
- Visit 3) was to allow the group of students to present their final concept ideas back to the pupil involved with that design. Selected designs from the small groups were presented to the whole group of over forty pupils and students in a 'dragon's den' style. (See table 1)

The teacher delivered briefing for each visit provided the pupils with a simplified version of the objectives:

1. identifying what they wanted to design;
2. choosing which design to develop and help in refining the design; and,
3. choosing which of the three designs should go forward to represent their group.

The students and staff had the additional task layer of collecting information not only for the purpose of designing a product, but also reflection on the effectiveness of applied methodology.

Students and pupils were matched in working groups. Students and pupils discussed their activities of daily living and their aspirations for things they would like to be able to do. In the subsequent two visits the pupils took the lead in deciding which designs should progress. Each visit was no more than 40 minutes of contact activity time. The restricted activity time was to avoid fatigue in the pupils that might affect their responses and decision-making during the visit.

Following each visit the HEI students and staff discussed the outcomes from two viewpoints:

Task	Special School/Academy	HEI
<b>Site visit 1</b>		
Interview and observation	Discussion of needs	Semi-structured interview Design specification Sketch concepts based on identification of needs and aspirations.
<b>Site Visit 2</b>		
Co-designing, refinement of sketch concepts	Choosing concept designs and further suggestions for design specification.	Identification of favoured concept designs and incorporate additional information from pupils.  Refinement of concept designs incorporating additional information REMAP expert advisors.
<b>Site visit 3</b>		
Design selection.	Choosing one of three designs.	Recording explanation of pupil choice.
'Dragon's Den presentation'	Presenting their design to teachers and invited pupil audience. Pupils undertake in-class design exercise based on design process demonstrated by students.	Supporting pupil presentation.  Review of pupil choice and preferences.
<b>Reflection on methods</b>		
	In-class paper-based survey	Online Survey

Table 1. Shows the sequence of activities planned for both pupils and students

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1. The quality and quantity information gathered as a result of the application of the specific method or methods; and
2. The ease of application of the generic method in terms of logistics, time and other highlighted issues.

At each stage students recorded their designs through initial sketch drawings and computer aided designs (CAD), directed and supported by pupils. The students recorded the activities through semi-structured interview; observation; co-designing; and, presentation illustrations. Co-designing is where an end user and designer visually alter existing concept designs to reach a consensus of attributes that should be embodied in the final set of values or design solution (Pralhad, C.K. and Ramaswamy, V., 2004). The HEI students also took advice on the feasibility of their designs from members of REMAP who came into the HEI to provide advice to the students. REMAP is a registered charity made up of a network of local panels. Each panel is made up of volunteers who have a background in engineering, design and healthcare. (REMAP, 2012)

## Survey reflecting on the research and design activity

Pupils and students from academic year 2011-2012 were asked, at the end of the activity, to complete an online questionnaire and reflect on the effectiveness of the activity. Reflection on the approach and methods used was done through anecdotal observations made during the activities by staff over the two academic years and the design outcomes produced. In addition, after each site visit the 21 students in 2011-2012 and the 8 students in 2012-2013 undertook group discussions reflecting on the methods applied.

The Industrial Design student's survey was online and utilised the Bristol Online Survey (BOS) website resources (BOS, 2012). The survey consisted of eight questions relating to the effectiveness of methods used and environment that facilitated the activities. The following list of questions asked of the pupils. Questions 1-3 were age, gender and status; i.e. pupil, teacher or teaching assistant (TA).

- Question 4. Before working with HEI design students, how many times in the last three years have you previously worked with design students?
- Question 5. Before working with HEI design students, had you experience of any of the following: being

interviewed; doing a questionnaire; co-designing/sketching and drawing with a designer; begin a part of a design presentation?

- Question 6. How true do you think the following statements are of working with HEI design students: The students were friendly; the University teacher was friendly; the students took an interest in what I/pupils liked; the students listened to what I/pupils wanted; the students produced sketches of what I/pupils wanted; the students produced a final design that matched what I/pupils had told them I/we wanted?
- Question 7. How useful were the following ways in which HEI design students found out about what you/pupils wanted: asking you to fill in a questionnaire; interviewing you and asking specific questions; seeing how you explain what you want; just being with you; just chatting with you?
- Question 8. Please explain how you think HEI design students could have better got to know what you/pupils like?

Questions 4 to 7 were based on a Likert scale of five options. The options incorporated the 'smiley' round face symbols to help students understand the strength of preference; two unhappy 'smiley' face symbol denoting very strong dissatisfaction through to two happy faces to denote a strong agreement. Question 8 was an opportunity to capture other opinions from the pupils through personal comment.

The student questions included interviewee details including: Age; Gender; Industrial Design experience; and, Qualifications. The interviewee was then asked about their experience of using the specified methods and how effective they were in gaining empathy with the pupils; and, gaining insights about their needs and aspirations. The student interviewees were also asked about which aspects of the activity best helped facilitate identification of each pupil's needs and aspirations.

## Results

The series of sites visits in both academic years went to schedule with only limited over-run during the Dragon's Den activity. There were no notable comments about the organisation or logistics from pupils, students or staff.

The images from the three site visits in 2012-2013 show that the students had included some improvements, particularly in site visit 1. Comments made by students in

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2011-2012 were discussed with students from the 2012-2013 cohort. The latter cohort employed mood boards, visual prompts and role playing to augment the generic

methods of semi-structured interview and observation. Students recorded preferences through note-taking, notes marked on visual prompts, and with some typed directly









Site visit 1		
Interview and observation	TA involvement, (bottom left), required to overcome shyness of pupils (no eye contact). 	Role play to confirm pupil's needs and aspirations. 
Site visit 2		
Co-designing, refinement of sketch concepts	TA's more observers, (standing back), not directly involved in co-design discussion. 	Pupils fully engaged with students, (eye contact). 
Site visit 3		
Design selection	Pupils choosing concepts (eye contact during discussion) 	Pupils taking ownership of final designs (no TA involvement). 
'Dragon's Den presentation'	Pupils presenting their ideas enthusiastically 	Minimal student or TA support. 

Table 2. Shows examples of the group activity from the three site visits

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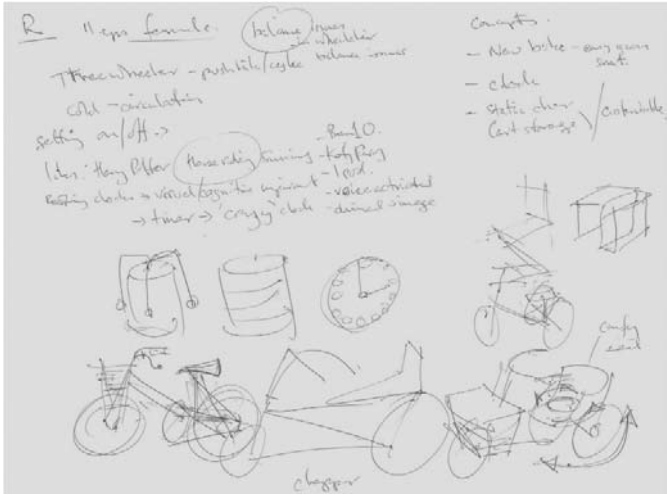

Site visit 1	
<p>Visual prompts used (right) to provide a starting point for discussions for the students, whilst note-taking. Pupil marked preferences on prompts. Summary sheet from student group Brainstorming (below) based on identified needs and aspirations from one pupil (R) during site visit 1. The exercise was completed for each pupil.</p>  <p><i>R</i> 11 yrs female. <i>belong</i> <i>space</i> <i>in</i> <i>shoulder</i> <i>volume</i> <i>smaller</i></p> <p>Three wheels - push/cycle volume - small      old - circular      setting on/off → <i>hand</i>      like: bag, Pflar, <i>Assembly</i> <i>training</i> <i>top</i> <i>bag</i> <i>load</i>      setting, <i>dark</i> → <i>visual</i> <i>bag</i> <i>to</i> <i>adjust</i> - <i>voice</i> <i>activated</i>      → <i>time</i> → <i>cray</i> <i>dark</i> <i>dark</i> <i>image</i></p> <p><i>Concepts:</i>      - New bike - <i>any</i> <i>year</i> <i>small</i>      - <i>dark</i>      - <i>static</i> <i>dark</i> <i>Cost</i> <i>change</i> ✓ <i>convertible</i></p> <p><i>Sketches:</i> <i>clapper</i></p>	

Table 3. Shows one of the student summary sheets of ideas from the group discussion (left) following the interview and observation, using visual prompts with pupils (right) from visit 1



Site visit 2	
	<p>Note the use of professional visual communication techniques, such as annotation, orthographic and perspective illustration and sample images that were considered by the student evocative of a pupil's aspirations for the product (mood boards).</p> 

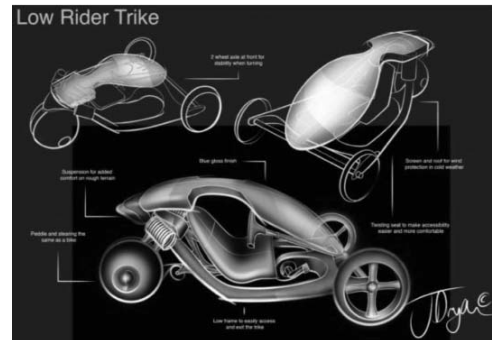
Table 4. Shows a sample of the outcomes from the co-designing through site visit 2

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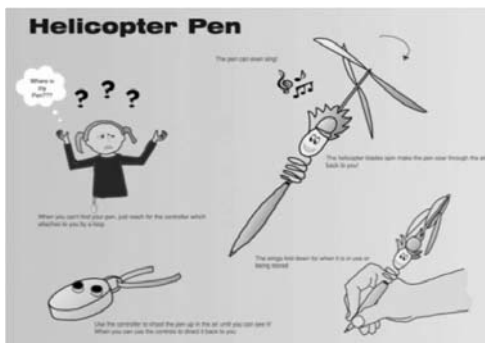
## Site visit 3



Some of the three concepts from which each pupil chose their preferred design.



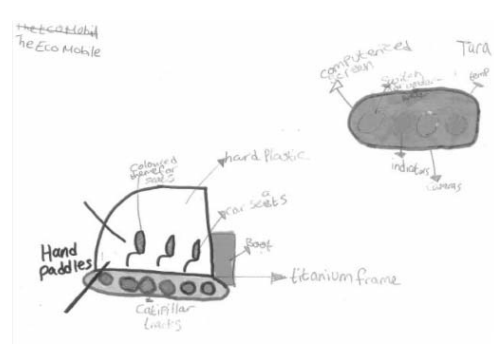
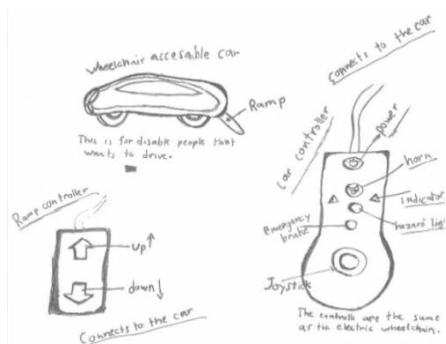
The 'winning' design concept.



Concept drawn in the style used by the pupil.



Concept designs drawn by pupils during the last week of the collaboration.



Note the use of annotation, specific materials detailed and arrows to explain functionality. Also, the use of branding through the naming of the product (left).

Table 5. Shows examples of design choice and presentations from site visit 3, with pupil design activity during the collaboration

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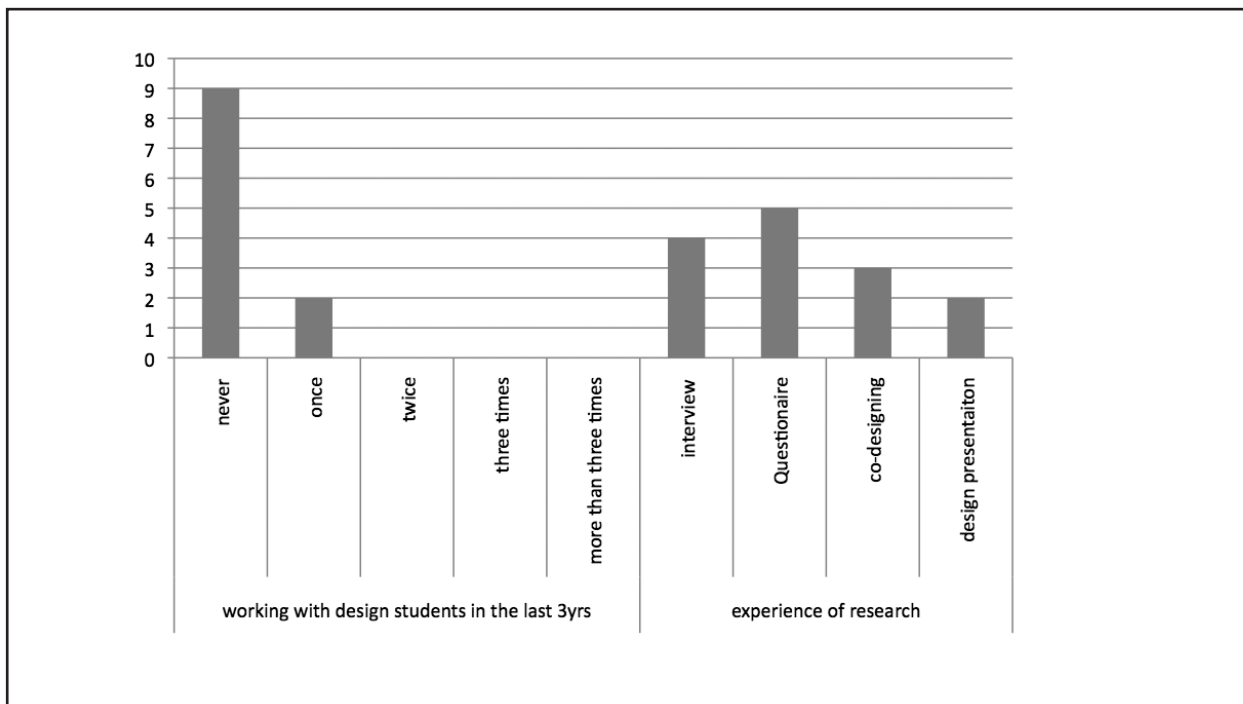


Figure 1. Shows the level of previous experience of pupils working with design students; and, being involved in applying research and design methods

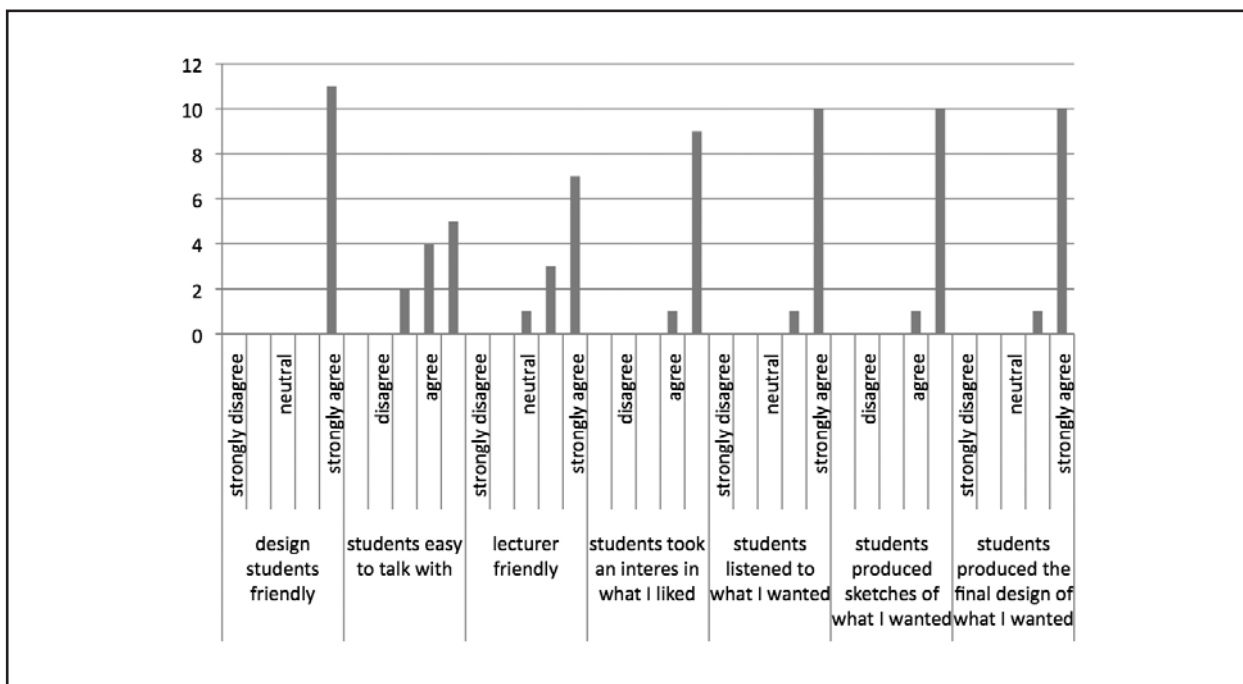


Figure 2. Shows the pupils opinion of the relationship between themselves and the design students and lecturer



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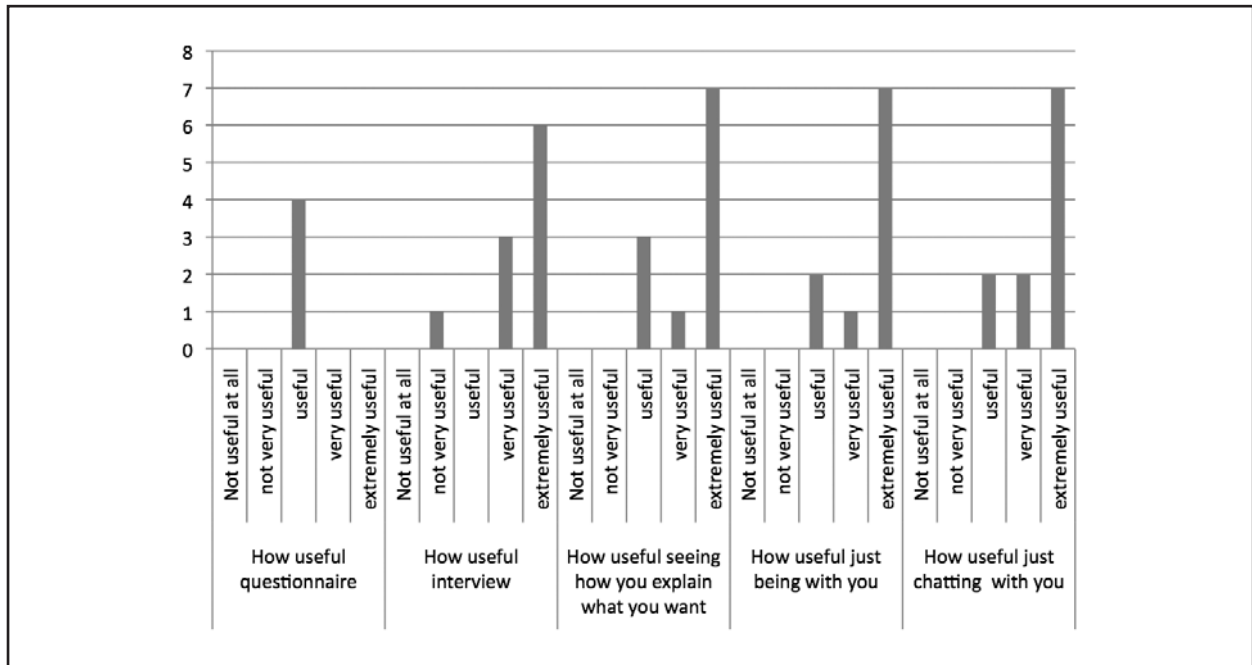


Figure 3. Shows the pupils reflection on the usefulness of the methods applied

into a laptop. Concept sketches were produced during the week after the interviews and discussed during a group tutorial (see table 3). These concept designs were developed into sketch designs and sketch models for review within a co-design activity in site visit 2 (see table 4). Final concept designs produced by HEI students are shown in table 5, alongside pupil design work which was produced in the later stages of the collaborative activity.

Following discussion with the supervising teacher, it was found that the online survey was difficult for the pupils to navigate without one-to-one support. Therefore, the online survey was printed and completed independently by the

pupils on hard copies and processed manually into a proprietary software spreadsheet for conversion to bar graphs. 11 pupils completed the survey, although some questions were not answered by all pupils. 14 online surveys were processed from the HEI students. The students' and pupils' reflections on the activity are shown in tables 6 and 8.

Only two of the 11 pupils had previously taken part in similar activities. Figure 2 indicates that the students and HEI staff were accepted and had presented themselves in a way that put the pupils at ease.

Participant number	Reply to the question "please explain how you think HEI design students could have better got to know what you/pupils liked?"
1	Explain how it could be improved
5	Ask more questions
7	If they came more often
11	They should ask more questions

Table 6. Shows the comments made from pupils when answering question 8

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The majority of pupils indicated they wanted face-to-face discussion with students through their strong preferences shown in figure 2. When asked how the experience could be improved some pupils commented that asking more questions and more visits would have been helpful. (See table 6).

The parallel survey completed by the HEI students provided a comparison of preferences and opinions on the methodology and methods used.

Table 7 shows the students had varied design experience and having used mainly questionnaires and design presentation as a way of eliciting information. Figure 4 indicates the majority of students perceived being in the presence of the pupils, observation and informal chatting were more effective than formal interviews. In addition, empathic modelling was perceived to be an effective method for gaining empathy with the pupils. It also indicates a similar distribution of student opinions when considering the same methods relating to the pupil's needs and aspirations. However, more of the responses were positive but less strong in opinion. They suggest that the positive and nurturing environment of School/Academy enhanced the facilitation of gaining information about pupil needs and aspirations.

Table 8 provides some insight into the reasons for the variation in student opinions about the methods applied.

## Discussion

The approach and methods applied delivered an enhanced experience for both pupils and students. School staffs' anecdotal observations of pupil and student engagement indicated the combination of research and design methods used in this activity appeared to be a good example of pedagogy. School staff noted the increase in focus and engagement during the visits. Teaching assistants were actively involved during the interviews to ensure pupils provided some comment. It was observed by the authors that even with visual prompts and role playing, students initially required much support from carers to help pupils overcome their reservations.

Based on comments made during group discussions and from staff observations, site visit 1 was considered the most stressful for pupils and students. A reason may be that it was the first meeting of individuals.

During the subsequent visits the groups were observed to focus quickly onto the task of interviewer and interviewee. School staff noted anecdotally that pupils engaged throughout the contact time period, where they would normally be more distracted in a conventional class task. However, staff noted that much more effort was required to overcome shyness of pupils during site visit 1. (See table 2.) The issue of familiarity was highlighted by student groups from both academic years. In academic year 2012-2013 an introductory tour around the School/Academy and a discussion with the host teacher prior to site visit 1 was undertaken. However, HEI students commented in the post-visit discussion groups that it was still not considered as effective as a potential icebreaking activity and meeting with pupils could have been.

Role playing, sketch models and visual prompts enabled more effective application of generic research and design methods. This was particularly noticeable with some pupils who had impairments that inhibited their perception of perspective drawing.

There had been much preparation by HEI students in relation to the way in which they would interact with the pupils, which is shown in the positive response by the pupils in figure 2. Providing as much information as possible to external collaborators prior to any visit about the School, the needs and aspirations of its pupils is critical to a successful outcome.

What was clear was that personal contact and a less formal approach was highly valued by pupils, something also highlighted by the HEI students. This was highlighted in figure 2 with pupils agreeing or strongly agreeing with the students wanting to listen to them, but also highlighting that some pupils did not find it easy to talk with students. Figure 4 indicated that students believed being in the presence of the pupils and informal contact were considered very or extremely effective. Tables 6 and 8 support these observations. For example: a student stated "Allowing the pupils to talk freely about their likes and dislikes"; another stated: "The learning capabilities of the student affected how effective the methods were, e.g. if the child struggled to talk then they needed prompting and benefitted more from yes/no answers." The observations were supported by a pupil, participant number 7, who replied to the question "please explain how you think HEI design students could have better got to know what you/pupils liked?" by stating "If they came

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No.	1. Are you female or male?	2. How Old are you?	3. What is your level of study? Please choose only one answer	4. In which of the following do you already have qualifications?	5. Before doing this module, had you used any of the following methods?
1	Female	20-24 yrs old	Final year Undergraduate student	Art	Design presentation, Co-design, Questionnaire, Semi-structured interview
2	Male	20-24 yrs old	Second year Undergraduate student	Industrial design	Semi-structured interview
3	Female	20-24 yrs old	Final year Undergraduate student	Work experience in a manufacturing factory, Art, Industrial design	Design presentation, Questionnaire
4	Male	20-24 yrs old	Second year Undergraduate student	Industrial design	Co-design, Questionnaire, Semi-structured interview
5	Male	20-24 yrs old	Postgraduate Student	Industrial design	Design presentation, Co-design, Questionnaire, Semi-structured interview
6	Female	25-35 yrs old	Postgraduate Student	Industrial design	Design presentation, Co-design, Questionnaire, Semi-structured interview
7	Female	20-24 yrs old	Final year Undergraduate student	Art, Industrial design	Questionnaire, Semi-structured interview
8	Female	18-19 yrs old	Second year Undergraduate student	Industrial design	Design presentation, Co-design, Questionnaire, Semi-structured interview
9	Male	20-24 yrs old	Postgraduate Student	Industrial design	Design presentation, Co-design, Questionnaire
10	Male	20-24 yrs old	Second year Undergraduate student	Work experience in a manufacturing factory, Art	Questionnaire
11	Male	20-24 yrs old	Final year Undergraduate student	Industrial design	Questionnaire
12	Female	20-24 yrs old	Postgraduate Student	Industrial design	Design presentation, Questionnaire
13	Female	20-24 yrs old	Postgraduate Student	Industrial design	Design presentation, Co-design, Questionnaire, Semi-structured interview
14	Female	18-19 yrs old	Second year Undergraduate student	Industrial design	Design presentation, Questionnaire

Table 7. Shows the characteristics and experience of the students who completed the survey

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Please explain why you think some methods are more useful than others in gaining empathy	Please explain your opinions on how the different elements produced an effective or ineffective facilitation to translate the pupils needs and aspirations to products
Allowing the pupils to talk freely about their likes and dislikes, although perhaps not necessarily focused on the task, helps to understand the child. It also brought up interesting points which we wouldn't have discovered had it been specific questions that had to be asked.	The pupil I worked with was very open and had specific opinions on what she liked and did not like and what she wanted to be changed. This helped a lot with the product.
Due to the age and nature of the children, I personally found it much more effective to observe their behaviour whilst maintaining relevant but informal conversation. The questionnaire I had prepared was very loosely used, as I felt it much more important, in terms of gathering useful results, to maintain the children's attention.	I felt the all the staff were able to communicate well about the needs and aspirations of the pupils, as they knew each child on a personal level and were able to explain their specific needs of the child in some detail. The school also promoted a positive learning environment for which it was obvious the pupils were gaining from. Finally, the activities organised between the university and the school I felt were appropriate in terms of time and the numbers of people interacting, whilst also taking place under appropriate 'rules and regs'.
I think the best way of gaining empathy is to really feel what they feel how pupils feel in different situations, therefore... empathic modelling is extremely effective, combined with being in the presence of the pupils. questionnaire and interviews are effective, since they offer ideas and deeper understanding of a particular issue, but in order to gain empathy other methods are more effective.	The friendly environment, and friendly people are very effective, since they help in loosen up and gain confidence between pupils and students. Sometimes, pupils were not feeling good, or were tired and that was a problem when finding their needs.
The learning capabilities of the student affected how effective the methods were, e.g. if the child struggled to talk ten they needed prompting and benefitted more from yes/no answers.	The more friendly the environment or carer with the child, the more likely of a response the child will give. Friendly helpers encouraged the pupil to help out and give there suggestions when they were asked questions.
Sometimes the fixed model is useless for you to understand the real part of people.	A good environment make them feel happy and comfortable.
Generally face to face is much more efficient in building the sense of empathy as the information is more direct/ has greater impact than just reading/observing.	Massive level of openness meant empathising was made relatively straightforward, the staff were useful at prompting /helping out the students and the environment meant they felt they could be themselves and were safe.
Interview is very direct.	The staff can lead the pupil.
Observation allows you to see what the pupil is struggling with or do differently, therefore, something they might not realise they have adapted to do.	All the staff were useful in explaining the disabilities with the pupil and what explaining what the pupils do.

*Table 8. Shows some of the comments made by the students*

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more often."A level of trust is required between pupils and students to enable a more open dialogue to be developed. This is not easily achieved through formal questionnaires or other digital interfaces, (such as Skype, an internet-based communication/social communication interface), which had been trialled in previous years of running this design collaboration.

Table 3 shows co-designing from the second site visit, where students had pre-prepared sketch images of their concept designs for pupils to modify, alongside blank sheets for pupils to draw new designs. The pupils took ownership of their design through a user-centred, co-design approach being taken by the HEI students. In addition, the shyness of pupils had been minimised by the final presentations, which were given by the pupils with limited support from teach assistants or students. (See table 2)

Drawings from a number of student's and pupil's designs, shown in table 5., demonstrate a number of professional techniques, such as annotation, which relate to a professional format of drawing language, practice and presentation.

The presentation sheets shown in table 5 suggest that informed insights into the daily living activities of pupils can produce a product design that is considered desirable by the target group. This is supported through another case study about an earlier collaboration between the same Special School and HEI (Torrens and Black, 2011b). The combination of pupil input and the empathy and affinity of the HEI student with the pupil produced an innovative concept product design, which was found to be desirable by the pupil cohort. The presentations indicated the efficacy of the pedagogy. The pedagogy of the planned schedule, pre-training and delivery of activities appears to be working well to engage both students and pupils, (see table 2). Anecdotal evidence of less carer involvement and enthusiastic presentations indicating the students having taken ownership of their design support this statement (shown in tables 3, 4 and 5). The use of visual communication techniques and professional practices by pupils in their drawings during and following the collaborative activity indicate some learning of these practices through working with the students (see table 5).

## Conclusions and recommendations

The conclusions are that the overall methodology or approach was effective in timing and the application of methods appropriate; however, an informal icebreaking activity would enhance the productivity of the interview and observation currently defined as site visit 1.

Recommendations for the development of future activities are:

- The HEI students benefit from a thorough literature review of the medical conditions associated with the children and their school activities.
- An initial informal meeting or group activity involving students and pupils would reduce shyness and perform an icebreaking role prior to the initial interview.
- The use of drawing templates, visual prompts, mood boards and low resolution sketch models upon which pupils may draw, handle or modify, (for example, a model made of plasticine or card) be more widely used; and,
- A more effective use of role playing be explored.

## Acknowledgements

The authors would like to thank Ellen Croft, Azmeena Abdulla and Sophie Willis for their support in collecting survey data and the management of the collaborative design activity. The authors are grateful for permission to use examples of design work from the following students: Samuel Chapman, Henrique Corazza, Josh Dryden, Charlotte Hodge, Flora MacLeod, Chris Mason, Frances Pike, Lucy Platt and Key Stage 3 pupils from Ash Field Academy, Leicester.

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