International Review of Research in Open and Distributed Learning

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Volume 12, numéro 4, mai 2011

Special Issue: Frontiers in Open and Distance Learning in the North

URI : https://id.erudit.org/iderudit/1067607ar
DOI : https://doi.org/10.19173/irrodl.v12i4.878

Aller au sommaire du numéro

Éditeur(s)

Athabasca University Press (AU Press)

ISSN

1492-3831 (numérique)

Découvrir la revue

Citer cet article

Øhrstrøm, P. (2011). Helping Autism-Diagnosed Teenagers Navigate and Develop Socially Using E-Learning Based on Mobile Persuasion. *International Review of Research in Open and Distributed Learning*, *12*(4), 54–71. https://doi.org/10.19173/irrodl.v12i4.878

Résumé de l'article

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International Review of Research in Open and Distance Learning

Vol. 12.4
May – 2011

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Abstract

The HANDS (Helping Autism-diagnosed teenagers Navigate and Develop Socially) research project involves the creation of an e-learning toolset that can be used to develop individualized tools to support the social development of teenagers with an autism diagnosis. The e-learning toolset is based on ideas from persuasive technology. This paper addresses the system design of the HANDS toolset as seen from the user's perspective. The results of the evaluation of prototype 1 of the toolset and the needs for further development are discussed. In addition, questions regarding credibility and reflections on ethical issues related to the project are considered.

Keywords: E-learning; autism; mobile learning; persuasive technology

Introduction

Autism spectrum disorders (ASD), including, among others, Asperger's Syndrome, are developmental disorders of the human nervous system. They result in a *lifelong condition* (see Volkmar et al., 2004). Many individuals with ASD find it difficult to handle daily tasks and to interact with others, often resulting in social marginalisation. Most individuals with autism require social, psychological, and/or pedagogical support services. Early intervention is crucial. In childhood and in the teenage years, support is often provided through the school, and teachers play an important role. The Helping Autism-diagnosed teenagers (of an age range between 13 and 18 years) Navigate and Develop Socially (HANDS) project aims to develop computer-based tools that teachers can individualize to support teenage students with an autism diagnosis. The HANDS toolset is supposed to facilitate the design of individual e-learning programs for teenagers with an autism diagnosis. Using the HANDS toolset, the teacher and teenager work together to tailor an individualized toolbox. The HANDS toolbox is implemented on a smart phone in order to provide support when required. The tools in the individual toolbox may be called e-learning tools because they have been designed by the teacher (in cooperation with the teenager) to support the teenager in learning how to obtain and better support social integration and inclusion and

independence in daily life. Implemented on smart phones, these individual HANDS tools provide portable, accessible support to assist with social and self-management skills.

HANDS is an EU-financed research project, which started in June 2008 (see http://hands-project.eu/). Ten partners from six different countries are involved in HANDS, and the project is coordinated from Aalborg University, Denmark. The purpose of the project is to improve the quality of life for teenage students with an autism diagnosis by providing an ICT toolset for designing assistive technology to support the teenager's social development.

The project is based on the idea that teenagers with autism should have an individually designed toolbox implemented on their personal smart phones in order to assist with and improve their social and self-management skills and thus promote their social integration and independence. The toolbox is designed in a cooperative process with the teenager's teacher.

Prototype 1 of the toolset was ready for use in November 2009. During the following months the system was evaluated based on observations, interviews, and various tests carried out at the four partner schools in the HANDS project (see Aagaard et al., 2010; Mintz et al., 2010; Gyori et al., 2010.)

During the evaluation of prototype 1, various questions were studied; for example, in which situations and under which conditions can the HANDS toolset be expected to be useful for the teenagers, and how can the use of the HANDS tools support the work of the teachers and the schools in their everyday practice? Although such questions cannot be fully answered at the present stage, some partial answers can be given based on the studies so far.

In this paper, some general aspects of the development and use of software as assistive technology for individuals with autism spectrum disorders will be considered. Also, the choice of persuasive technology as a theoretical framework for the HANDS project is described, the general design of the HANDS toolset and its potential uses for e-learning are discussed, and the results of the evaluation of prototype 1 are outlined. The need for further development of the toolset is discussed as well, and, finally, there is a discussion of fundamental ethical issues related to the HANDS project.

The Use of Assistive Technology for Individuals with Autism

The theoretical framework and the design of the HANDS project are based on an analysis of the literature on the use of assistive technology for individuals with autism spectrum disorders. Indeed, prior to the start of the HANDS project in 2008, ICT solutions were developed to assist individuals with an autism diagnosis. In some cases these products have specific educational purposes. ICT-based tools have many properties that teenagers with ASD and their teachers may find attractive and useful. As pointed out in Bell et al. (2006), the computer applications potentially offer some important features in the communicative situation of young people with autism. In particular, the teenagers normally see computer applications as high status devices, and such devices can be flexible as learning tools. In addition, individuals with ASD typically

appreciate that the dialogue with the device is a safe experience in the sense that it is predictable within a very narrow scope, which matches the focused attention that in many cases characterize individuals with ASD.

Unfortunately, only few of the software products designed for young people with autism have been created explicitly to support the development of social skills. However, the project "Systemizing Empathy" (Golan & Baron-Cohen, 2006) should be mentioned. With this educational software it is possible to focus on empathy. This application makes use of a sort of a social simulator. Others have used a similar approach, but according to Bölte (2004), the long lasting effects of the use of these products are somewhat discouraging. Bölte argues that in order to be efficient, such educational applications should be customised to the needs of the individual user and designed to be used not only in a classroom setting but also at home and in other relevant environments. It should be pointed out that many software projects, which performed well in the laboratory, failed in the field test (Dawe, 2006). This means that the assistive software in question should be tested not only in a classroom setting but also in relevant environments outside the school.

It is important to be able to customize the assistive software to the individual user and also to be able to offer suggestions at the right time. In this way the user may be taught to use the application when and where there is a need for the assistance that the systems offer. The possibility of customizing the applications makes it realistic to take the user's intuition and knowledge into account in the actual design and development of the assistive software system in question.

If software products designed for young people with autism should focus explicitly on the development of social skills, it would be an attractive idea to implement the tools using mobile technology. Significant success has been reported from small studies of the use of various applications managing everyday life activities (Myles et al., 2007; Sørensen 2005). Given that the HANDS tools are meant to support and guide teenagers with ASD in their social development in everyday settings, a theoretical framework with a clear focus on individual e-learning involving mobile technology is an obvious choice.

In the following section we shall present some of the key ideas within persuasive technology. The assumption is that this theory can provide a theoretical framework corresponding to the ambition on which the HANDS project is based.

Mobile Persuasion as a Useful Theoretical Framework

Persuasive technology or *persuasive design* is a new field introduced by Professor B.J. Fogg at Stanford University. It is sometimes called *captology*, which is a term derived from the acronym CAPT (computers as persuasive technology), first suggested by Fogg in 1996. In short, captology is the study of the possibilities and problems related to the use of computers for persuasive purposes.

The study of persuasive technology is a rapidly growing research field. A large number of scientific papers have been published within the field during the last decade. Since 2006 yearly conferences have been organized (see http://www.persuasive2010.org/). There is also a growing interest in the use of mobile technology for persuasive purposes (see http://www.mobilepersuasion.org/).

Fogg's book *Persuasive Technology: Using Computers to Change What We Think and Do* (2003) is the most important attempt to define the scope of the field. According to Fogg, interactive technology can be persuasive in three different ways:

1. as tools,
2. as media, and
3. as social actors.

If the interactive system is a *tool*, the crucial point is that the system can give the persuader an increased capability. Such a tool-like system can be persuasive by making the target behavior easier to do, by leading the user through a process, or by performing calculations or measurements that can motivate the user.

If the system in question is seen as a *medium*, it can offer users an important experience. Fogg has pointed out that in this case the persuasiveness of the system will typically allow users to explore some important cause-and-effect relationships and thereby provide them with an understanding of some important relations or with some vicarious experiences that can motivate or help to rehearse a behavior.

When the computer serves as a *social actor*, it can be persuasive by rewarding users with positive feedback, by modeling a target behavior or attitude, or by providing social support.

In his discussion of computers as persuasive tools, Fogg has identified and discussed the following seven types of persuasive technology functioning as tools:

1. reduction: persuading through simplifying;
2. tunneling: guided persuasion;
3. tailoring: persuasion through customization;
4. suggestion: intervening at the right time;
5. self-monitoring: taking the tedium out of tracking;
6. surveillance: persuasion through observation; and
7. conditioning: reinforcing target behavior.

In his discussion of computers as persuasive media, Fogg has mainly considered persuasion through simulation. He has proposed that the following three categories are particularly relevant to the design of persuasive technology:

1. cause-and-effect simulations (offering exploration and insight);
2. environment simulations (creating spaces for persuasive experiences); and

3. object simulations (providing experiences in everyday contexts).

Regarding the use of computers as persuasive social actors, Fogg has discussed five social cues through which the user may be persuaded:

1. physical cues,
2. psychological cues,
3. language,
4. praise, and
5. social dynamics.

Two chapters in Fogg's book are devoted to the discussion of issues related to credibility. This clearly has to do with the simple fact that a technological device is unlikely to be persuasive to the user unless it is considered to be credible. If we consider a computer system, which offers, for instance, advice to the user in a specific situation, it will, of course, be interesting to ask how the user will evaluate the advice given by the system. To what extent will the user conceive the advice as credible?

Although there are several rather complicated aspects of credibility, and although any numerical measure of credibility will represent some kind of reduction, it may be useful to introduce a measure expressing the degree to which the user believes that the technology in question will be helpful. Fogg suggests that the perceived credibility of the computer system may be understood as a sum of two components, namely perceived trustworthiness and perceived expertise. In other words, Fogg says that the following equation can be used:

perceived trustworthiness + perceived expertise = perceived credibility

Here the perceived trustworthiness will depend on how the user evaluates the personal qualities of the advisor behind the advice given by the computer system. Is the originator of the advice somebody who is truthful, fair, and unbiased? Has the advisor actually done her or his best to provide good advice?

The other component in Fogg's equation, perceived expertise, has to do with the intellectual qualities of the advisor behind the advice given by the computer system. Is the originator of the advice somebody who is actually skilled and able to give good advice in this case? Is the advice actually based on a sufficiently high level of expertise, knowledge, competence, and experience?

Fogg is correct in claiming that these two components both contribute to the perceived credibility of the application in question. However, Fogg's equation may still be criticized. Let us assume that the expertise of the advisor behind the system is maximal (i.e., perceived expertise = 1) but that the advisor is without any trustworthiness at all (i.e., perceived trustworthiness = 0). Following Fogg's equation the perceived credibility then becomes 50% of the maximal value. It can certainly be argued that this is unacceptable. At least, it appears just as reasonable to say that the perceived credibility of the advice in this case should be 0% because the advisor is totally

unreliable. On such grounds, it may seem more correct to see perceived credibility as a product of perceived trustworthiness and perceived expertise.

Clearly, both components of the perceived credibility are dynamic because they may change from time to time. In the HANDS project it is seen as rather important to find a practical way to follow this change. In order to do so, we need a way to quantify the degree to which the teenager believes that he or she can find help in relevant situations by using a particular component in his or her HANDS toolbox (we shall come back to this challenge).

It is easy to read Fogg's 2003 book as a contribution to e-learning, although there are certainly other perspectives of the theory. But persuasive technology can clearly be applied to the teaching and learning situation studied in the HANDS project. When conceived in this way the theory suggests a number of strategies and techniques for making tools that can support the teenager with autism in his or her social development. In persuasive technology there is a strong emphasis on customization. This means that the teacher in close cooperation with the teenager has to tailor the relevant tools individually. In order to make this possible, it is essential that the appropriate components are available in the HANDS toolset.

Fogg is very much aware of the fact that the use of persuasive technology may give rise to a number of ethical considerations. He has devoted one chapter in his book to the study of ethical issues. However, there remains much to be done in the study of the ethical perspective of the development and the use of persuasive technology.

Fogg has suggested that persuasion can be broadly defined as "an attempt to change attitudes or behaviors or both (without coercion or deception)" (2003, p. 15). This definition may however be slightly problematic because it is not always clear when something is coercive or deceptive. A more useful way of talking about this would be to distinguish between ethically acceptable types of persuasion and ethically unacceptable or problematic types of persuasion, such as coercion, deception, manipulation, and so on. This strategy leaves us with a definition of persuasion as "an attempt to change attitudes or behaviors or both" with a challenge to formulate principles according to which certain types of persuasion should be regarded as ethically acceptable whereas other types should be regarded as unethical. Within the HANDS project it is seen as essential to deal systematically with the ethical questions that occur.

The General Design of the HANDS Toolset and its Use for E-learning Purposes

The HANDS toolset has been developed using the ideas from persuasive technology. There is an emphasis on designing individual tools for the users. It has been the ambition in HANDS to make the specific techniques and options available for the teachers as they are designing individual tools for their students. The assumption is that the use of mobile persuasion will turn out to be effective for this purpose.

The HANDS toolset consists of software developed at two levels:

1. systems running on a server accessible on the Internet, and
2. software that can be used by the teachers in order to develop applications that can be downloaded to run on smart phones belonging to the teenagers participating in the project.

The following diagram outlines the general system design in HANDS.

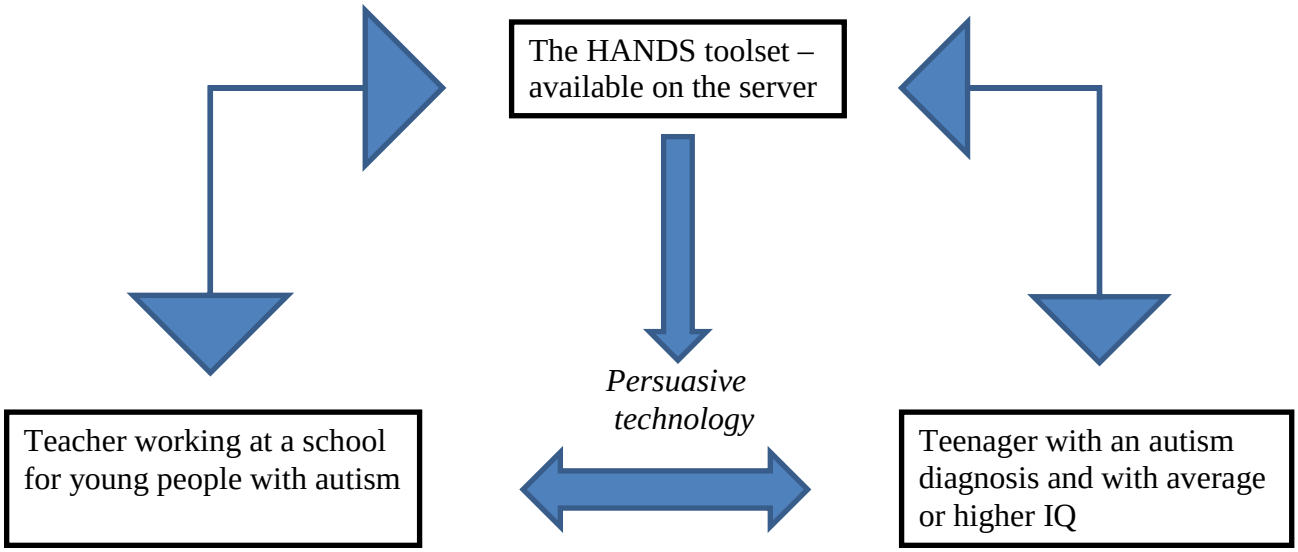

Figure 1. The general HANDS system design.

Each of the teenagers in the project is supposed to use the applications in an individually tailored format. The teachers develop the individual applications using the HANDS toolset available on the server. Then the individual applications are downloaded from the HANDS server onto the smart phone. The result, an individual collection of HANDS tools implemented on a specific smart phone, is called a toolbox. It is important that the toolbox is tailored in close cooperation with the teenager, who is supposed to use it as a practical help in everyday life. The teacher can update the HANDS toolbox on the server, from where the updated applications may be downloaded to the smart phone belonging to the individual teenager. The teenager may choose to synchronize her or his toolbox with the server at any time. In doing so the teenager accepts to have her or his toolbox updated.

It is assumed that the smart phone can be an attractive platform for the use of the personal toolbox and for individually organized training and e-learning. In this way the teenagers may learn to handle what they see as difficult situations occurring in various everyday situations.

The HANDS software implemented on the server include a number of tools, developed from ideas originally formulated by the teachers and the teenagers at the partner schools in close cooperation with the researchers at the partner universities. The development of the HANDS tools

has been strongly influenced by the ideas of persuasive technology. The HANDS toolset includes the following main functionalities:

1. The Handy Interactive Persuasive Diary (HIPD),
2. The Simple-Safe-Success Instructor (SSSI),
3. The Personal Trainer (TT),
4. The Individualizer (TIn),
5. The Sharing Point (SPo),
6. The Credibility-o-Meter (CoMe).

Functionalities 1-4 have been implemented in prototype 1 of the HANDS toolset, whereas 5-6 have not. All the functionalities will be included in prototypes 2 and 3.

The HIPD is an interactive calendar with a number of additional possibilities. The purpose of the HIPD is to support the teenager in the temporal organization of her or his everyday life and also to give the teachers a tool which can make it easier to be prepared for situations where the user is likely to be persuaded to adopt a new behavior or attitude (Ranfelt et al., 2009).

Each of the tools must offer advice at the right time. In the theories of persuasive design, the idea of Kairos, which includes the notion of the right or the appropriate time, is considered essential with respect to the persuasive effect (Aagaard et al., 2008).

The SSSI and TT are both believed to support the teenager when he or she wants to learn how to navigate certain situations better. The following is an example illustrating the kind of problems in question (Schärfe et al., 2009):

> Morning time is very hectic in AA's home. His mum has to get three children ready for school, and it would be good if AA takes responsibility for preparing his school bag. Besides managing time effectively, AA also should remember what he should pack for the school day. Doing so will make both AA and his mum less anxious and angry in the morning. Understanding that there is a need to change AA's behavior, AA's teacher and AA have designed an application for AA's toolbox on his smart phone. This application can stepwise tell AA what to pack in his school bag. In this way it can support that AA's behavior in the morning situation is changed.

This approach is inspired by the so-called *social stories* (Gray 2000), that is short stories describing a specific type of situation considered to be problematic, challenging, or difficult for the individual teenager with autism. The idea is to use the story to focus on the social aspects of the situation. In this context, the teenager and the teacher may agree on some behavioral changes that they both want to see. Using such social stories, relevant pictures, and written advice, it may

be possible to develop an application on the smart phone that can direct the teenager to an appropriate behavior in the situation in question (Gyori et. al, 2010).

It is generally believed that the HANDS software will only be accepted by the teenager with autism if it has been individually designed and personalized. The user should be able to choose the colors and other features of the user interface. This is the purpose of the TIn tool. Using this tool from the HANDS toolset, the teenager will be able to individually tailor the HANDS toolbox. The toolbox can be adapted so it has a unique appearance and functionality for each person. In this way the HANDS value, one for each, can be carried out in pedagogical practice.

The purpose of the SPo tool is to allow the teachers in the HANDS project to share their experiences. In addition, the tool should provide a communication platform for the teenagers in the project. The SPo is still under development and was not included in prototype 1 of the HANDS toolset.

The teacher would clearly like to know the extent to which the use of the toolbox can actually influence the behavior of the teenager. However, this is not sufficient. It will also be important for the teacher to know to what extent the teenager believes that the toolbox can be of any help. When using the HANDS toolbox in a practical learning situation in cooperation with a particular teenager with autism, the teacher needs to know, at least approximately, to what extent the HANDS toolbox is experienced as being credible by the teenager. It is the purpose of the Credibility-o-Meter (CoMe) to establish this information. The Credibility-o-meter is partly based on the electronic footprints left by the user on the mobile device during normal use. CoMe is still under development and it has not been included in prototype 1. Some of the basic questions involved in this development will be discussed.

From the teenager's perspective, the HANDS toolbox offers help whenever certain situations arise. These situations were previously identified when the teacher and teenager cooperatively constructed the toolbox. Typically the smart phone will prompt the teenager when a situation is becoming nearer in proximity, either in time or place. A built-in GPS in the smart phone allows the prompt or alert to be location-related, that is the situation may be related to a certain location. Whenever the user comes close to this location, a warning is issued.

All actions performed by the teenager and the GPS data will be logged on the HANDS server. This means that the teenager is under the surveillance of the teacher, as well as the researchers and the parents (given that the teenager has consented).

The general system architecture as seen from the user's perspective may be presented in the following manner.

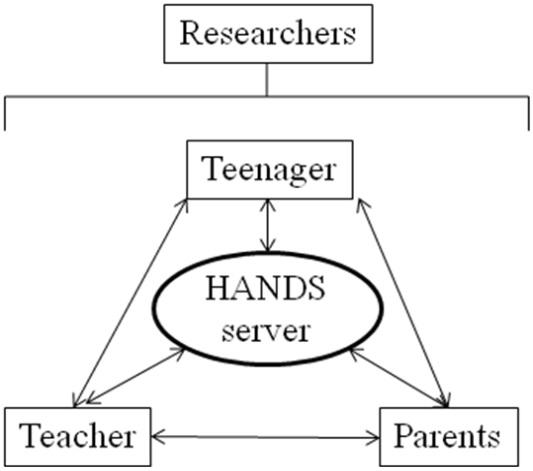

Figure 2. The general system architecture as seen from the user's perspective.

This high level of surveillance gives rise to ethical considerations.

Prototype 1 Evaluation

Prototype 1 of the HANDS toolset has been evaluated at the four schools in the HANDS project from November 2009, and a part of it from September 2009. However, because of various delays and practical problems not much testing was carried out before December 2009. In fact most of the testing was done in the late spring of 2010. The test period ended in June 2010.

Twenty-nine teenagers and their teachers at the four schools have participated in the test of prototype 1. The teachers have been asked to use the HANDS toolset in cooperation with the teenagers in order to create individual toolboxes, which the teenagers should download on their smart phones. The teachers have also been asked to continue their pedagogical practice as usual involving the HANDS software as much as possible. In particular, the teachers have been asked to look for cases in which the teenager could benefit from the use of the HANDS software in order to learn to navigate better socially. All teachers and all teenagers were interviewed after the test period. In addition, all activities on the smart phones have been recorded on the HANDS server.

A total of 5,990 instances of use were recorded on the server during the test period. This is less than expected which probably is due to the fact some of the teenagers started using the software very late in the test period.

The two most frequently used applications were the calendar functions with HIPD (2,171 instances) and the Personal Trainer (TT) and Simple-Safe-Success Instructor (SSSI) (2,122 instances). This is in full accordance with what was expected. Both of these major HANDS facilities have been assumed to be attractive for the teenagers in the HANDS project.

Some of the teenagers used the HANDS software frequently, whereas others almost never used it. It is tempting to link this to the teacher's degree of motivation to use ICT. However, it is simplistic to assume that the teacher must be highly motivated to use ICT in order for the teenager to use the HANDS software actively. In fact, there are cases from the test period of teachers with a very low interest and motivation to use ICT in their teaching, who nevertheless developed HANDS toolboxes with their students, and the students then became very active HANDS users.

The most interesting result from the test period is probably that it has been clearly documented that there are cases in which the teenagers and their teachers found the HANDS software very useful in supporting the teenagers in their social development. In a report of prototype 1 findings (Mintz et al. 2010, p.24), teachers and students identified the following cases as examples of how the use of the HANDS toolset helped in their development of social and life skills.

- Communication: One of the teenagers "says goodbye to his/her grandmother with the help of the machine's instructions – this never happened before."
- Socializing and making friends: Some teenagers formed new friendships with other teenagers using the smart phone.
- Managing emotions: Some teachers reported that the use of the HANDS toolbox in practical situations was a useful way for the teenagers to learn "how to handle stressful thoughts."
- Organization: A teacher reported that "Tidying up and homework, just with SSSI, helped the child's independence."
- Independence: A teacher pointed out that the HANDS software seems to provide a more effective way of doing things than the earlier methods: "On account of the interest in using the machine, [the teacher] was capable of independently carrying out any activity, which in the previous paper format was not at all typical."
- Life skills: A teacher reported the following: "Arts and crafts – capable of sewing with the help of a series of diagrams, willing to use scissors – he/she likes the machine giving him/her 'instructions'."
- Personal hygiene and health: One of the teenagers benefitted from the use of the toolset because "He is being reminded of some rules in, e.g., sex and health."
- Taking medication: A teacher reported that "With the help of the machine he/she was capable of independently preparing, packing together necessary equipment (every time he/she leaves the school building, it is necessary for them to take their essential diabetic medical equipment with them)."
- Shopping: A teenager learned how "to get to the store and shop for groceries."
- Daily routine: A teenager reported that the software has helped him "with his daily routine at home and stuff like that."

Based on the finding of the evaluation of prototype 1, the HANDS software can be helpful for teenagers with autism. In particular, it has been emphasized by several of the teachers that in this way, teenagers may learn how to act more independently in society. On the other hand, the

findings do not give a clear indication of why some teenagers in the test group benefitted from the use of the toolbox and others did not.

The Need for Further Development of the HANDS Toolset

Two of the planned functionalities, The Sharing Point (SPo) and the Credibility-o-Meter (CoMe), were not implemented in prototype 1 of the HANDS toolset. However, some design considerations have already been carried out in order to make a qualified decision on how these two functionalities should be implemented.

Some of the findings from the evaluation of prototype 1 attest to the importance of the idea on which the planned SPo functionality is based. It has been noted that there is a potential in the use of HANDS for socializing and making friends simply by sharing the experiences from the use of the toolset. Similarities between HANDS and social media such as Facebook have also been noted.

In order to develop the Credibility-o-Meter, it will be necessary to establish a way to quantify the degree to which teenagers believe that they can find help in certain kinds of situations by using a particular component in the HANDS toolbox. Such quantification may be based on

- input from the electronic footprints logged on the HANDS server system, and
- information provided by the teenager to the teacher.

On the basis of this input, the teacher could estimate the degree of credibility on a scale (e.g., from 1 to 10). It is important to distinguish between the credibility as evaluated by the teenager and the credibility as evaluated by the teacher. The two values may be very different and both are useful in pedagogical practice.

Let us assume that a particular teenager with an autism diagnosis has to face a certain type of difficult situation every morning on the school bus. Let us assume that the kind of problem he has to deal with involves communicating or relating to other people on the bus. The teenager recognizes the problem and has discussed it with his teacher. Together they have developed a strategy, which may help the teenager to cope with the problem. The strategy is in fact a stepwise procedure, which the teenager will be advised to follow whenever he finds himself in the difficult situation in question. This strategy has been implemented on the smart phone, which the teenager brings with him wherever he goes. The question is how we may estimate the credibility of the individual HANDS toolbox components designed to help the teenager in the difficult situation he is facing on the bus every morning. The idea is that the estimate of this credibility should be a result of a discussion between the teacher and the teenager, partly based on the data from the HANDS server. The general procedure in this regard is illustrated in Figure 3.

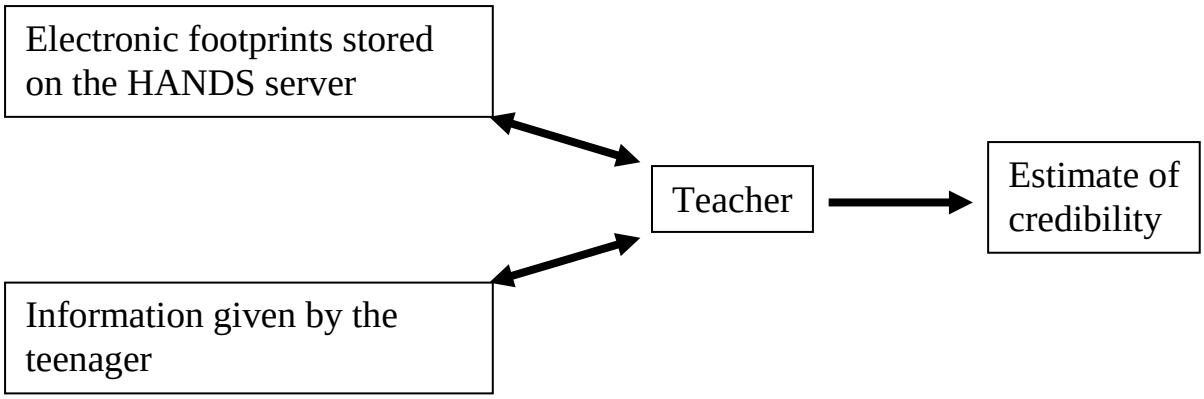

Figure 3. The teacher has to estimate how credible the teenager finds the particular component in his individual HANDS toolbox. The degree of credibility is an estimate of how helpful the component is according to the evaluation of the teenager. In addition to this, it is useful to have an estimate of how helpful the component could be according to the evaluation of the teacher.

The estimates of credibility established in this way will to some extent be subjective. It is, however, one of the interesting challenges of the HANDS project to develop standards for this evaluation procedure in order to make it as reliable and useful in practice as possible. Such standards may be incorporated in an interview guide to be used by teachers when communicating with the teenager in order to estimate the degree of credibility of a component in an individual HANDS toolbox. One problem in this regard will be how the teacher should make use of the electronic footprints logged on the HANDS server system. How should the teacher react if the data from the server indicate that the teenager has been in a difficult situation several times, without activating the relevant component on his smart phone in order to get help? One possible interpretation of this finding could be that the teenager does not find the component credible. Alternatively, it could be that he tends to forget everything about the system on his smart phone when he gets into the difficult situation in question. During the interview the teacher should try to find the most probable interpretation of the data from the server as seen in relation to what is known about the practical experiences of the teenager.

In some cases the credibility as evaluated by the teenager and the credibility as evaluated by the teacher may be very different. If the teacher's evaluation is significantly higher than the teenager's evaluation, the teacher needs to find a way to persuade the teenager to use the component. In dealing with this challenge, the teacher may make use of various persuasive technology tools involving praise and rewards.

The numerical level of the credibility of a given system in a certain context is not the only aspect of credibility. It will also be relevant to consider to what extent the user has obtained direct experience and interaction with the system. Fogg (2003, p. 131) has suggested a distinction between "presumed credibility" (based on general assumptions in the mind of the perceiver), "surface credibility" (based on simple inspection or initial firsthand experience), "reputed credibility" (based on third party endorsements, reports, referrals), and finally "earned credibility" (based on firsthand experiences that extend over time). Here the first two and the last have to do

with the user's direct experiences with the system, whereas reputed credibility is based on reports from others. Alternatively, Gerdes et al. (2010) suggest that the assessment of system credibility may evolve through the following four identifiable stages:

1. initiation,
2. interaction,
3. personalization, and
4. integration.

Such considerations indicate that credibility as a receiver-based construct is a complicated idea. Maybe we should operate with different kinds of credibility or see credibility as a notion with several dimensions. Actually, we may see the degree of credibility and the four stages just mentioned as two different dimensions, which are both relevant in the discussion of credibility and e-learning. In fact, the four stages may be understood as an indication of the extent to which the system has been brought into practical use. One may speak about the degree of *technological involvement* or perhaps about the degree of *embodied credibility*.

Ethical Issues

The founder of the field of persuasive technology, B.J. Fogg, has put emphasis on the importance of ethical issues (2003, p. 211). One may ask the fundamental question concerning the use of persuasion: In principle, is it unethical to use persuasion? There is no quick and obvious answer, but it is clear that ethical problems arise if coercion or manipulation is used to make people change their attitudes or behavior as such techniques or strategies might not respect human freedom and dignity

As indicated in Figure 2, the general system architecture as seen from the user's perspective, a high degree of surveillance is involved in the HANDS project. Every time a teenager in the project updates his or her toolbox and every time one of the tools in the toolbox is used, it will in principle be reported to the HANDS server from where the teacher, the parents, and the researchers may download the information. The stored data also include all the responses given by the teenagers as they have been using the software. In addition, when prototype 2 of the HANDS toolset has been implemented, the server may also contain GPS data corresponding to the geographical movements of the teenagers. The collection of data based on the various kinds of surveillance in this context should be explicitly justified. The researchers must present valid arguments that this level of surveillance is in the best interest of the teenagers, is not harmful, and does not violate the basic rights of the individuals in question. Such arguments should be established before the surveillance software is implemented (Jespersen et al., 2007).

The data stored on the HANDS server is a potential threat to the privacy of the teenagers in the project. Therefore it must be carefully discussed with the teenagers and their parents to determine which data should be available to the parents, to the teachers, and to the researchers. It is essential to look carefully into the ethical principles for giving access to the study of personally sensitive data (Øhrstrøm et al., 2007).

If a user finds a tool very credible, he might get highly involved with it. In fact, we can imagine that the tool is fully integrated in the everyday practice of the user. In some cases, this means that the tool should almost be conceived as a part of the user's body (Gerdes et al., 2010). In consequence, we may ask whether the user will become addicted to this tool. Will the teenager actually depend too much on it? This question should be carefully considered in relation to each of the tools in the toolbox. Whenever there is a risk for a teenager to develop a high degree of dependence on a certain tool, the teacher or researcher must provide a convincing argument justifying the introduction of the tool before the tool can be a part of the user's toolbox.

In some cases the teenager may not want to use the toolbox because he or she does not find it credible. In such cases the teacher might try to convince the teenager to change his or her view on the credibility of a certain tool in the toolbox. However, it is important that such attempts are only carried out if there are good reasons for trying to make the teenager change his or her view. For instance, a teacher should not try to convince a teenager that a certain tool is more credible than the teenager perceives it to be.

In order to establish a careful investigation of the ethical problems related to the development and the use of the HANDS toolset, an ethical board has been formed that includes members who are independent specialists in research ethics and in the treatment of young people with ASD and members who represent the parents of children at the test schools (Holm et al., 2010).

One possible position regarding the ethics of the use of persuasive technology is that it is acceptable if it is carried out according to informed consent. Whenever possible, the teenagers with an autism diagnosis should be asked to give informed consent prior to participating in the tests. However, the HANDS project is dealing with a vulnerable population who may not be able to give fully informed consent, even when given all appropriate information. In such cases, the acceptability of consent given by a parent or legal guardian alone will have to be considered by the ethical board. Another important aspect in this consideration should be the age of the teenagers. The older the subjects, the more problematic it will be to accept their participation in a test based on informed consent from their parents but without their own informed consent. Clearly, the teenagers should not be forced to take part in any test. It is important for the ethical board to consider the possible stress and irresolvable ambivalences caused by pressure being put on those autistic subjects who are not initially willing to participate.

Even if such consents are given by the teenagers and their parents, an independent ethical evaluation should be carried out by the ethical board prior to the tests. In fact, the ethical considerations should be carried out before the actual test phase, during the design and implementation phase. The HANDS project attempts to employ the ethical standards during the development process in close cooperation between researchers working with ICT ethics and system developers. This is an attempt inspired by *value sensitive design*, which according to Friedman et al. (2002) can be presented as "a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process.'' From a practical point of view, this means that all stakeholders have been

involved from the early stage of the design and implementation of the HANDS software. In particular, the ethical board has been involved during the requirement elicitation, prototyping, and testing phases of the software.

Conclusion

It can be concluded that it is possible to create e-learning tools designed for teenagers with autism using server and mobile technology and based on ideas from the theory of persuasive technology. Studies in the use of assistive technology for individuals with autism suggest that the choice of this theory may provide a useful framework for the further development of software to be used by teenagers with ASD and a normal or high IQ.

The test of prototype 1 of the HANDS toolset shows that we may create tools which can at least in some cases be very helpful for teenagers with autism in their social development. In order to be helpful, the tools have to be tailored individually.

However, some teenagers with autism do not find such tools helpful. It is still an open question why some teenagers with ASD find the HANDS tools very helpful in order to gain independence in their social life, whereas others do not find this kind of technological solution helpful. One possibility is that the members of the latter group for some reason do not find the tools credible. This possibility should be further investigated based on an elaborated and quantifiable notion of credibility.

The use of mobile persuasion, as in the HANDS project, gives rise to a number of important ethical problems. In particular, the use of the server solution and the high level of detailed surveillance may cause concerns regarding the privacy of the teenagers involved in the project. It has been argued, however, that it is possible to deal with such ethical problems in a satisfactory manner by involving an independent ethical board with some members representing the parents and some members with specialist qualifications in research ethics and the treatment of young people with autism.

References

Aagaard, M., Øhrstrøm, P., & Moltsen, L. (2008). It might be Kairos. *Persuasive, 08*. Oulo, Finland.

Aagaard, M., Schärfe, H., & Øhrstrøm, P. (2010). *Evaluation of prototype 1 and requirements for prototype 2 – as seen from the perspective of persuasive technology* (HANDS Deliverable D4.3.1). Retrieved from http://hands-project.eu/.

Bell, E., Potter, D., & Walsch, B. (2006). *Computer applications for people with autism*. London, England: National Autistic Society.

Bölte, S. (2004). Computed-based intervention in autism spectrum disorders. In O.T. Ryaskin (Ed.), *Focus on autism research* (pp. 247-260). New York: Nova Science Publishers.

Dawe, M. (2006). Desperately seeking simplicity: How young adults with cognitive disabilities and their families adopt assistive technologies. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1143-1152). New York: ACM Press.

Ferguson, H., Myles, B.S., & Hagiwara, T. (2005). Using a personal digital assistant to enhance the independence of an adolescent with Asperger Syndrome. *Education & Training in Developmental Disabilities*, *40*(1), 60-67.

Fogg, B.J. (2003). *Persuasive technology: Using computers to change what we think and do*. San Francisco: Morgan Kaufmann Publishers.

Friedman, B., Kahn, P.H., & Borning, A. (2002). Value sensitive design: Theory and methods. *UW CSE Technical Report*, 02-12-01.

Gerdes, A., & Øhrstrøm, P. (2010). Issues of credibility in developing mobile solutions for autism-diagnosed teenagers. *Persuasive*. Copenhagen.

Golan, O., & Baron-Cohen, S. (2006). Systemizing empathy: Teaching adults with Asperger syndrome or high-functioning autism to recognize complex emotions using interactive multimedia. *Development and Psychopathology*, *18*(2), 591-617.

Gray, C. (2000). *The new social story book*. Arlington, TX: Future Horizons.

Gyori, M., Stefanik, K., Kanizsai-Nagy, I., & Öszi, T. (2010). *Evaluation of prototype 1 and Requirements for prototype 2 - in the perspective of cognitive psychology* (HANDS Deliverable D2.4.2). Retrieved from http://hands-project.eu

Holm, S., & Ploug, T. (2010). *Ethics board – annual report year*. HANDS/D1.5.2/AAU/R/PU/2010-7-15.

Jespersen, J.L., Albrechtslund, A., Øhrstrøm, P., Hasle, P.F.V., & Albretsen, J., (2007). Surveillance, persuasion, and panopticon. In *Lecture Notes in Computer Science: Persuasive Technology: Second International Conference on Persuasive Technology, PERSUASIVE 2007: Revised Selected Papers* (pp. 109-120). Berlin/Heidelberg : Springer.

Mintz, J., Branch, C., Lerman, S., & March, C. (2010). *Evaluations of prototype 1 and requirements for prototype 2* (HANDS Deliverable D3.4.1). Retrieved from http://hands-project.eu.

Myles, B.S., Ferguson, H., & Hagiwara, T. (2007). Using a personal digital assistant to improve the recording of homework assignments by an adolescent with Asperger Syndrome. *Focus on Autism and Other Developmental Disabilities, 22*(2), 96-99.

Øhrstrøm, P., & Dyhrberg, J. (2007). Ethical problems inherent in psychological research based on internet communication as stored information. *Theoretical Medicine and Bioethics. 28*(3), 221-241

Ranfelt, A.M., Wigram, T., & Øhrstrøm, P. (2007). Towards a handy interactive persuasive diary for teenagers with a diagnosis of autism. *Proceedings of the 4th International Conference on Persuasive Technology. Association for Computing Machinery*. ACM International Conference Proceeding Series, 350. http://portal.acm.org/citation.cfm?doid=1541948.1541953

Schärfe, H., Øhrstrøm, P., & Gyori, M. A conceptual analysis of difficult situations - developing systems for teenagers with ASD. *International Conference on Conceptual Structures (ICCS-2009), CEUR Workshop Proceedings. 483*. http://ftp1.de.freebsd.org/pub/publications/CEUR-WS/

Sørensen, M. (2005). En PDA – hva' for noget? *Autismebladet*, *3*, 32-33.

Volkmar, F.R., Lord, C., Bailey, A, Schultz, R.T., & Klin, A. (2004). Autism and pervasive developmental disorders. *Journal of Child Psychology and Psychiatry*, *45*(1), 135-170.