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A MOBILE PHONE SOLUTION FOR YOUNG PEOPLE WITH AUTISM: INTRODUCING THE “HANDS” PROJECT

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ABSTRACT

This paper outlines the main features of the three-year European Commission sponsored HANDS (Help Autism/Diagnosed Navigate and Develop Socially) project on the use of mobile technology for children with autism spectrum disorders (ASD). After locating the use of the new mobile technology within an emergent field of research and practical pedagogical application, and after reviewing the state of research on technology for autistic children, the paper devotes more space to the description of the theoretical and technological innovative aspects of the HANDS toolset. The paper concludes with a number of reflections on the lesson learned so far in carrying out the research.

Introduction

The HANDS\(^1\) (Help Autism/Diagnosed Navigate and Develop Socially) project is a multi-disciplinary project aimed to develop a mobile ICT solution to help young people with an autism spectrum diagnosis (ASD) to become better integrated in society. The project is formulated as a European Commission (EC) Framework Seven Project, as part of the Accessible and Inclusive ICT section of the framework. Based on new research from Human-Computer Interaction (HCI) and Persuasive Technology (PT) in particular, cognitive psychology and neuropsychology, and educational theory and practice on the impact of ICT on teaching and learning, the mobile ICT solution will support children and young people (ages 11 to 16) in handling situations they find difficult and where they have to act autonomously, as well as to develop their social skills and self-management skills.

The HANDS project has a strong multi-disciplinary academic base, including Persuasive Technology (Aalborg University – overall project lead partner, Denmark), Cognitive Psychology (ELTE University, Hungary) and Education (London South Bank University). Its collaborative approach also includes close links with two software developers companies, located in Denmark, Romania and Norway, and four special schools for children with ASD located in Denmark, Sweden, Hungary and the UK. The involvement of partners with differing theoretical perspectives, knowledge and expertise of working with children with ASD, and particularly with varying positions on approaches to evaluation, has at times generated debate within the project, which has acted as an impetus for both creative dialogue across academic boundaries and for reflection on the nature of the autism itself.

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Besides its multi-disciplinarily, the HANDS project is innovative in as much as it strives to develop a set of software components based on Persuasive Technology which would allow not only

a) the provision of a mobile software tool to facilitate the development of social skills and self management skills and the ability to manage social activities,

but also

b) The creation of a software design which makes exchange of experiences and software components easy.

In this latter sense, HANDS aims to provide a tool for teachers to plan and prepare activities and monitor and assess learning.

HANDS, also, aims to provide a Proof of Concept test as to whether Persuasive Technology in a mobile ICT toolset can support young people with autism. In evaluating this possibility, a key strength of the project is the direct involvement as project partners of the four autistic special schools. The input of end-users across these schools was central in the initial software specification phase which took place during the 2008 Autumn term. As such, there is recognition across the project consortium that teachers who spend their working lives supporting and fostering the development of children and young people with autism, have a unique base of professional knowledge to draw on. Further, in the UK in particular, this user-centred design approach has been extended to include the parents and the voice of the children (see Devecchi, Mintz and March, 2009a).

The HANDS project runs over three years from June 2008 to May 2011. It follows a software development cycle as follows:

- Specification of Functionality for Prototype 1
- Development of Prototype 1
- Implementation and Evaluation of Prototype 1, feeding in to:
  - Specification of Functionality for Prototype 2
  - Development of Prototype 2
  - Implementation and Evaluation of Prototype 2
- Review and Dissemination

At time of writing (August 2009), the third phase – implementation of Prototype 1 of the software in the schools is just commencing. 27 children, aged 11 to 16 at time of entry to the project, across the four schools will use the software in this phase, and approximately 50 children will use the software at the prototype 2 stage. All participating children are considered “higher functioning” and have an IQ score over 70. Teachers will be working collaboratively with children, their parents and other professionals to develop specific scenarios, that is situations which the children find difficult, to support the needs and aspirations of individual children, which will then be implemented and evaluated.
This paper reviews the main features of the technology starting with a brief outline of persuasive technology. It will then show how the HANDS ICT tools should work, and outline the multi-disciplinary evaluation framework. It will focus mainly on the evaluation on the educational impact of the use of the technology by locating in the field of research on education and technology and it will conclude with some remarks and lesson learned so far in the project.

**Persuasive Technology**

Persuasive Technology, also referred to as ‘captology’, is a relatively new research field developed by the Stanford psychologist, B. J. Fogg (2003). Persuasive Technology seeks to combine insights into various aspects of computing technology with the insights of theories on persuasion. ‘Captology’ relies heavily on experimental psychology, and in some parts rhetoric, to frame the notion of persuasion. A central concept in Persuasive Technology is that humans have unique properties as persuaders and so does technology. These persuasive properties are distinct between the two groups, yet when they are utilised together they create a strong synergy of persuasive activities (Fogg, 2003). Persuasive Technology then becomes the attempt to work with people on their attitudes, and behaviour, or both, through technology. The use of Persuasive Technology lends an understanding of the value of ICT as persuader and meta-level advisor, thus framing the design of the proposed ICT tools to have the highest degree of persuasive efficiency.

Persuasive Technology focuses on many of the same issues that are considered within the broader research field of Human Computer Interaction, including: users need, user-oriented methods and technology, which match the user’s needs. Whilst the overall goal of HCI is to “....create user experiences that enhance or augment the way people work, communicate and interact” (Preece, J., Rogers, Y. & Sharp 2007: 11), the overall goal of Persuasive Technology is far more focused on “... design, research, and analysis of interactive computer products created for the purpose of changing people’s attitude or behaviour” (Fogg, 2003: 5). In more recent work, such as (Fogg, 2008) the focus has shifted from HCI to Computer-Mediated Communication (CMC). Under this view, computing technology is seen as carrying, shaping and promoting human communication. The focus thus shifts from the individual and a machine, to communicating parties connecting through computers. The implication is that from a CMC perspective, it becomes very important to focus on the teacher – child interaction, and the effect that the software has on that interaction. To a large extent, the HANDS software is developed in the tradition of participatory design - this means that strong emphasis is given to actual praxis in the context for which the software is designed.

The features of Persuasive Technology are such for which:

- It is a voluntary change
- It is about planned persuasive effects of technology
- It focuses on endogenous, that is, the ‘built-in’ persuasive intent that is designed into the computing product.

In so doing, persuasive technology draws on three basic functional roles of computers, which are:

**TOOL**

*increases capability by:*

- Making target behaviour easier to do
- Leading people through a process
- Performing calculations or measurements that motivate

**SOCIAL ACTOR**

*creates relationships by:*

- Rewarding people with positive feedback
- Modelling a target behaviour or attitude
- Providing social support

**MEDIA**

*Provides experience by:*

- Allowing people to explore cause-and-effect relations
- Providing people with vicarious experiences that motivate
- Helping people to rehearse a behaviour

Fig. 1: Basic functional roles of computers (from Fogg, 2003)

The HANDS project is particularly focused in developing, at least in its initial stages, the technology as a tool. In this respect, supporting the children’s social and self-management skills through the use of persuasive technology involves the informed and effective use of 7 types of persuasive technology tools, which are:

- **REDUCTION** - These technologies make target behaviour easier by reducing a complex activity to a few simple steps’ (Fogg, 2003: 33);
- **TUNNELLING** - Tunnelling is leading users through a predetermined sequence of actions or events, step by step (p. 34).
- **TAILORING** - ‘a computing product that provides information relevant to individuals to change their attitudes or behaviours or both’ (p. 37).
- **SUGGESTION** - ‘a computing technology that offers suggestions at the opportune times’ (41). This is based on the idea of Kairos, or motivating people to act when it is the right and moist favourable moment.
- **SURVEILLANCE** - The technology also allows one party to monitor the behaviour of another in order to modify the behaviour. Surveillance must be overt and good behaviour should be rewarded.
- **CONDITIONING** - It reinforces target behaviour by rewards through operant conditioning and periodic reinforcement.
- **SELF-MONITORING** - This technology ‘allows people to monitor themselves to modify their attitudes or behaviours to achieve a predetermined goal or outcome’ (44).

The development of a mobile ICT toolset for children with autism based on Persuasive Technology is the key innovative feature of the HANDS project. However, it has been clearly recognized within the project that the introduction of this innovation needs to be treated with caution. Issues of social perception, social integration and social motivation are at the heart of autism (Gyori 2006), and indeed at the core of the key focus of the project on the development of social skills. In particular, the normative social expectations that parents and teachers have for the development of the children in their care are typically with children with autism not matched to the internal motivational structure of the child. This is of particular relevance with regards to the use of persuasive technology, which is based on an assumption of typical motivational patterns in the subjects using the technology. In developing the specification for the prototype, it has been important to bear in mind that typical responses to persuasive intervention cannot be assumed in children with autism.

Furthermore, there may be, on occasions, divergence between what the child perceives to be in his or her best interests and what parents, teachers and other adults may consider a desirable outcome for them. This potential conflict also has implications for the overall project ethos of placing the needs of individual children at the centre of the specification process, i.e. if the teacher sets a goal that is outside of the motivational structure of the child, how should we proceed? Of course, it needs to be recognized that this dilemma is an aspect of interactions between teachers and children generally (and indeed between adults and children generally) – but the specific social impairments that form part of autism mean that it needs specific consideration for this population of children. Furthermore, the ways in which the school and the classroom operate also have an influence on the identification of needs. Thus, differences in teaching style and structure whereby there may be differences in levels of autonomy offered to children could have an effect on both which needs are expressed and how they are identified. Of course, many children with autism benefit significantly from structured environments where opportunities for choice are in fact reduced (REF). Furthermore, social impairment in autism may mean that even when given an opportunity to express choice, that such children may find this very difficult. This has been a particular issue in undertaking interviews with children about their identification of need and functions for the toolset.

**Technology use with Children with Autism**

There has been considerable development in the last ten years of educational software for use with children on the autistic spectrum, with such technology seen as potentially offering benefits such as a predictable dialogue partner and opportunities for practice in
different communication environments (Bell, Potter and Walsch 2006; Gyori, Stefanik, Kanizsai-Nagy, Oszi, Katalin, Balazs, Stefanics 2008). The HANDS technology tool is aimed specifically at developing social skills in children with autism. A number of studies and projects have developed educational software targeted at this area. Most prominent is Baron-Cohen’s project “Systemizing empathy” (Golan & Baron-Cohen, 2006), which also has evolved into a commercial product, Mind Reading. The software teaches empathy parallel to teaching mathematics by using a sort of social simulator. Further, Olive, et al. (2008) reported on the use of software which integrated the use of visual means such as pictures of facial expression with language and communication skills. There are more examples in the category of virtual reality environments (VLE). For example, Bernard-Opitz et al (2001) developed a software programme which presents everyday social problem situations, and also elicit effective solutions for these. Likewise, Parsons et al. (2005) and Strickland, et al. (1996) have developed virtual reality environments to teach social skills and appropriate emotional responses. Hetzroni & Tannous (2004) and Massaro et al (2008), on the other hand, have developed programmes aimed at enhancing communication skills and language development respectively. Mitchell, et al. (2007) have used VLE and simulated environments to teach social and living skills. In most of these papers, however, the indication of long lasting effects are unfortunately discouraging (Bölte 2004). One possibility considered by the HANDS project team is that the ICT tools in these studies were not sufficiently customized to the individual’s specific needs and furthermore the interventions where not offered at the time when the pupil was actually having a problem and potentially open to learning more. In fact, a key concept proposed by Fogg (2003) in the development of the theoretical basis for persuasive technology is “kairos”. In practice, this means that for persuasive interventions there is an optimal time for their delivery. Thus, the use of mobile technology, which allows the child to have the device with them at all times, offers a potential solution. Rather than being dependent on receiving relevant persuasive input during a particular lesson in a particular place, the input can be stored electronically on the device, and in collaboration with the child, accessed at the time when it is likely to be most effective.

Other more general potential benefits of the use of mobile technology with children with autism are identified by Gyori (2008) as follows:

- It works in a consistent and predictable way;
- It provides a comfortable and rewarding environment;
- It raises less social demands;
- It allows the learner to control the pace;
- It allows for mastery learning through repetition;
- It is a visually-based medium;
- Mobile technology in particular is culturally accepted – i.e. acceptance by the wider peer group is of particular significance for children and young people with autism. A key advantage of an intervention running on a mobile smartphone is that to an external peer audience, it just looks like the child is using a mobile phone.
They also warn about possible problems of technology in general and the use of smartphones in particular, such as:

- Dependency
- Maladaptive attachment
- Accessing dangerous or inappropriate websites
- Putting unreasonable high level of responsibility on learners and their parents

These potentially negative issues have been considered in depth by the project team, and procedures and safeguards put in place at local school level to minimize these potential risks.

The project is fully ethically grounded, which includes the provision of an independent Ethical Board (EB), who review the ongoing work of the project from an ethical standpoint. The EB’s members are independent of the consortium partners. Ethical consent has also been sought from the ethics committees of individual academic partners.

**Key Functional Aspects of the HANDS ICT Toolset**

The key functionalities included in the ICT toolset, running on a mobile smartphone, are as follows:

   An interactive calendar function with usual calendar facilities, but also with configurable/programmable abilities and, potentially in Prototype 2, “knowledge” about situations, where the user is more likely to be persuaded to adopt a new behaviour or attitude (Kairos).

   It is an instructor function, which gives precise and practical advice on how to solve a given problem. Similar to the commonly used Social Stories™ (Gray, 2001), the SSSI, together with the diary, operate on the notion of persuasion as suggestion, or kairos (Pertou and Scharfe, 2009) (e.g., how to travel by public transportation. This function is also configurable/programmable, and its level of support to the user can be reduced once the user becomes better capable of managing the problem).

   A training function that is basically a simulator of problematic situations with concrete and practical advice input, given with the necessary credibility. The Traveling Trainer can be used whenever the user has the time and is motivated, e.g. while traveling on the bus.

   Essentially a log file function, the Credibility-o-Meter is based on the electronic footprints left by the user on the mobile device during normal use. Crucial in the
evaluation of the prototypes, it allows for analysis of the frequency and timing of the use of particular functions by an individual child.

Here is one possible example of how the software might work:

Jack has been driven in taxis to his school ever since he started school. Now that he is twelve years old, he would like to go to school by himself. Traveling by public transportation demands, however, that he uses two buses. Jack and his teacher have been talking about this goal and how to achieve it. They have taken the trip together and the teacher has taken pictures of Jack traveling. Afterwards the teacher has created an SSSI instruction sequence which runs on the smartphone software. Furthermore, the teacher has recorded a video of Jack and himself, which runs on the smartphone explaining what to do in case Jack has a problem. As a result of using the software, Jack is better able and supported to manage public transportation in a safe way.

Findings from interviews with children, their parents and teachers carried out during the initial specifications and functional requirements stage also show that the HANDS technology can be used to support children in the following areas:

- Managing money
- Preparing for difficult situations
- Understanding and managing time
- Emotions and appropriate reactions
- Organisation within and beyond school
- Health and hygiene
- Food preparation
- Travel

In practice, teachers and children would choose, amongst the categories listed above, the situation that proves to be difficult and teachers will design scenarios of how the children can overcome their difficulty. Through the use of various strategies (written or visual instruction, photography or videos), teachers will plan the support which will then be uploaded onto the child’s smartphone and used when the child requires it.

**A Mixed Mode Approach to Evaluation**

The HANDS project represents one of the few attempts to integrate knowledge and expertise cross-disciplinary from cognitive psychology, education, and persuasive technology to both the development of the software and evaluation of the technology as a whole. Thus, the evaluation framework for the HANDS project relies on a mixed-method testing methodology, which uses a variety of the methods – quantitative and qualitative – and disciplinary approaches in a parallel and integrated way. Thus, the HANDS project is
firmly located in a growing field of interdisciplinary research. The complexity of such an evaluative design is an exciting feature, but also a very challenging one.

The multidisciplinary and collaborative process of user engagement in all stages of the research is also an innovative feature of the project and one that has been supported generally as necessary to understand and draw conclusions on complex practices such as pedagogy and technology (Burke-Johnson and Onwuegbuzie, 2004; Orlikowski and Baroudi, 1991). As Chatterji (2006) suggests, the rationale for employing a mixed-method approach and in particular a qualitative approach, resides in the fact that ‘in depth and often site-specific studies of context variables, along with systematic examinations of programs inputs and processes as potential moderators and intervening factors, are a necessary prerequisite to both designing and implementing sound field experiments geared towards answering causal questions on program impact’ (2006: 15). Thus, multidisciplinary and mixed-method approaches, based on the pragmatic goals of both development and assessment of programme intervention, can sustain a more detailed and holistic approach to software development and evaluation. In the second case, a collaborative bottom-up approach to development and evaluation locates the project directly in the field of educational practice.

It should be noted, however, that although all partners in the project team are committed to collaborative working, the use of a mixed-method approach has inevitably involved tensions, which can be considered to some extent as mirroring the tensions between a medical model and social model approach to conceptualizing ASD. In particular, the use of standardized psychology test instruments, as described briefly below, to measure social skills competency is based on a particular medical and cognitive view of ASD. Whilst no-one in the project team would deny the existence of a neurobiological impairment at the heart of the syndrome, our research team at London South Bank University take a more nuanced approach to considering ASD. We consider that how these impairments are expressed in particular social contexts, such as the classroom, is to a significant degree a function of the attitudes and skills of the “neurotypical” adults and peers interacting with the individual with ASD. Thus, as Xu and Fuller (2008) point out when reporting on the implementation of practice models in the USA based on Bronfenbrenner’s ecological model (Bronfenbrenner 1979), where the teaching and other professional staff are able to treat the children in their care as individuals, and to create an environment where their abilities can be recognised and fostered as much as their disabilities, then children are in a position to develop their full potential. In such a social, individualized context, the efficacy of standardized tests alone in measuring the impact of a new innovation is, in our view, limited. This is why we believe that the qualitative, case study approach to evaluation of the impact of the HANDS ICT tool offers a necessary adjunct to the use of standardized tests.

The Evaluation Framework

The evaluation of Prototype 1, taking place between August 2009 and February/March 2010, seeks to gain knowledge on how the phone and its related technology can be
improved. It pursues this overall goal by collecting both quantitative and qualitative data in order to evaluate:

1. The effect of the introduction of an ICT tool based on persuasive technology in developing the children’s social skills, self management skills and social integration;

2. The applicability of the ICT tool to the learning environment – i.e. how it fits in with existing practices of teaching and learning AND what impact it has on such practices;

3. Gaining feedback on the development, improvement and overall technical assessment of the ICT tool and elucidating recommendations for functional changes for Prototype 2.

Cognitive psychology (ELTE University, Hungary) is responsible for designing sound standardized tests and measuring the effect and efficiency of the Personal Mobile ICT tools in relation to (1) above. The effect and efficiency of the HANDS toolset will be measured as the progress relative to an individual baseline established before the tests.

Persuasive technology (Aalborg, University, Denmark) is responsible for creating a design experiment, where the core ideas of Persuasive Technology – that is credibility and intrinsic motivation, and their potential for use with children with autism, are evaluated. This relates to (1) and (3) above.

Applicability to the Learning Environment (as the Education component is named within the project and the responsibility of London South Bank University) is responsible for research considering how the use of the HANDS toolset may be integrated into the learning environment, in relation to (1) above. It also includes a qualitative evaluation of the effect of the ICT tool in developing social skills as in (2) above. The evaluation and results from all three aspects will also crucially provide recommendations for changes and developments required for Prototype 2, as in (3) above.

Applicability in the Learning Environment

For the remainder of the paper, we focus on aspects of the evaluation programme set out by the London South Bank University team for the evaluation of Prototype 1.

Evaluation of Technology in the Classroom

The last twenty years have seen an increase in the development of new technologies and an increase in their use in school (BECTA 2008). Simultaneously, there has been a growing interest in evaluating their impact on teaching and learning. Some of the
literature, based on a linear model of the relationship between teaching and learning, focuses on quantitative outcome measures based on attainment or grade scores. For example, Somkh, et al. (2007) report on a relatively large scale analysis of the relationship between the level of use of ICT and attainment test scores showed that test score improvement were more significant in primary than secondary schools. However, the ability of such an approach to provide explanatory models as to why technology does (or does not) have an effect is limited. In fact, predominantly the literature is rooted in the recognition that teaching and learning are complex, multi-faceted activities, and that a range of methodological tools are necessary to properly consider this complexity. Thus many studies are based on a more complex concept of learning which envisage a number of related objectives apart from just grade outcomes, to broader considerations of the aims and purposes of education and its impact on social and emotional development, as well as incorporating a focus on potential mechanisms by which technology can affect processes of learning and teaching. For example - Cox, 2003 indicates that technology has the potential to:

- Increase children’s **motivation**
- Improve **writing** and **presentation skills**
- Support and foster children’s **imagination** and **creativity**
- Enable a faster and easier **manipulation of data**
- Facilitate **communication, social interaction** and **collaboration**

Cox (2007), in a review of developments in classroom technology research, reports on a number of claims that technology makes the lessons more interesting and increases self-confidence. Higgins (2008), on the other hand, claims that technology motivates learning because it enables children to master a task through repetition, or until they feel confident with it. This is mainly because computers in particular are non-judgmental, and allow for the task to be matched to the child’s level of knowledge and mastery. Others (BECTA, 2008) link mastery, increase in self-confidence and self-esteem with the fact that technology allows children to use a tool they are confident with outside the classroom, and which enables them to be in charge of their learning. Others consider that this promotion of autonomy allows children to become more responsible for their learning, and thus aids metacognitive development (James et al, 2006). However, as Cox (2007) points out, it is nonetheless hard to make causal links between the use of ICT and motivational aspects, and to some extent the claims made by these authors could be considered as being in the form of assertions rather than as actual claims based on evidence.

**Impact of Technology on Teachers**

When considering the impact of technology on learning, it is important to bear in mind that the process of teaching and learning is a two way social process. Thus when new technology is introduced in to learning environments, it can have an impact on the development of new working practices by teachers as they adapt to the use of the new tool in their setting. Much of the literature focuses on how the introduction of technology in to the classroom can facilitate teachers moving from transmission based models of
pedagogy to more interactive child-centred models, sometimes categorized as social constructivist approaches. Again, it is the changes in social and communication features of classrooms, this time viewed from the teacher’s perspective as the main actor, that are considered as having an impact on learning. Thus Hennessy et al. 2003, in a review of US research on the use of technology in already highly technologically oriented schools, show that teachers shifted their practice from a teacher-centred and transmission model to a more child-centred one. Sandholz, Ringstaff, & Dwyer, 1997, reporting on the ACOT project in the US, where a range of technology tools were introduced, reports on self-reported changes in practice by teachers. Roschelle, Pea, Hoadley, Gordin, & Means, (2000) report on several examples of new technology use in schools where changes in teacher practices were observed. Hennessy et al. (2005) in a study of secondary teachers’ perceptions of how ICT had affected their practice using repeat focus group interviews, notes that a gradual process of pedagogical evolution was apparent; teachers were developing and trialing new strategies specifically for mediating ICT-supported learning.

**Questioning Shifts in Practice**

A number of authors, however, have in the last decade questioned whether such a shift in teacher practices is in fact a common or uniform outcome of technology introduction. Thus Cuban, Kirkpatrick and Beck (2001), in a study of two US high schools using interviews with teachers in tandem with classroom observation, report low levels of actual use of technology in classrooms and suggest that teachers who are successfully integrating ICT into subject teaching tend to be teachers who already have an innovative pedagogic outlook. Zhao, Pugh, Sheldon, and Byers (2002), in a study of K-12 teachers working with technology rich projects in the classrooms, determined that the further a type of technology use was from existing practices, the less likely teachers were to implement it. Similarly Glover and Miller (2001) found that serving teachers, have used Interactive Whiteboard technology as a way to reinforce their hegemony as providers of teacher talk at the head of their students.

Some more recent studies have restated the argument for technology being able to affect practice. In a seminal paper, Matzen and Edwards (2007) report on a study of the introduction of new technology with a linked continuing professional development programme. They indicated that in this context teachers increased their use of constructivist practices independently of their prior preferences. Data collected for the evaluation included surveys, case studies, teacher reflections, interviews, feedback on the professional development, and final teacher projects. The survey instrument was used to give a measure of correlation between the two key factors. Their study reports, however, on a 50 hour professional development programme, and the authors do not, perhaps, give enough consideration to the practical and economic restrictions in using such an approach on a wider scale. Nevertheless, their evidence that linking technology introduction to effective training can lead to desired changes in teacher practice is an important point, and it is interesting to note that to date few other studies in the literature have expanded on this point.

The studies presented above, have given widely differing interpretations of the relationship between technology introduction and changes in teacher practice. It is worth
noting that most of these studies have been relatively small scale, involving only a small number of schools. This is perhaps one of the drawbacks of qualitative studies in that the resources required make large multi-site studies difficult to achieve, but the question remains as to what extent the differences reported between the studies are due to inherent variability between the settings.

**Teacher Attitude to Innovation**

According to Saye (1998), who reports on a study using interviews with teachers in US schools, the extent to which new technology has an effect on working practices is linked to some degree to the confidence that teachers have in dealing with innovation, including technology innovation in the classroom. In particular, where teachers were uncertain about the use of technology, level of adoption of new practices was diminished. Cuban, Kirkpatrick and Beck’s study (2001)) also indicated that where teachers are uncertain about their own skills and abilities in relation to technology or about the appropriate ways in which such technology can be used to develop children’s learning, then this can have a significant effect on the ways in which such technology is used in the classroom.

**Technology for Children with Learning Difficulties**

A significant amount of research has focused on the use and benefits of technology for children with disabilities and/or learning difficulties. The use of technology in this area can be classified according to six purposes (Florian, 2004):

- Tutoring;
- Exploration;
- Assistance;
- Communication;
- Assessment;
- Management purposes.

With regard to the use and application of technology and its benefits for learning, the literature on ICT and autism reports similar outcomes to the one already reviewed. While mindful of the possibility that the use of technology can become obsessive, Hardy (2000) suggest that learners with ASD show interest and engagement with computers which can impact on their sense of achievement, self-efficacy, and can increase their self-esteem and integration. According to Hardy, such positive outcomes are the result of five computer and technology qualities, and they are:

- Automaticity;
- Capacity;
- Provisionality;
- Interactivity; and,
- Sociability
The Applicability in the Learning Environment evaluation of the HANDS ICT tool, therefore, contributes to the overall project by locating the use of the new technology within relevant educational research and by supporting the other two research proposals by adding to the evaluation of the practical pedagogical aspect of technological implementation and application.

**Data Collection Methods**

The overall objective of the study is to use a naturalistic, case study approach that draws on an interpretivist theoretical framework that can be typified as a limited ethnographic approach. This will involve undertaking, at the UK and Denmark schools, semi-structured interviews with teachers, parents and the children involved in the use of the ICT tool. These will be supplemented with classroom and wider setting observations (Croll, 1986) which will allow for:

1) identification of particular examples of the use of the tool with further elucidation in interviews, and
2) triangulation between the observer view of the use of the ICT tool and
   a) teacher interpretations of the use of the tool in interviews and
   b) children’s interpretations of the use of the tool in interviews.

Further, interviews with children and parents will be included in the design, as well as the use of a “writing/visual” tasks with the children to help stimulate children’s considerations and interpretation of their use of the ICT tool.

At the other test schools, children will be asked to complete the same “writing/visual” task, and teachers will be asked to complete a multiple stage questionnaire, focusing on their interpretation of the use and impact of the ICT tool during the implementation of Prototype 1

In all schools, specific information will also be gathered on the children. Such information is to be coordinated across the three strands of research. This will include demographic information, information on diagnosis and teaching strategies, as well as including a description by their teachers and parents of the child. Further, relevant documents such as individual education plans or equivalent will also be included in this child specific dataset.

Further, in all settings, specific information on the structure, organization and working practices of the school will also be sourced. This will include basic structural information such as number of pupils and teachers, as well as teaching approaches, and management approaches. Schools will be invited to give further written information on whole school factors. In the case of the UK school, this will be triangulated with information on whole school factors gained during observations and interviews.

**Data Analysis**
Observation field notes and interview transcripts will be analyzed using a thematic analysis (Boyatzis 1998, Braun and Clarke 2006). Thematic categories will be initially developed from the literature review and previous experience. These will be further developed from the initial set of categories using an interactive approach during the data analysis (Carley, 1990), and new categories added as required. Codes and categories will therefore be both a priori and in situ.

The process of data analysis will be iterative (Miles and Huberman, 1994) and responsive to the context in order to acquire a deep understanding of the cultural, attitudinal, professional and social factors which influence the effectiveness of the technology. The analysis will consist of both content analysis and systemic analysis. The first would seek to achieve an overall understanding of the use and effects of the technology, while the second will critically seek to make connections between different dimensions and levels of use and professional practice. Data analysis will be supported by the use of data analysis software such as NUDIST or NVivo.

**Conclusions**

Individuals with autism (ASD) have a highly increased chance of becoming marginalised in all forms of mainstream institutional education, becoming victims of various forms of exploitation and crime, becoming involved in criminal acts due to social naivety and lack of insight into social norms, and becoming institutionalised in psychiatric hospitals and care homes for long periods (Shea & Mesibov, 2005), (Haskins & Silva, 2006). At the same time, they have a highly decreased chance of finding adequate jobs (and jobs at all), of managing an independent life, and of establishing long-term interpersonal relationships and partnerships (Howlin, 2003). As the occurrence of ASD is estimated as 0.6-0.8 % of the total population worldwide, it is a significant social group whose marginalisation is currently a widespread phenomenon. Without adequate psychological/pedagogical intervention and life-long support, the affected persons’ life quality is sadly potentially poor. Thus the moral responsibility of society is clear with regards to the need for a more effective integration and inclusion of persons with autism (Howlin, 2004). Indeed, social isolation and marginalisation are quite frequent elements of life stories of individuals with autism (ASD). In our initial specification interviews with children and parents at the UK schools, it was remarkable how many commented on the fact that they felt themselves to have no real friends. Adolescence and young adulthood are especially critical periods in respect to isolation and marginalisation in individuals with (Howlin, 2004).

It is possible that the HANDS ICT tool may help foster the development of social skills and self management skills in children and young people with ASD. Its focus on an individualized approach, where input from the child in setting their own objectives, with support from teachers, parents and other adults, may allow them to develop their sense of autonomy and independence. Its mobile nature may allow them to take useful supportive (and persuasive) interventions that they have had a hand in formulating with them, so that
they can access them at the most appropriate and effective time. If, as we are on the verge of discovering at time of writing, the HANDS ICT tool can help even some children and young people with ASD in a secondary school based environment, it may then also be of potential use when they move out of secondary education into further and higher education and the world of employment.

References


