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**Supporting Practitioners in Social Story
Interventions:
The ISSS Authoring Tool**

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Abstract

Children with Autism Spectrum Conditions (ASC) have difficulties in learning social and communication skills. This leads to impairments in social interaction, including lack of understanding others' intentions, emotions, and mental states, and impairments in communication both verbal and nonverbal. One of the most widely used interventions that addresses social and communication skills is the "social story". A social story aims to support children with ASC in coping with their own behaviour. Practitioners use social stories to present specific scenarios and to help children understand how they should respond. However, the development of social stories is time consuming, and teachers comment that it is difficult to share them as a resource for others or to customise them to individual children, using their current tools.

This thesis explores how a social story authoring tool can be designed, developed and evaluated. The final aim is to better support practitioners in writing, using and assessing social stories for children with ASC compared with their current approaches.

A series of studies with practitioners and researchers was carried out to inform the design of a social story authoring tool and to evaluate it. A framework for social stories was built with the purpose of informing the design. Based on this framework, a prototype was iteratively designed and developed. The final prototype (ISISS-Improving Social Interaction through Social Stories) was evaluated with practitioners with experience in social story interventions. The evaluation showed that ISISS is perceived by practitioners to be a considerable improvement over their current approaches. The methodology employed in this research combines Action Research, User-Centred Design and Participatory Design. Practitioners and researchers were empowered with different roles at different research stages in order to maximise their contributions to the development process.

Lay Summary

Autism Spectrum Conditions (ASC), also known as Autism Spectrum Disorders (ASD) or simply Autism, define a range of conditions characterised by deficits in social interaction and communication skills, as well as stereotyped behaviour, interests and activities.

One of the most widely used interventions that addresses social and communication deficits in children with ASC is the “social story”. A social story aims to support children with ASC in coping with their own behaviour. Practitioners use social stories to present specific scenarios and to help children understand how they should respond. However, the development of social stories is time consuming, and teachers comment that it is difficult to share them as a resource for others or to customise them to individual children, using their current tools.

This thesis explores how technology can be designed, developed and evaluated in order to better support practitioners in writing, using and assessing social stories for children with ASC compared with their current approaches. A series of studies with practitioners and researchers was carried out to inform the design of the technology for social stories and to evaluate it. Based on these studies, a computer-based tool was designed and developed. This tool (ISISS-Improving Social Interaction through Social Stories) was evaluated with practitioners with experience in social story interventions. The evaluation showed that ISISS is perceived by practitioners to be a considerable improvement over their current approaches.

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My sister deserves my gratitude for her love, support and constant encouragement. Many thanks to Elena for her care during my participation in the CHI conference.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

Aurora Constantin

This dissertation is dedicated to my beloved parents, Ecaterina and Gheorghe, for their inestimable love, constant encouragement and unconditional support.

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List of Abbreviations

Abbreviation	Definition
AIED	Artificial Intelligence in Education
AR	Action Research
ASC	Autism Spectrum Conditions
ASD	Autism Spectrum Disorders
CAI	Computer Assisted Instruction
CARSS	Context, Activities, Roles, Stakeholders and Skills
ERT	Expert Research Team
GT	Grounded Theory
GTM	Grounded Theory Methods
HCD	Human-Centred Design
HCI	Human-Computer Interaction
ID	Informant Design
IDE	Integrated Development Environment
ILE	Interactive Learning Environments
ISISS	Improving Social Interaction through Social Stories
LCD	Learner-Centred Design
PCM	Persistent Collaboration Methodology
PD	Participatory Design
PR	Principal Researcher (the author of this thesis)
SUS	System Usability Scale
TA	Think Aloud
UCD	User-Centred Design
VTSS	Visiting Teachers & Support Services

Peer Reviewed Papers, Posters and Presentations

Constantin, A., Pain, H., Waller, A. (2014): Using Grounded Theory Methods to Inform the Design of an Authoring Tool. *In Proceedings for the BCS HCI 2014*, September 9-12, 2014, Southport, UK.

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Constantin, A. (2014): Interactive Technologies for Children with Complex Communication Needs, *In Proceedings for Supporting Children with Complex Communication Needs Workshop, CHI 2014*, April 27-May 1, 2014, Toronto, Canada.

Constantin A., Pain H., Waller A. (2013): Informing the Design of an Authoring Tool for Developing Social Stories. *In Proceedings for the 14th IFIP TC13 Conference on HCI, INTERACT 2013*, Cape Town, South Africa, Springer, pp. 546-553.

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Chapter 1

Introduction

Autism Spectrum Conditions (ASC) define a group of developmental disorders with a neurological basis (APA 2000, Frith 2003). Individuals with ASC have noticeable difficulties in three domains: social interaction, communication and imagination (the last one known also as rigidity in thought and behaviour) (AAP 2001, Wing and Gould 1979; Pimley and Bowen 2006). The degree of difficulty varies from one individual to another. It is well-known that individuals with ASC form an extremely heterogeneous group, with a huge palette of capabilities and weaknesses (Baron-Cohen 2004). As a matter of fact, in many cases, individuals with ASC also demonstrate a “triad of strengths”: inclination for details, strong and particular interests, and advanced skills in specific areas (Baron-Cohen 2004).

Recent statistics highlight alarming rates of autism in various countries. For example, in the US the impact of ASC is 1 in 88 children (CDC 2008). ASC affect the whole life of individuals, but also their families. Recently, there are more and more proponents of the idea that autism is a “lifelong condition”, a way of being; consequently it should not be treated as a disorder (Frith 2003, p. ix). The adherents of this idea argue that people with autism have a distinct set of characteristics that makes them superior to their non-autistic peers in some regards. However, individuals with ASC often need special support and special education. Research studies show that most adults with ASC “remain very dependent on parents or others for support” (Howlin et al. 2004, p. 226).

Although no cure exists for ASC, there is evidence that children with ASC can benefit from educational interventions to improve their social communication skills. According to Parsons and Mitchell (2002), it is extremely important to create interventions which can reduce or eliminate any difficulty in social interaction, as these difficulties can entail social exclusion, which damages the individuals’ social

relations. Current research indicates that there is no one method, or intervention which can approach all the impairments for all the individuals with ASC. On the contrary, Parsons et al. (2009, p.6) emphasise that: “There is currently no evidence that a single intervention or solution will meet the needs of all learners with ASC, so a range of options (types of educational settings and interventions) should be available and should be chosen to fit the profile of the child or young person”.

The use of computers in interventions for people with autism has become very popular. Part of the explanation is the attraction towards computers which is characteristic for the majority of children with ASC, but also in the huge number of technologies which makes it possible to customize interventions to the particular needs and interests of users. If properly designed, computer-based interventions may be helpful in enhancing social communication skills in children with ASC (Williams et al. 2002, Ploog et al. 2012). Recently, a call for new technological tools to help professionals and families was launched at the ITASD (Innovative Technology for Autism Spectrum Disorders), Paris, France (ITASD 2014).

Interventions which use social stories appear to be successful if they are appropriately applied. A social story is a short story written from the student’s point of view that describes a social situation and provides support for appropriate social behaviours (Gray 2000). Although there is a lack of evidence in identifying the specific features that ensure the success of social stories, the literature indicates that they can have a positive impact on social communication skills for children with ASC (Barry and Burlew 2004, Scattone et al. 2008, Reynhout and Carter 2009, Samuels and Stansfield 2012). In a meta-analysis examining the use of social stories Kokina and Kern conclude that: “additional experimental studies are needed that would explore the critical variables associated with intervention effectiveness” (2010, p. 825).

A literature review of international interventions for ASC individuals (2002-2008), concluded that: “Greater collaboration between researchers and practitioners¹ is needed to establish what works best for children and young people in real-world

¹ Teachers, speech and language therapists, nursery nurses, learning assistants

classrooms. There tends to be a lack of consideration of wider factors in research studies focusing on specific techniques, and (sometimes) a lack of objectivity and rigour in classroom-based studies. Ideally, a greater synthesis between applied and basic research strands is required” (Parsons et al. 2009, p.123).

1.1 Purpose of Research

The main goal of this research is to discover how a social story authoring tool can be designed and implemented in order to be evaluated by experts as an improvement over the current approaches.

A methodology framework which combines Action Research (AR), User-Centred Design (UCD) and Participatory Design (PD) approaches was employed. It was inspired by the Informant Design (ID) and the Persistent Collaboration Methodology (PCM). Initially, a framework of social story interventions was built based on empirical data collected from an exploratory study with practitioners, and on the existing research in social story interventions. This framework was translated into a set of design guidelines and an initial set of requirements for the design of social story authoring tools. The authoring tool was designed and implemented in an iterative way. The development process started with low-fidelity prototypes from which a high-fidelity prototype was created and refined through formative evaluation studies. Finally, this prototype was evaluated and compared with the tools that practitioners currently use.

1.2. Thesis Claim and Research Questions

The claim of the present thesis is the following:

It is possible to design and implement a computer-based authoring tool that supports practitioners in social story interventions, and which is evaluated by experts to be an improvement when compared to current approaches.

In order to support this claim the following questions are relevant:

Q1. How do practitioners currently develop, present and assess social stories?

Q2. Can we develop computer-based technology that enables the development, presentation and assessment of social stories? If so, in what ways?

Q3. Does the computer-based technology enhance the practitioners' activity in developing, presenting and assessing social stories?

A computer-based authoring tool was designed, developed and evaluated by comparing it with the tools that practitioners currently use.

In order to answer the research questions the following research objectives were pursued:

O1) create a framework of social story interventions, based on empirical studies with practitioners having experience in developing social stories, and on previous research;

O2) translate the framework of social story interventions into a set of design guidelines and a set of basic requirements for authoring tools that support practitioners in social story interventions;

O3) build a proof of concept prototype for an authoring tool that better supports practitioners in writing, presenting and assessing social stories, when compared to the tools that they currently use;

O4) evaluate the authoring tool by comparing it with existing tools that practitioners currently use;

The first objective is connected with question Q1, the next two objectives with question Q2, and the objective O4 with question Q3.

1.3 Thesis Outline

Chapter 2 discusses the research work that is the foundation of the present thesis. It begins by presenting a short overview of ASC. It then describes the main cognitive theories of autism. The chapter further introduces the social story interventions and explains how these interventions are related to the main cognitive theories of autism. Then, educational interventions for ASC are described, particularly social story interventions. The chapter also highlights the benefits of using computer-assisted technology for individuals with autism. Finally, the motivation of this research is presented.

Chapter 3 analyses the main methodological approaches that inspired the five stages of the methodology framework for this research. After explaining the rationale of the methodology framework which was employed in this research, this chapter describes how this framework was applied at each of the five stages of the present research.

Chapter 4 focuses on the second stage of this research (Pre-design: Defining Domain and Problems). The main aim of this stage was to uncover the practitioners' practices in social story interventions and to bridge practice and research with the purpose of informing the design of a social story authoring tool. Two studies with practitioners are described in this chapter. The first one is a focus group which aimed to get an insight into practitioners' current approaches in social story interventions. The second study aimed to uncover the practitioners' procedures and practices during social story interventions (including the development, use and assessment of social stories). Based on the empirical data collected in these studies this study and on the research literature, a framework of social story interventions was built. This framework was translated into a set of guidelines and a set of requirements for social story interventions. This chapter includes a discussion of the roles and contributions that the participants in the pre-design stage each play.

Chapter 5 covers the third stage of this research which consisted of designing and exploring two versions of low-fidelity prototypes for the social story authoring tool. The prototypes were built based on the requirements and guidelines presented in

Chapter 4, as well as on HCI principles. An exploratory study with practitioners was conducted to explore the design space. This study, as well as the changes which were made based on its results, are outlined in this chapter. Finally, the chapter concludes with the roles and contributions that both practitioners and researchers brought to the third stage of the research (Designing and Exploring Low-fidelity Prototypes).

Chapter 6 illustrates how the results from the previous study (exploring the low-fidelity prototypes) were incorporated into an evolutionary prototype authoring tool and how this tool was iteratively explored and refined. The chapter starts by presenting the technical implementation decisions and then proceeds to describing the evolution of the prototype during three cycles which involved practitioners and researchers in HCI, Education and ASC. At the end of this chapter the roles of practitioners and researchers in the design of the prototype are presented. Chapter 6 covers the fourth stage of the present research project (Designing and Exploring the High-Fidelity Prototype).

A summative evaluation study of the prototype built in the fourth research stage is described in Chapter 7. The evaluation involved practitioners in two stages which were designed to answer the third research question: *“Does the computer-based technology enhance the practitioners’ activity of developing, presenting and assessing social stories”*. The chapter begins by describing the seven evaluation dimensions which were used to evaluate the prototype. It proceeds by presenting each stage of the evaluation and reporting the corresponding results. Finally, Chapter 7 discusses what roles and contributions each group of participants played in the summative evaluation stage.

Chapter 8 concludes by discussing how the research questions were addressed by the work described in the previous chapters, and how practitioners and researchers were involved during the design and development processes. A set of guidelines for involving practitioners and researchers in the design of computer-based educational tools is then presented. This chapter suggests directions for future work and highlights the contributions of this thesis.

A summary of the research questions and the ways that they were addressed is presented in Table 1.1.

Research Question	Ways to address (Where it was addressed)
<i>How do practitioners develop, present and assess social stories?</i>	Focus group and exploratory study with practitioners (Chapter 4)
<i>Can we develop computer-based technology that enables the development, presentation and assessment of social stories? If so, in what ways?</i>	Exploratory study with practitioners based on low-fidelity prototypes (Chapter 5) Formative evaluation studies of the high-fidelity prototype with practitioners and researchers (Chapter 6)
<i>Does the computer-based technology enhance the practitioners' activity of developing, presenting and assessing social stories?</i>	Summative evaluation study of the 'proof of concept' prototype involving practitioners (Chapter 7)

Table 1.1: Summary of research questions and studies

Chapter 2

Related Work

This chapter discusses the related work which is the foundation of the present thesis. Section 2.1 presents a short overview on the ASC, including the criteria which describe ASC, the prevalence of and the interventions for ASC, as well as the cognitive theories of autism. Social stories have specific formats and are implemented in a specific way. These are described in section 2.2. The use of computer-assisted instruction comes with a number of benefits, but also with concerns. All these are presented in detail in section 2.3. This section also includes a short overview on the educational interventions for ASC, particularly social story interventions. Section 2.4 presents the motivation of this research project.

2.1 Overview on Autism Spectrum Conditions

2.1.1 General Characteristics and Prevalence of Autism

ASC cover a range of pervasive developmental disorders. The resulting deficits in social interaction, communication and rigidity in thought and behaviour are known today as the “triad” of impairments which characterises ASC (Wing 1981).

Individuals with ASC have difficulties in analysing common social situations, are unable to react to them, or react with delay or in an unusual way. The lack of social and emotional reciprocity is very common in people with autism. Therefore, they usually fail to develop relationships appropriate to their developmental level. Many of these individuals are impaired in the use of non-verbal behaviours, such as eye-to-eye gaze (Leekam et al. 1998). While they show a lack of interest in social stimuli, they appear to be attracted to inanimate objects (Dawson et al. 2004, Klin et al. 2003). The difficulty in shared attention is frequently observed in individuals with ASC (Baron-Cohen 1995, Hobson 1993, Mundy 1995). For example, individuals with autism may not have any reaction when their names are called, or fail to orient to social cues.

Communication deficits include delay in the development of language skills and sometimes total lack of spoken language. Inability to initiate or sustain a conversation is often common in individuals with autism. Echolalia (repetitive speech patterns) may appear instead of taking turn in a conversation. Monotonal or inappropriate intonation (Lord and Paul 1997) and the use of words in a wrong way (Tager-Flusberg and Anderson 1991) are also examples of communication difficulties. In their study, Rajendran, Mitchell and Rickards (2005), found that individuals with Asperger's Syndrome have difficulties in understanding non-literal language. Consequently, these individuals seem not to be able to understand humour or double meaning words. Another particular characteristic of people with ASC is the obsession for specific topics of conversation (e.g. trains, planes, or robots). The tendency to perform monotonous activities for a long period of time, with restricted and stereotyped patterns of behaviour and interests and the lack of imaginative play are referred to as rigidity in thought and behaviour. The need for sameness exhibited by the individual with ASC is well-known (Kanner 1943, Baron-Cohen et al. 2007). Also, the adherence to routines and rituals and an unusual resistance to changes are frequently observed in children with ASC (Cox et al. 1999, Howlin and Asgharian 1999, Stone et al. 1999, Lam et al. 2008).

ASC subsume autistic disorder, Asperger's syndrome, pervasive developmental disorder not otherwise specified (PDD-NOS), Rett syndrome and childhood disintegrative disorder (AAP 2001; Dumont-Mathieu and Fein 2005). High rates of co-morbidity with other developmental disorders have been highlighted, such as: intellectual disability (Levy et al. 2009), sleep problems, depression, hyperactivity, and anxiety (MRC 2001).

Autistic Disorder (AD)

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, in AAP 2001, p.1) there are 12 criteria (see Table 2.1) which describe ASC. In order to receive a diagnosis in AD one should meet at least 6 criteria, with at least 2 in the group of social impairment, 1 in communication impairment and 1 in repetitive and stereotyped patterns of behaviour (AAP 2001).

<p>A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):</p> <p>(1) qualitative impairment in social interaction, as manifested by at least two of the following:</p> <p>(a) marked impairment in the use of multiple nonverbal behaviours such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction</p> <p>(b) failure to develop peer relationships appropriate to developmental level</p> <p>(c) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g. by a lack of showing, bringing, or pointing out objects of interest)</p> <p>(d) lack of social or emotional reciprocity</p> <p>(2) qualitative impairments in communication as manifested by at least one of the following:</p> <p>(a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)</p> <p>(b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others</p> <p>(c) stereotyped and repetitive use of language or idiosyncratic language</p> <p>(d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level</p> <p>(3) restricted repetitive and stereotyped patterns of behaviour, interests, and activities, as manifested by at least one of the following:</p> <p>(a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus</p> <p>(b) apparently inflexible adherence to specific, non-functional routines or rituals</p> <p>(c) stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole-body movements)</p> <p>(d) persistent preoccupation with parts of objects</p>
<p>B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.</p>
<p>C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder</p>

Table 2.1: Diagnostic Criteria for Autistic Disorder

(after *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision (DSM-IV-TR)* in AAP, 2001, p.2).

Asperger's Disorder

Unlike AD, Asperger syndrome (AS) is not characterized by learning difficulties and delay in spoken and receptive language. However, AS individuals also show poor abilities to develop relationships, lack of empathy and an excessive interest for certain topics (AAP 2001).

Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS)

PDD-NOS is also known as atypical autism. This diagnostic is given to a child who meets some criteria of AD, but not all. There are cases when a diagnosis of PDD-NOS is later changed into AD, when more symptoms appear (AAP 2001).

Rett Syndrome

The aetiology of the Rett syndrome has been explained by a mutation in the gene MECP2. This disorder seems to affect only girls and begins at the age of 1 or 2 years. The individuals with Rett syndrome have small hands and feet and abnormal movement of hands like hand wringing. They have severe motor and coordination problems. Language, cognitive and social skills are also seriously impaired (AAP 2001).

Childhood Disintegrative Disorder (CDD)

This disorder is extremely rare, starting usually after the age of 2 years. The individuals present more severe deficits in social interaction, communication and motor skills than those with AD or PDD-NOS. Also, repetitive behaviour and stereotyped interest patterns are present (AAP 2001). CDD is considered by some experts as a low-functioning form of autism (MacPartland & Volkmar 2012)

ASC are much more frequent among the population than was initially considered, being the second highest category of cognitive challenges after learning difficulties (Newschaffer et al. 2007). The incidence of ASC has been dramatically increasing from about 5 per 10,000 persons in 1980s (Newschaffer et al. 2007) to 60 per 10,000 in the beginning of 2000s (Bertrand et al. 2001; Chakrabarti and Fombonne 2001; Chakrabarti and Fombonne 2005). A more recent report in US shows that ASC impact has a rate of 1 in 88 children (CDC 2008). Some possible explanations for this increase are certainly changes in diagnostic practices and public awareness, such as:

- 1) the definition of autism has become broader by introducing the concept of

spectrum of conditions;

- 2) clinicians and community have become more aware of the different manifestations of autism;
- 3) the cases of ASC without learning difficulties, such as AS and High Functioning Autism (HFA) have been better detected;
- 4) the increase of interest following the diagnosis tests due to services offered for these disorders;
- 5) increased awareness that the earlier the child is diagnosed the better the outcome is;
- 6) the extension of screening tests.

In spite of numerous possible explanations there is not enough evidence to determine the real causes of this phenomenon.

According to Fombonne (2009) ASC have a higher frequency among boys, with an average of 4.3 males to 1 female.

2.1.2 Cognitive Theories of Autism

Psychological research in the field of autism has generated a number of theories. These can be seen as attempts to explain and interpret what is observed in terms of hidden mental functions. Three of these are dominant: the theory of mind, executive dysfunction and weak central coherence (Rajendran and Mitchell 2007).

2.1.2.1 Theory of Mind

The adherents of Theory of Mind (ToM) advocate that people who suffer from autism are not capable of inferring beliefs, desires, thoughts and intentions of other people (Wimmer and Perner 1983; Baron-Cohen et al. 1985, Perner et al 2002). This has repercussions on social interaction, since the failure in recognising others' mental states can obviously lead to inappropriate reactions. A related concept is *empathy*, which is understood as the ability “to put oneself into another person’s shoes”. The test of false belief conceived by Wimmer and Perner (Wimmer and Perner 1983, Baron-Cohen et al. 1985, Leslie 2000) is based on a story played with two dolls, Sally and Anne. Each doll has a basket and a box, respectively. Sally has a marble

which is initially in her basket. When Sally leaves the room, Anne takes the marble from the basket and changes its place, for example putting it in her box. The child who attends the test is asked to answer where Sally looks for the marble when she returns in the room. The child who passes the test (answering that Sally will look in the basket) is able to understand the mental representation of the situation from another person's point of view. The studies showed that 80% of children with autism are not able to pass the test of false belief (Baron-Cohen et al. 1985). Happé (1994) remarked that this deficit is not universal since 20% of children with autism pass the test of false belief. Baron-Cohen (1995) answered this remark by arguing that individuals with autism do not have a completely developed theory of mind, bringing the concept of the delay of the ToM, rather than a deficit of it.

A new concept, called the enactive mind, has been recently introduced. According to this hypothesis, Klin et al. (2003) argue that an autistic mind is not prepared to interpret social meanings, unlike a typically developed mind which extrapolates the ability to find social meanings even in inanimate forms.

Although the ToM can explain many of the symptoms which are specific to ASC, it cannot explain all of them. For instance, there is not an easy correlation between ToM and repetitive and obsessive behaviours, problems in switching attention and lack of impulse control.

2.1.2.2 Impaired Executive Functions

Executive Functions (EF) is a generic term for functions such as: initiating and inhibiting actions, and sustaining and shifting attention (Zelazo and Müller 2002). It is considered that the EF is responsible for handling novel situations where the routine is not enough to perform optimally. A detailed definition is given by Ozonoff et al. (1991, p.1083): "Executive function is defined as the ability to maintain an appropriate problem-solving set for attainment of a future goal; it includes behaviours such as planning, impulse control, inhibition of prepotent but irrelevant responses, set maintenance, organized search, and flexibility of thought and action". Thus, the deficit in executive functions can explain the stereotype behaviours, the

difficulty in switching attention, the predilection to persevere, as well as the impaired impulse control.

One of the most common tests in EF investigation is the Wisconsin Card Sorting Test (WCST), which assesses the flexibility of the participant, while sorting a set of cards according to a changing set of rules (Tsuchiya et al 2005, Rajendran and Mitchell 2007).

Although the impairment in executive functions can partially explain many of the problems that individuals with autism face, there are limitations. One of the limitations is that executive dysfunctions are not seen in all people with ASC, and those who have these dysfunctions have various profiles of EF. In addition, people who suffer from other disorders also present problems with EF. The relation between the ToM and EF has been debated and there is no clear answer “whether theory of mind tasks could be reduced to executive process, or whether a theory of mind is required for executive control” (Rajendran and Mitchell 2007, p.237).

2.1.2.3 Weak Central Coherence

Weak Central Coherence (WCC), known also as *monotropism* (Murray, Lesser and Lawson 2005) is the inability to process global information. Thus, individuals with ASC are biased towards identifying details and have difficulties in extracting the gist (Frith 1989, Happé and Frith 2006). According to WCC people with autism pay attention to constituent parts, and are weak or fail to derive the high-level meaning, namely “central coherence”. This is what in other terms is expressed as: “not to see the forest for the trees”. The studies show that children with autism are better than typically developed children on the Children’s Embedded Figures Test (CEFT, Shah and Frith 1983). In the CEFT, the children are asked to identify a small embedded shape in a larger shape, which is supposed to attract the attention making it harder to find the smaller shape.

The Embedded Figure test was developed in the work of Witkin and his collaborators (Witkin and Asch 1948, Witkin and Goodenough 1981). They were initially exploring the importance of perceptual cues for trainee aircraft pilots, but quickly

appreciated that this entire perceptual area was generic. Field dependency was seen originally as a cognitive style, but it was later appreciated that being able to focus on what is important for the task in hand, leaving aside other important but irrelevant information is always an advantage in educationally related performance (Tinajero and Paramo 1998).

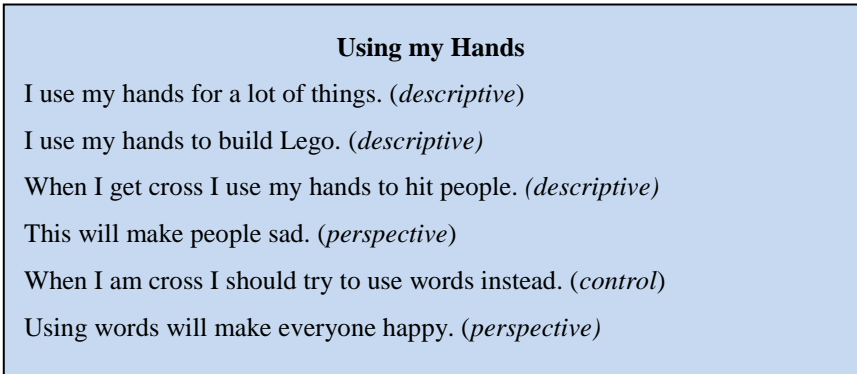
Thus, individuals with autism tend to be attracted to detail, but with some effort they may be able to grasp the overall meaning. WCC theory does not seek to explain all the features of the ASC. The question whether WCC can be explained through EF deficit does not yet have a clear answer.

2.2 Social Stories

One way of addressing the social interaction difficulties in children with ASC is through the use of social stories (Shattuck et al. 2007). A social story aims to support children with ASC by presenting specific scenarios and helping the children understand how they should respond.

2.2.1 Gray’s Guidelines and Good Practice in Social Stories

A social story is written from the student’s point of view and is a guide to follow when they have difficulties with a social situation (see Figure 2.1 for an example). Social stories are used to help the child acquire appropriate behaviour, reduce inappropriate behaviour, teach routines, teach skills, or cope with transitions and novel situations.



Using my Hands
I use my hands for a lot of things. (*descriptive*)
I use my hands to build Lego. (*descriptive*)
When I get cross I use my hands to hit people. (*descriptive*)
This will make people sad. (*perspective*)
When I am cross I should try to use words instead. (*control*)
Using words will make everyone happy. (*perspective*)

Figure 2.1: Example of a Social Story

Possible topics for social stories might be: walking in line, asking a question, taking turns, getting a friend's attention, why I should not shout, sharing, etc.

Gray (2004) suggests that social stories should be customised to meet the distinct needs and skills of the child, such as: reading and comprehension skills, learning style, interests and attention skills. Based on practice and research, she also introduced a set of criteria and guidelines to support the development of social stories, as follows:

- a. social stories should meaningfully share social information, in a simple, literal way, answering “wh” questions (who is doing, what, where, when and why?) and how questions;
- b. a social story is composed of three parts: introduction, body and conclusion which clearly identify, describe and respectively summarize the main concepts in a social story;
- c. social stories should use the first or the third person;
- d. a social story should be written in positive language, avoiding references to negative behaviour in favour of positive. For example, the directive sentence “I won't go in front of the queue” should be better worded in positive terms, such as: “I will wait in line until my turn comes”.
- e. social stories contain six types of sentences:
 - **descriptive** - which present factual statements, free of opinions or assumptions
Example: The bell rings at the end of playtime.
 - **perspective** - which describe a person's internal state, thoughts, feelings, beliefs
Example: When the bell rings at the end of break time the children know it is time to go back to class
 - **directive** - which identify a suggested response or a choice to a situation
Example: I am in yellow class, I sit at the front of the class, and I listen to my teacher when she is talking
 - **affirmative** - which enhance the meaning of previous statements

Example: I will try to hold an adult's hand when crossing the road (previous sentence). *This is very important.*

- **cooperative** - which identify what others will do to help

Example: *Mum and Dad can help me wash my hands.*

- **control** - which identify strategies for recalling or applying information in social stories

Example: *When the fire alarm rings I will think about dinosaurs following each other out of the forest to escape the burning meteors.*

- f. the ratio between the sentences should be 0-1 directive and control to 2 or more descriptive, perspective, affirmative and cooperative.

The following social story is a good example with respect to the previous ratio: “I enjoy talking to other people (*descriptive*). We sit in our classrooms and talk and we talk at lunch (*descriptive*). Other people like to talk also; they have things they like to talk about (*perspective*). It can be hard for them to talk about things if I don’t take turns (*descriptive*). I will try to wait my turn (*descriptive*). I will ask a question or add a comment about what they are talking about (*directive*). I can be a good communication partner (*affirmative*).”

- g. illustrations should be used when appropriate.

Descriptive, directive, perspective and control sentences may be either complete or partial. An example of partial perspective sentence is:

“*Mum and Dad will feel _____ if I finish all my dinner*”.

The rationale of the partial sentence is that it gives the student with ASC the chance “to make a guess regarding the next step in a situation, the response of another individual, or his own response” (Gray 2003, quoted in Reynhout and Carter 2006, p.446).

Initially, Gray and Garland (1993) considered the use of visual representations as being confusing and misleading for the student. Later, in accordance with other findings, the idea that visual representations are in fact helpful was promoted.

(Dettmer et al. 2000). In their study, Kokina and Kern (2010) also conclude that social stories with visual illustrations are more successful than social stories which use text only.

According to Smith (2001), in order to include the accepted good practice in ASC, social stories should be as follows:

- written in a predictable style and respecting a recommended formula;
- based on a rigorous assessment of the child;
- presented in a written form including also visual representations suitable for the child developmental level;
- confined to a specific topic from the three core domains of deficits (for example, social interaction);
- permanent - the children can reread them whenever they need;
- factual - providing the information in a simple way, about “who is doing, what, and why” (p.339);
- focused directly on people’s thoughts and feelings related to their behaviour (i.e. trying to help children build a theory of mind).

2.2.2 Social Stories and Cognitive Theories of Autism

As it has been already specified, individuals with ASC may be impaired related to the Theory of Mind. In other words, they have difficulty understanding what other people think, feel, or intend to do. A social story can provide information about what other people think or how they behave in a specific social situation. The perspective sentences (see § 2.2.1) refer to the thoughts, feelings, actions and motivation. Therefore the individual can learn other people’s perspective about the social situation. In this way a social story might reduce or remove the confusion and might ameliorate the deficit in the Theory of Mind.

Another theory of what underlies ASC is weak central coherence, which describes the inability to build a higher level meaning. Briefly said an individual with ASC is too much focused on details and therefore missed the ‘whole picture’. Social stories

are helpful in guiding individuals with ASC to identify the relevant details for a specific event and to correct the wrong suppositions. Providing logical connection, a social story supports the individual to grasp the big picture.

Social stories also aim to be useful in reducing the deficit in executive functions. They are specifically created to provide an individual with ASC with planning and organizing strategies in specific social situations, with initiation and impulse control.

2.3 Educational Interventions for ASC

There is no cure for autism, but it seems that early interventions can help children with ASC to become more independent and to acquire social and communication skills (Lord and McGee 2003, Parsons et al. 2009). Researchers and practitioners have been working on designing and implementing interventions which aim to make the individuals more independent and to help their families cope with the specific problems they face (Goldstein and Naglieri 2013).

2.3.1 Introduction

Educational interventions try to support children to cope with the school programme, but also to enhance their communication and social skills, to decrease disruptive behaviour and to generalize the skills learnt by extending them to new circumstances and environments. Since the group of children with ASC is extremely heterogeneous, the range of educational interventions outcomes is huge. However, Lord and McGee (2003) emphasized that: “gains occur in many specific areas, including social skills, language acquisition, nonverbal communication, and reductions of challenging behaviours. Often the most rapid gains involve increasing the frequency of behaviour already in the child’s repertoire, but not used as broadly as possible (e.g., increasing use of words). In single-subject reports, changes in some form are almost always documented within weeks, if not days, after the intervention has begun” (p. 44). They also conclude that it is necessary to identify more effective educational interventions for children with ASC.

Koegel et al. (2010) provide a summary of research-based interventions for students with ASC. They conclude that: “to date there is no single effective intervention for ASD. Therefore, a variety of interventions, implemented simultaneously, addressing different aspects is recommended”. Since programmes for students with ASC should be highly individualised, they consider that regular data collection and continuing assessment of the response to intervention are crucial to be sure about the effectiveness of an intervention for a particular student. Based on a meta-analysis of the current school-based interventions, Bellini et al (2007) recommend increasing the frequency and intensity of the intervention, and call for more interventions that address the specific needs of the child with autism.

There is an increasing popularity in the use of technology-based interventions for ASC children. Computer-based interventions for children with ASC are particularly successful. Computers have been widely used to teach various skills to children with ASC, such as vocabulary and grammar skills (Bosseler and Masaro 2003), problem solving (Bernard-Opitz et al. 2001), reading and communication skills (Heimann et al.1995, Williams et al. 2002), social skills ((Bernard-Opitz et al. 2001, Silver and Oakes 2001, Swettenham 1996, Rajendran et al. 2005, Ramdoss et al. 2012), joint attention (Whalen et al. 2006), collaboration skills (Gal et al. 2009) and others.

According to Swettenham (1996), there are several reasons for which computers seem to be appropriate when exploring aspects of autism, as follows:

- computers act as an interface between individuals with ASC and other people and that creates emotional and social distancing which is likely to diminish the anxiety;
- computers can satisfy the need for sameness and predictability;
- users can work at their own pace and can get control over the program;
- information that might distract attention from the main task can be eliminated.

Williams et al (2002) consider that the software presents the advantage of not becoming impatient as a human being does and, therefore, it is a comfortable and relaxing environment for children.

Computers seem to be appealing for children with autism and that results in benefits such as increased motivation, attention and learning compared with traditional methods (Goldsmith and LeBlanc 2004). Moore (1998) also considers computers to be motivating for individuals with ASC, as well as safe and emotionally engaging. Some studies report that students with ASC show increased motivation, attention, learning and referential communication towards computer aided instruction compared with traditional instruction (Bernard-Opitz et al. 1990, Chen and Bernard-Opitz 1993, Moore and Calvert 2000, Bosseler and Massaro 2003). Williams et al (2002) discovered that individuals with ASC used more spontaneous gestures and verbal requests to ask for help when they received computer aided instruction compared with direct instruction given by a teacher.

In spite of the apparent benefits, there are several concerns regarding the use of Computer Assisted Instruction (CAI) for students with ASC. One of the most prominent is related to the social withdrawal. Thus, there is the concern that CAI may encourage non-human interaction and result in social isolation (Bernard-Opitz et al. 1990, Ploog et al. 2012). Another concern is related to the obsession that people with ASC might develop for technology itself, which might obscure the main aim of the instruction which is the skills learning. Generalisation might be also a problem (Anderson et al., 2009), as the purpose of using CAI is to teach the students skills which they can then apply to real-life situations.

Ploog et al. (2012, p. 319) claim that: “assuming good design, computer-assisted instruction can be useful in providing opportunities for individuals with ASD to learn skills accurately, independently, and efficiently. A properly designed CAI program can encourage performance of a variety of new social and communication skills.” Furthermore, they also argue that a good designed intervention that uses computers can possibly provide better training than a teacher does. They are confident that

computers will play a crucial role in the interventions for individuals with ASC, provided they are based on a rigorous scientific research.

2.3.2 Social Story Interventions

As described above, the main goals of educational interventions with individuals with ASC using social stories are to increase the individuals' understanding, to make them more comfortable and to provide the common appropriate responses in specific situations. Reynhout and Carter (2006, p. 447) state that: "the use of social stories has been popularized, widely discussed and recommended in the literature". Parsons et al. (2009, p.234) claim that research shows: "positive results for social story use" in increasing appropriate behaviours and reducing inappropriate behaviour.

2.3.2.1 Traditional Interventions with Social Stories

Crozier and Sileo (2005) outline the main steps to take for implementing a social story:

- *identifying a need for intervention.* This step is achieved through observations or formal assessments. The needs should be prioritise following various criteria (e.g. 'the level of risk for the students and others', 'how irritating the behaviour is' (Crozier and Sileo 2005, p. 25)
- *completing the functional behaviour assessment.* This assessment can provide the image of the behaviour and informs about its causes. The tools which can be used are behaviour observations, interviews and self-assessments (O'Neill et al. 1997, quoted in Crozier and Sileo 2005, pp. 27-28). The functional behaviour assessment allows the researcher to increase the effectiveness of the social story in improving the targeted behaviour.
- *including the social story in behaviour plan.* The social story can be a part of a larger plan to change the behaviour.
- *writing the social story.* The social story might be written following Gray and Garand's (1993) guidelines, taking into account the functional behaviour assessment.

- *introducing the social story and monitoring the progress with data.* The comprehension of the social story has to be checked initially. The length of the intervention is tailored to the child's skills. The story must be accessed by the student at any time, which means that it could be kept within the child's view. The data are collected during the intervention.
- *evaluation of the success.* The data should be analysed and compared with the baseline data to assess whether or not the social story is effective or if it has to be modified.

In general, the way of assessing social story effectiveness is to compare data (e.g. the percentage of intervals of appropriate/inappropriate social interaction or frequencies of identified social communication skills/instances of target behaviours) collected before, during and after intervention. Anecdotal evidence about generalization or maintenance is sometimes considered in assessing the efficacy of social stories.

The interventions based on social stories can be achieved in three different ways (Crozier and Sileo 2005). The child who can read is asked to read the social story individually, after the teacher initially reads it with the child. For the child who is unable to read, the social story is recorded and the child is taught to play it, while auditory cues indicate to go to the next page. The non-reader can go through the story independently. Finally, the last method is video modelling. The story recorded onto videotape is matched with images conveying the social situation and appropriate behavioural attitudes. The process of 'fading' has also to be tailored to meet the individual's needs and skills (Gray and Garand 1993). Fading is achieved by extending the time between readings or writing again the social story, omitting or revising some sentences.

In Thiermann and Goldstein's (2001) study, which involved 5 children with autism and social deficits, each child was included in a triad together with two peers (typically developed children). The intervention was provided in sessions of 30 minutes consisting in 10 minutes of instruction using social stories, text cues and pictures, 10 min of social interaction and 10 min of video feedback. The 30 minute sessions were implemented twice per week, over 15 to 19 weeks. The targeted social

communication skills were: securing attention, initiating comments, initiating requests and contingent responses. For each child, the intervention was focused on two or three of these skills, and the frequencies of the observations of skills were determined during the baseline, the treatment and maintenance. The researchers reported that the targeted skills were improved during the treatment. The children showed also generalization of some of the taught skills (e.g. in the classroom). Only 3 of the 5 children maintained some of the targeted skills. Overall, this study provided evidence for the benefits of the social stories when combined with other social intervention techniques.

Smith (2001, p.342) found that social story interventions are effective in improving the behaviour of children with ASC. She evaluated the effects of 19 social stories written and implemented by teachers, parents and educational psychologists for children with ASC in order to correct particular inappropriate behaviours. The evaluation was performed on a Likert-type rating scale with 11 points (with 0 for no change in targeted behaviour and 11 for a complete change). 13 social stories were rated between 7 and 10. However, the report did not present evidence on the student improvements.

Reynhout and Carter (2006) conducted a review of 16 empirical studies on social story interventions, of which 15 involved children with ASC. The studies addressed a number of targets, including social skills, communicative behaviours, on-task behaviours, as well as tantrums and challenging behaviours. The settings were the school, the home or a “game room”. The reviewers concluded that the effectiveness of the interventions is highly variable. However, this review showed that social stories are promising, being relatively easy to implement and effective for various behaviours in most of the cases. Thus, in nine of the studies the authors reported a reduction in inappropriate behaviours, while in eight studies the authors reported an increase in positive behaviours. Two studies did not show any change in target behaviours and two studies reported an increase in negative behaviours.

The authors highlighted several limitations and future work suggestions. One of the main limitations was the low external validity of the studies, due to the use of a

single subject design in 12 of the studies. Another general limitation consisted of the lack of documentation referring to the communication and cognitive abilities of the participants. It is important to have a clear image of the participant characteristics, taking into account the big differences between the different ASC subgroups, but also between the individuals within the same group. In this way, it can be decided which intervention is suitable for a distinct set of characteristics. Therefore, Reynhout and Carter (2006) concluded that documentation about the cognitive and communicative skills of the participants is highly important in order to decide if the social stories are suited to the individuals with some characteristics.

Another problematic aspect emphasized by Reynhout and Carter (2006) was related to the maintenance and generalization. These two issues are definitive for an effective programme of intervention. Talking about generalization, Klin et al. (2003, p.345) stated: “One of the most intriguing puzzles posed by individuals with autism is the great discrepancy between what they can do on explicit tasks of social reasoning (when all of the elements of a problem are verbally given to them), and what they fail to do in more naturalistic situations (when they need to spontaneously apply their social reasoning abilities to meet the moment-by moment demands of their daily social life)”. Reynhout and Carter (2006) concluded that there are few studies which approach maintenance and generalization and more research is needed to investigate these aspects.

Finally, Reynhout and Carter (2006) suggested that social stories which did not follow Gray’s recommendations might nevertheless be effective. A number of the stories did not respect Gray’s ratios. According to Gray (see 2.2.1), perspective sentences should be written from the point of view of others, and only occasionally from the perspective of individuals with ASC. In their study, Reynhout and Carter (2006) reported that 47% of the perspective sentences were written from the view point of the individuals with ASC, while 6% were written both from the perspective of others and the perspective of people with ASC. However, the social stories which deviated from the Gray’s recommendation did not appear to be ineffective.

A similar conclusion is drawn by Kokina and Kern (2010) in their review. They studied the effectiveness of 18 interventions based on social stories and explored the role of different variables, such as: settings, format of social story, length of intervention, comprehension checks, skill development, participant's age, and diagnosis. Their review reveals that social stories are more useful in reducing inappropriate behaviours than in enhancing social skills. Kokina and Kern (2010) explain that social skills are abstract and complex and that makes them difficult to be understood. Furthermore, social stories help children with ASC understand social concepts or situations which results in reducing challenging behaviours. However, a child may understand a concept, but “may lack social skills to apply this knowledge” (Kokina and Kern 2010, p.823). Therefore, social stories must be carefully planned, because, if the child lacks the pre-requisite social skills, then teaching certain skills may involve supplementing social stories. Another finding is that social stories are more effective when approaching single behaviours than when approaching complex behaviours.

This review also showed that social stories are more effective in educational settings than at home. The advantages of the educational environments are the easiness of implementation of social stories and “a relative unobtrusiveness” (Kokina and Kern 2010, p.823). Moreover, the authors found that the children who read the social stories are more successful than those whose social stories are read by other people (e.g. teacher, parent). The amount of time between the moment of reading the social story and the moment when the child faces a target situation is also important. Social stories which are read just before the child is engaged in the targeted situation are more successful than those read a longer time ago.

The social stories included in this review fell into two categories: written and written with illustrations. Social stories with visual illustrations were more effective than those without. Consistent with Crozier and Sileo's (2005) main steps in implementing social stories (see section 2.3.2.1), initial functional behaviour assessment, as well as comprehension checks of the child's understanding improve the success of social stories. Another conclusion was that children with lower cognitive abilities perform better than those with higher cognitive abilities. However,

this result should be interpreted with caution, because the two groups had significantly different numbers of individuals. The authors discovered also that children with high levels of communication skills are more successful than those with low levels. The explanation may reside in the nature of social stories which is language-based interventions. Thus, social stories may be more appropriate for children with higher verbal skills.

Reynhout and Carter's (2006) as well as Kokina and Kern's (2010) reviews concluded that social stories are promising tools, but there is no clear evidence about what specific features make a social story to be successful or not.

2.3.2.2 Technology-based Interventions with Social Stories

Researchers and practitioners have attempted to develop interventions with social stories which incorporate various technologies, such as video modelling, or text-to-speech technology.

An attempt to implement a multimedia social story was done by Hagiwara and Smith Miles (1999). They conducted a study with social stories in a computer-based format. The stories were developed using the HyperCard (Apple Computer 1994) software. They had a book-like format, which contained the text of the social stories and videos of the participants' acting corresponding to the social story sentences. Scripts were read aloud for each page using a synthesized computer voice. Navigation was made possible through a clickable button. The social stories were used with three boys, diagnosed with autism, in a multiple baseline design across three settings for each boy. The authors report that this multimedia social story intervention was effective. All three participants demonstrating an increase in skill levels, with one demonstrating obvious generalization of skills across the three settings. However, the process of the social story development was quite complex and time consuming.

A similar study was conducted by Sansosti and Powell-Smith (2008). They created and presented social stories using Microsoft PowerPoint. The social stories were designed according to Gray's rules. Each story contained a short video (45-60 s) which presented the social story with similar-aged peers engaged in the targeted

behaviour. The researchers reported positive effects in increasing specific communication skills in three boys (aged 6-10 years) during the intervention phase. Improvements were observed also during a follow up session which was conducted two weeks after the intervention was completed. Although this method seemed to be promising, the authors remarked that educators might encounter difficulties in using it, since it requires some advanced technical skills.

Carol Gray and Mark Shelley (2012) have recently released Storymovies, a series of 25 social stories acted out by real children, parents and teachers. These stories were designed for children with ASC, aged 8-12 years. The videos are created similar to the children's television shows, and include questions about the target behaviour which has just been presented. Although the authors promise to come up with new social stories, it is clear that these stories cannot cover the multitude of behaviours and situations which practitioners need to target in their social stories. Moreover, the children's engagement with the social stories is limited, since they can only watch the videos, without having validated their answers to the questions raised in the story.

The Reflex/React Autism project, developed by researchers at the Georgia Institute of Technology attempts to help adolescents with high-functioning autism (HFA) to learn and practice social skills, with a minimum intervention from practitioners, parents, guardians and therapists. Refl-ex (2012) is a prototype which includes three interactive scenarios: Going to a movie, Going to a new restaurant and Unlocking the door. In each scenario, a situation is presented in a book format style, with text and a corresponding image. Their stories differ from previous approaches, as they introduce a structure called obstacle-based branching. During the story, the student is presented with obstacles (see Fig 2.2) and possible solutions for overcoming each obstacle from which the student is asked to choose one (see Fig 2.3). The student gets feedback according to their answer. The approach exemplifies errorless learning, which means that the student cannot fail. In the case of an undesirable answer the system prompts the student to try again, removing the choice which had been selected.

REACT is a prototype authoring tool that allows users to create Refl-ex instructional modules using crowdsourcing approach personalised to adolescents with HFA to that allows users to author deliverable material using an intuitive interface. Crowdsourcing is a process of voluntarily undertaking a task by a group of individuals as a result of an open call launched by an individual, an organisation or an institution (Estellés-Arolas & Ladrón-de-Guevara 2012). In this project crowdsourcing was used to build models of social knowledge in order to provide support to the authors of social skills instructional modules

Two researchers from University of Leeds and Leeds Metropolitan University have developed Story Builder, a computer-based tool that can be used to build book format social stories for children with autism (Usability North 2014). This tool offers a shell with which the user can write text and add pictures from the computer. The story can be written from scratch or by editing an existing social story. This tool does not support the monitoring of the story during the interventions, the assessment of the story, the check of child's comprehension.

Stories in Motion is a web-based application developed by the 3C Institute which allows educators and students to create individualised social stories, and to print the story in a book format (StoriesInMotion 2014). This application also includes data collection and monitoring functions that permit practitioners to track the student progress and performance. Stories in Motion does not address the broad range of children with ASC, being addressed only to a specific group of the students with HFA for 3rd to 5th grade.

Several commercial mobile apps have been developed to support social stories development, such as: Pictello (AssistiveWare 2014), Story2Learn (App Store 2014), Social Stories (Apps for Children with Special Needs 2012) and StoryMaker (Dentremont 2014, Handholdadaptive 2014) and others. However, these applications focus primarily on editing and presenting social stories, and do not support checking comprehension, monitoring, or assessing the story. A more detailed discussion on the current social story authoring tools is presented in Section 4.4.

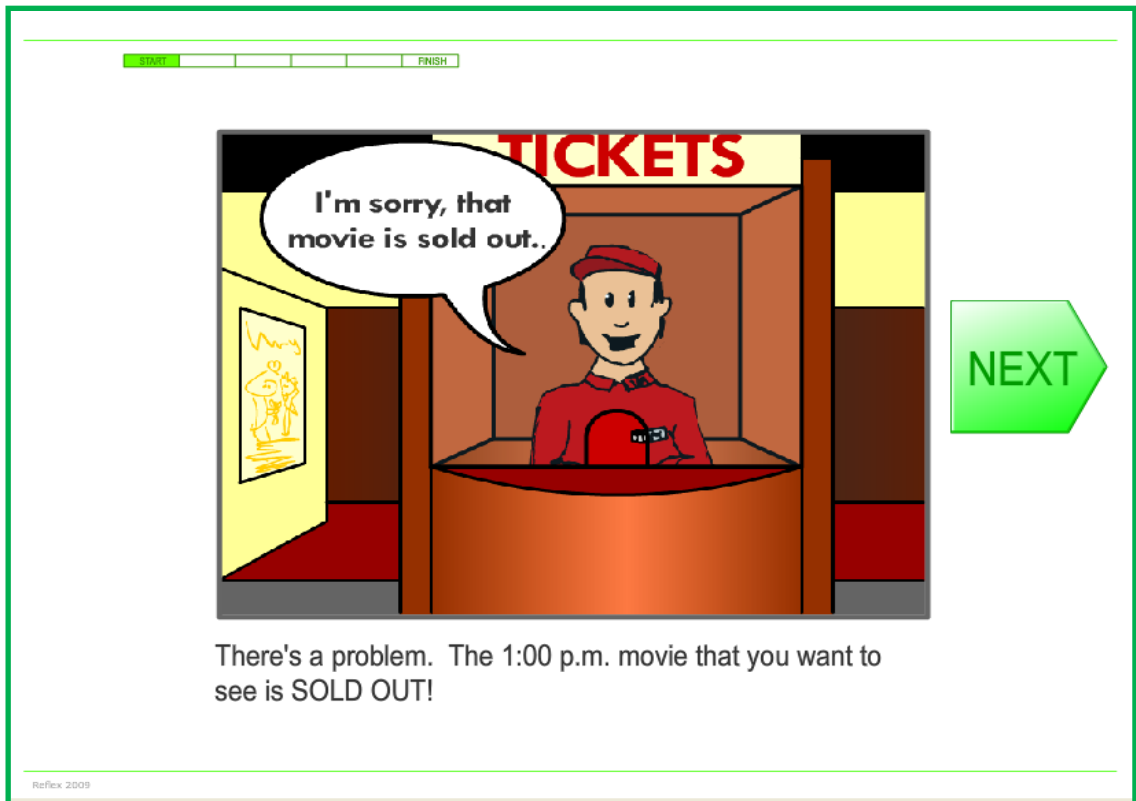


Figure 2.2: Introduction of an obstacle in the “Going to a movie “ scenario

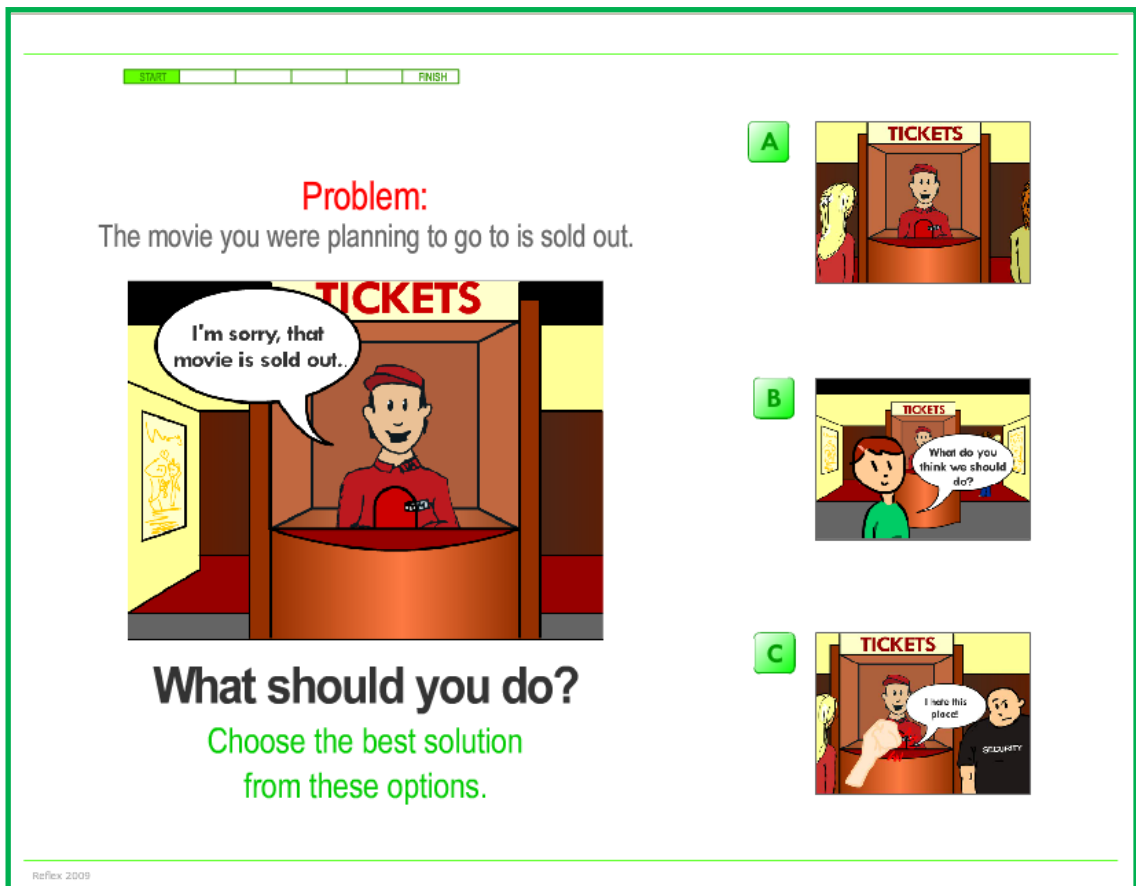


Figure 2.3: Decision point in the “Going to a movie” scenario

2.4 Motivation of the Project

The literature review showed that social stories are widely used interventions with children with ASC (Olley 2005) and studies revealed that they are promising (Crozier, and Tincani 2005, Sansosti and Powell-Smith 2006). Exploratory studies conducted in the first stage of this research confirmed that **social stories are frequently used in schools by a large number of practitioners** (see chapter 4). Although social stories' effectiveness appears to be highly variable (Reynhout and Carter 2006, Kokina and Kern 2010) this is not surprising since children with ASC are a very heterogeneous group and consequently an intervention should not be expected to work for all of them and in all situations.

Gray (1995) suggests that the success of social stories is crucially dependent on the way they are written. Moreover, Howley and Arnold (2005) argue that the way of presenting social stories is essential for their effectiveness. These researchers also argue that technology may have important benefits in supporting social stories. However, the exploratory studies with practitioners conducted in the first stage of this research (see 4.1.3) as well as the evaluation studies (see 7.2.3.2) showed that they prefer to use pen and pencil, Microsoft Word or PowerPoint because the existing applications for social stories are not flexible enough and do not meet their needs, being cumbersome to use and limited in their functionality. The exploratory studies conducted in the pre-design stage (see chapter 4) also revealed that **practitioners would value a computer-based tool to support them write, deliver and assess social stories, as well as to organise their work** during the entire process of social story interventions (Constantin et al 2013).

A review of the **existing computer-based applications** for social stories revealed a number of limitations and led to the conclusions that these **do not fully support the social story interventions**. For example, none of these applications provides support to check the child's comprehension, to organize the social stories and the resources used, to save the child's preferences, to create partial sentence stories, to annotate sentences, or to monitor the impact of social stories (see Section 4.4 for a detailed description of these limitations).

The present research aims to **explore how a computer-based technology can be built to better support practitioners in the development and use of social stories** compared with current approaches. In addition, it aims to inform the emerging technology for social stories from the best practices in social stories and from the recent research in this field, creating a **bridge between research and practice**. This project involves researchers in Education, HCI and ASC, and practitioners with experience in social stories in the process of developing technology for social story interventions. By bringing together researchers and practitioners, the present research gives the first an opportunity to ground their work on the best practices. At the same time, it offers practitioners a chance to reflect on their current practices and improve them, both during this project and the ongoing process that the resulting tool would foster.

The exploratory studies conducted in the first stage of this project concluded that practitioners are divided with respect to the importance of applying the Carol Gray's guidelines in social story interventions. In addition some studies show that social stories which deviate from these guidelines are not necessarily ineffective and that it is not clear yet what makes a social story successful or not (Reynhout and Carter 2006). These findings lead to the conclusion that **further research is needed** to investigate these aspects. Therefore, a new computer-based technology would not only be beneficial for practitioners who work with social story interventions, but could also **assist researchers in their future work** "to ensure evidence-based practice in the use of Social Stories by practitioners working with children with autism" (Reynhout and Carter (2006, p. 250). The potential of a computer-based technology for social stories as a research tool is described in more detail in sections 8.2.5 and 8.2.6.

2.5 Summary

This chapter presented the related work which is the basis of the present research project. It started with a brief overview of ASC. It then proceeded by discussing the main cognitive theories of autism. The social story concept was introduced and the relations between social stories and the cognitive theories were explained. The

chapter also discussed the educational interventions for autism, with an emphasis on social story interventions. It concluded with the motivation of this research. The next chapter discusses the methodology which was followed in this project.

Chapter 3

Methodology

The main purpose of this chapter is to describe the methodology framework employed to support the claim of the current research:

It is possible to design and implement an authoring tool that supports practitioners in social story interventions, and which is evaluated by experts to be an improvement over the current approaches.

Researchers commonly agree that it is essential to involve users in the system's development process (Damodaran 1996). Moreover, there is a strong emphasis on the bridge between theory and practice, when building educational tools in general (Kennedy 1997, Broekkamp and van Hout-Wolters 2007, Hook et al. 2013), and educational tools for autism in particular (e.g. Parsons et al. 2009, Reynhout and Carter 2006). Therefore, the first step before describing the methodology for the current research is to describe and discuss the existing approaches which take into consideration user involvement in design and evaluation, as well as the frameworks that are successful in bridging the gap between theory and practice (e.g. User-Centred Design, Participatory Design, Informant Design, Action Research, and Persistent Collaboration Methodology). The next step is to explain the rationale of the methodology framework employed in this research. Finally, the present chapter provides an overview on how this framework was applied to this research project.

3.1 User-Centred Design

User-Centred Design (UCD) also called Human-Centred Design (HCD) by ISO 13407 (1999), is one of the most used participatory approaches. This section explains the concept of UCD, the principles that are central to this approach, the activities and methods employed in UCD, as well as its benefits and limitations.

3.1.1. The User-Centred Design Concept

UCD refers to both a philosophy and a variety of methods used “in design processes in which end-users influence how a design takes shape” (Abrams et al. 2004, p. 763). The key concept in UCD is that users are involved in design in one way or another, although the ways in which the users are involved in UCD vary broadly. For example, in some UCD approaches users are invited at certain times during the design process and consulted about their wants and needs, in most of the cases during requirements elicitation and usability evaluation. In other UCD approaches, users are involved throughout the entire design process.

The concept of UCD was first introduced by Norman and Draper in their work: *User-Centered System Design: New Perspectives on Human-Computer Interaction* (Norman and Draper 1986). Since then it has been transformed and interpreted in various ways. According to Norman (2002, p. 188), UCD is “a philosophy based on the needs and interests of the user, with the emphasis on making products usable and understandable”. Although his recommendations place the user at the centre of design, Norman does not consider the direct dialog between users and designers.

Karat (1997, p. 38) states that: “For me, UCD defines an iterative process whose goal is the development of usable systems. There is general agreement that this is achieved through involvement of potential users of a system in system design”. He further explains that the lack of shared meaning of UCD could be in fact an advantage: “I suggest we consider UCD an adequate label under which to continue to gather our knowledge of how to develop usable systems. It captures a commitment the usability community supports—that you must involve users in system design—while leaving fairly open how this is accomplished” (Karat (1997, p. 38). Karat calls UCD techniques all the techniques which imply the involvement of the user in the design. He stresses the importance of the user’s involvement in the design and states that it is essential to understand how and when each technique is appropriate.

According to Sanders (2002, p1), in the UCD the focus is “on the thing being designed (e.g., the object, communication, space, interface, service, etc.), looking for

ways to ensure that it meets the needs of the user”. She distinguishes between the roles of the designer and that of the researcher. The researcher is the interface between the user and the designer who should learn about the user’s needs by collecting data and interpreting them “often in the form of design criteria” (Sanders 2002, p1). These criteria are then used by the designer to create sketches or scenarios. Moreover, Sanders emphasises that the focus is on design and that the researcher and user do not necessarily go back into the process. In this view of UCD the user is not part of the team, being only spoken by the researcher.

Gulliksen et al. (2003) more recently define UCD as an approach which focuses on usability in the entire development process and life cycle of computer-based interactive systems. They base their definition on the ISO 9241-11 standard’s meaning of usability: “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11 1998, quoted in Gulliksen et al. 2003, p. 407). The usability measures in ISO 9241-11 (1998) are:

- **Effectiveness:** “Accuracy and completeness with which users achieve specified goals”. This is usually counted in terms of number of people who completed some critical tasks (the tasks that users commonly carry out with the system). In brief this is about doing the right things.
- **Efficiency:** “Resources expended in relation to the accuracy and completeness with which users achieve goals”. Efficiency is often measured in terms of time expended to perform a task. Efficiency can be briefly described as doing the things right.
- **Satisfaction:** “Freedom from discomfort, and positive attitudes towards the use of the product”. Satisfaction is usually measured through verbal or nonverbal behaviour during the task, or through post-task questionnaire (e.g. SUS questionnaire).

Gulliksen et al. (2003) emphasised that their understanding of usability includes the concept of utility or usefulness which is not always implied by usability definitions. They warn about the fact that a full-time involvement of users in a project transforms

them into domain experts. Therefore, they recommend also having users involved on a temporary basis as representative users.

3.1.2 User-Centred Design Principles

In Norman's (2002, pp. 188-189) view UCD can be summarised through seven principles, as follows:

1. "*Use both knowledge in the world and knowledge in the head*". Systems should be designed to support users in creating a correct mental model of what is going on.
2. "*Simplify the structure of tasks*". The tasks should be structured to avoid excessive memory load and complex problem solving.
3. "*Make things visible*". The users should be able to figure out what the system can do and how. The interface should provide clear feedback for the user's actions on the system.
4. "*Get the mapping right*". The user should be able to determine what does what and to what extent.
5. "*Exploit the power of constraints*". The system should be designed in such a way that the user can only perform the correct action.
6. "*Design for error*". The designer should anticipate all possible errors and allow the user to correct them.
7. "*When all fails, standardize*". If natural mapping is not possible, a universal standard should be adopted.

As can be seen from the above, Norman's principles give the user a central position and focus on developing usable systems. However, in line with his definition (see section 3.1.1), Norman's principles do not refer to the user's involvement in the design process.

The Norman's key principles can be found in the Shneiderman's (1998) eight golden rules to some extent:

1. "*Strive for consistency*". The terminology used in menus, pop-up windows, or icons should be identical; the sequences of actions should be consistent in similar

conditions; consistent commands should be used throughout the entire application. This rule somehow corresponds to the seventh Norman's principle.

2. "*Enable frequent users to use shortcuts*". This rule is meant to simplify user's interaction, similar to the second Norman's principle. Schneiderman suggests using abbreviations, macro facilities, or function keys to decrease the number of interactions.

3. "*Offer informative feedback*". The user should receive feedback for every operator action. This rule matches the third Norman's principle.

4. "*Design dialog to yield closure*". This rule corresponds to both the third and fourth Norman's principle. The users should get informative feedback at the end of actions in order to have clear about what they accomplished and to prepare for the next actions.

5. "*Offer simple error handling*". As in the fifth Norman principle, the system should be designed to support the user avoiding errors. When an error is made, the system should allow the user to handle the error – similar to the sixth Norman principle.

6. "*Permit easy reversal of actions*". This rule permits the users to undo the errors, hence to relieve anxiety. This somehow overlaps the sixth principle of Norman.

7. "*Support internal locus of control*". This allows the experienced users to take the control over the system and to initiate rather than only respond to actions.

8. "*Reduce short-term memory load*". This rule is determined by the limitation of human short-term memory. Therefore, this rule requires keep at minimum the number of action steps, designing screens where options are obvious (see the second and third principles of Norman).

It can be noticed that there is not an obvious matching between the first principle of Norman and the Schneiderman's rule. Also, the seventh rule of Schneiderman cannot be found among the Norman's principles.

Like Norman's principles these rules are abstract and need to be interpreted or translated into appropriate guidelines. Again, like Norman's principles Schneiderman's rules do not refer to user involvement or the system development process.

Wallach and Scholz (2010) base their definition of UCD on Gould and Lewis' (1985) paper *Designing for Usability: Key Principles and What Designers Think* which clearly stresses the importance of bringing together designers and users and describes the development process by following three principles:

1. **Early user-centricity.** Gould and Lewis emphasised the importance of understanding the users and not only identifying, describing, stereotyping and ascertaining them. They argued that the designers should be in direct contact with the potential users in the pre-design phases. By using methods such as observations and interviews, they should uncover within early studies the user's tasks, but also be informed about users' characteristics, such as literacy level, or behavioural working conditions.
2. **Empirical usability measurement of user behaviour using prototypes.** Gould and Lewis enumerate among empirical measures the following: errors, learning time, attitude, or numbers of requests for help. They also state that: "intended users should actually use simulations and prototypes to carry out real work, and their performance and reactions should be observed, recorded, and analysed" (Gould and Lewis 1985, p. 300). They recommend the use of low-fidelity prototypes or semi-functional prototypes to explore the users' reactions.
3. **Iterative design.** Iterations were emphasised as being crucial when designing for usability. This principle implies a multiple cycle process, including design, test, empirical measurements and redesign based on the feedback gathered from users.

Though Gould and Lewis (1985) do not clearly define usability, their proposed principles of designing for usability and the conditions to meet them are in line with the ISO 9241-11 standard (1998) definition of usability. The ISO 9241-11 standard (1998) describes six key principles that are to be followed in order to ensure that the design is user centred:

1. Clearly understand users, tasks and environments prior to design;
2. Actively involve users throughout the entire development process;
3. Drive the design and refine it based on users' feedback;
4. Adopt an iterative process;

5. Address the whole user experience in the design;
6. Include people with multidisciplinary skills and perspectives into the design team.

Gulliksen et al. (2010) conclude that user-centred systems design must be defined in terms of a process which integrates user involvement, usability and the development process. These three elements map the three principles stated by Gould and Lewis (1985) and are reflected in the six principles of the user-centred design mentioned above which are considered also in the present research.

The principles are, by definition, general and abstract, so they cannot be applied directly in practice. Therefore a list of activities, potential tools, methods and techniques is required to help on the application, understanding and assessment of the principles. Such activities, tools, methods and techniques are presented in the next section.

3.1.4 User-Centred Design Activities and Methods

The ISO 13407 (1999) standard on HCD defines the following five categories of design activities:

Plan the human-centred design process. In the first step the stakeholders should be brought together in order to discuss and agree on how usability can support the project objectives. A cost-benefit analysis can be used to establish the need of UCD and also to assess the importance of various activities or to compare usability methods.

Understand and specify the context of use. It is essential for UCD to understand the users, the work environment and the tasks that they are performing by using the system. For that, the first step is to identify the users. Users can be *primary*, if they actually use the system, *secondary*, if they only occasionally use it or use it through a proxy, and the *tertiary* if they are people affected by the use of the system. Some recommended methods for collecting information about the context of use are: observation, interviews, questionnaires, TA, surveys and collecting samples of

artefacts (Constantine and Lockwood 1999, Benyon 2010).

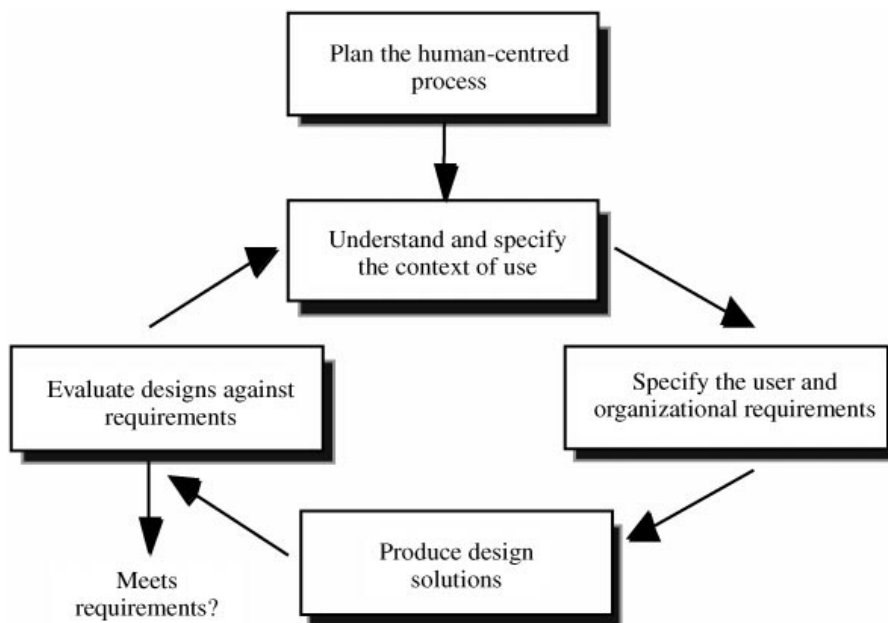


Figure 3.1: Activities in the HCD (after ISO 13407, in Maguire 2001, p. 589)

Specify the user and organizational requirements. At this stage the focus is on structuring the data which were gathered within the previous activity. The most frequent methods used for that are: personas, scenarios, and use cases (Maguire 2001). *Persona* describes an imaginary person who is representative for a distinct user type, including her specific goals and characteristics (Dix et al. 2004). A *scenario* is a story of interaction describing what a persona does to achieve a specific goal (Wallach and Scholz 2012). “A *use case* is a task which an actor needs to perform with the help of the system.” (Stevens and Pooley 2006, p. 29). A use case is usually described as a list of steps which define the interaction between an actor (a human or an external system) and a system to achieve a goal.

Produce design solutions. The goal of this stage is to transform the results of the previous stages into tangible artefacts. Among the methods that can be used at this stage, Maguire (2001) proposes: brainstorming, parallel design, storyboarding, paper prototyping and software prototyping. *Brainstorming* is a problem-solving technique based on a list of ideas which are spontaneously produced by a group or an

individual (Maguire 2001). *Parallel design* consists of small groups of designers working independently to develop and evaluate different design ideas before choosing a single solution (Nielsen 1993). A *storyboard* is a short and usually rough graphical representation of a scenario used to illustrate how a system feature works (Truong et al. 2006). A *paper prototype* is a simulation of the user interface elements (windows, buttons, icons, etc.), usually created by using paper and pens. It emphasises the big picture with minimal detail, and fosters design thinking (Beaudouin-Lafon and Mackey 2003). A *software prototype* is a computer-based simulation of the system which provides a more realistic representation of the system compared to a paper prototype (Maguire 2001).

Evaluate design against requirements. Design solutions are evaluated in order to determine if the solution meets the requirements and usability goals, and to generate feedback for improving the system. The methods used are influenced by the project resources and time constraints. They can be grouped into two categories: *expert-based methods* and *participant-based methods*. The first one implies the use of experts and includes heuristic evaluation, consistency inspection and cognitive walkthrough (Nielsen 1993, Benyon 2010, Wallach and Scholz 2012). The latter employs end-users who are usually required to perform a set of tasks/scenarios while digital cameras record the interaction and sometimes their facial expression (usability testing). The *think aloud protocol method* (Ericsson and Simon 1980) or versions of it, such as *cooperative evaluation* (Dix et al., p. 343), or *constructive interaction* (Holzinger 2005) are often used to get more insight into the user's thinking process. The participants are asked to verbalize their thoughts while interacting with the artefact. Usability testing can be conducted in many ways, such as laboratory testing, informal guided walkthroughs or remote usability testing using a screen sharing application. Additionally, usability questionnaires and post-task interviews are often applied to get the user's perception on the system's usability. For example, the SUS (System Usability Scale) questionnaire (Brooke 1996; Sauro 2011a) is a ten-item five-point Likert scale questionnaire which can be used to elicit the global perception on usability of the users.

The design activities presented above are repeated iteratively, as illustrated in Figure 3.1, until the requirements and usability goals have been met (Jokela et al. 2003).

Maguire presents a set of possible methods and activities in each of the five categories above mentioned (see Appendix A).

Wallach and Scholz (2012) identify a set of slightly different activities, which includes: *Scope, Analyse, Design, Validate and Deliver*. *Scope* is similar to the first category in the ISO model of HCD. It aims to find a common agreement among the various stakeholders with respects to the product which involves intertwining the product's vision and research results. This category of activities usually addresses the product's goals and constraints. The activities at the *Analyse* stage cover the second and third steps from the ISO standard on HCD. Their purpose is that of understanding the users, the tasks that they perform and the context of use of a current or future application. They frequently focus on usability assessment. The assessment can be done with or without involving the users. The *Design* stage has the goal "to transform insights and findings from the *Scope* and *Analyse* phases into a tangible artefact." (Wallach and Scholz 2012, p. 25). This stage corresponds to the fourth stage from the ISO 13407 (1999) standard. Regardless of the fidelity of the artefact created in the design stage, this artefact has to be iteratively validated against goals. The *Validate* stage corresponds to the fifth stage from the ISO 13407 (1999). *Deliver* is a new stage introduced by Wallach and Scholz (2012) which refers to the deployment of the last version of the artefact. A table of the methods and techniques used in these stages is presented in Appendix B.

Monk (2000) identifies a set of four common processes in the UCD which includes: *understanding the work context, understanding the work, testing a top level design against your understanding of work and user testing of more detailed prototypes*. A summary of the methods, representations and problems is presented in Appendix C.

The UsabilityNet project (Bevan et al. 2002) provides usability professionals with web resources including recommended methods for user centred design. These methods are categorised into six stages of the development process: *planning and*

feasibility, requirements, design, implementation, test and measure, and post release. Following a review of a broad set of methods, 35 methods which had “a track record of cost-effective application in a commercial environment” were selected by UsabilityNet partners experienced in European Commission (EC) and commercial projects (Bevan 2003, p. 3). Each method has a detailed description. A screenshot of the table with UsabilityNet methods is presented in Appendix D.

Although the methods differ from one source to another, it appears that, regardless of their names, the categories of activities to be followed in a UCD approach are almost the same for different authors, and they match with the ones proposed by ISO 13407 (see Figure 3.1). For this project they will be referred to as: planning, context of use, requirements, design and evaluation. A summary of all the methods and techniques used in each of these categories is presented in Appendix E. These methods and techniques are usually selected based on the available time and resources, access to users and the researchers’ skills and expertise.

3.1.4 Benefits and Limitations of User-Centred Design

The adoption of UCD, no matter the chosen version, brings both a list of benefits and limitations which will be briefly explained in this section.

According to Bias et al. (2003) the benefits of employing UCD are: increased user satisfaction and system acceptability, reduction of production costs, training, and support, and increased productivity. Furthermore, a study conducted by Vredenburg et al. (2002) shows that UCD increases the utility and usability of computer systems.

Abras et al. (2004, p. 11) consider that the essential benefit of UCD consists of “deeper understanding of the psychological, organizational, social and ergonomic factors that affect the use of computer technology”. They also conclude that the users’ involvement leads to a product which is suitable for the purpose it was built for, in the context it was expected to be used. Since the users are involved from the early stages in the design, the designers understand user’s expectations about the product. Moreover, since the users’ ideas and suggestions are incorporated in the

design, this leads to a sense of ownership of the product which entails higher customer satisfaction and system acceptability (Preece et al. 2002).

However, some argue that the feedback designers obtain from users is “exclusively based on reaction rather than initiation” (e.g. Scaife et al. 1997, p. 343). Scaife et al. (1997) explain that this kind of unbalanced relationship requires designers to translate the users’ reaction. This translation can be done in a wrong way from different reasons. One of them could be the designers’ difficulty in changing their own ideas, or time constraints.

Among the main disadvantages of UCD, Abras et al. (2004) emphasise the increased time and cost of developing the product. They also mention as a disadvantage the need of employing additional team members (e.g. usability experts, ethnographers) and a large number of users.

Moreover, in a survey of interviews involving 200 interface designers, Grudin (1991) identifies the following obstacles in applying UCD: difficulty in finding appropriate users, obtaining access to and motivating them, as well as the lack of time.

3.2 Participatory Design

Another approach that takes into consideration user involvement in design and evaluation is Participatory Design (PD). It comes with a shift in attitude towards the user.

3.2.1 The Participatory Design Concept

PD refers to theories, practices and studies that aim to make the ultimate users effective contributors to the design and development lifecycle of the software (Greenbaum and Kyng 1991, Schuler and Namioka 1993, Carroll and Rosson 2007). At every stage of the design process in PD, the central design philosophy is to give careful attention to the end-users’ needs, wants and abilities.

According to Titlestad et al. (2009, p. 31): “a key PD principle is to bridge and blur the user-designer distinction from both directions, through mutual learning processes.

Effective methods to achieve this usually rely on prototyping and intensive face-to-face interaction between users and designers”. This approach is very diverse, building on a range of fields including software engineering, graphic design, sociology, political science, psychology, and user-centred design (Gregory 2003 cited in Muller 2003, p. 167).

Sanders (2002) considers that PD created a shift in the perspective from “designing for users” (which is central in UCD) to “designing with users”. It implies collaboration with users throughout the entire design and development process and not just designing a product for users. Sanders (2002, p. 1) adds that PD is a “new way of thinking, feeling and working”, not just a set of methods, but ‘a mindset and an attitude about people’. It is based on the belief that all people can be creative, hence able to bring something to design when they are offered appropriate tools to express themselves. Therefore, PD changes “what we design, how we design, and who designs” (Sanders and Stappers 2008, p. 7).

Asaro (2000) presents two perspectives on technology which contributed to the PD approach: Joint Application Design (JAD) which originates in the USA, and the European approaches which started in Scandinavian countries and Britain.

The JAD, which is often neglected as a contributor to PD, “not only addresses the integration of users into systems design, it also provides insights into the corporate culture which would later adopt variants of the participatory design methods originating in Europe” (Asaro 2000, p. 259). JAD was created by two IBM employees. Their goals were to reduce the time of the System Development Life Cycle (SDLC), enhance the system quality and decrease the cost of the system. In order to achieve these goals they created a methodology to include meetings with users in the SDLC. These meetings occurred both during the early stages and the later stages of the design. While in the early stages the meetings were focused on the users concerns and needs, in the later stages more information was required from the users with the purpose of generating a list of user requirements with the group consensus. The group was made up of designers, users and a facilitator (designer leader) who led the discussion. JAD had two purposes: 1) to elicit the information

(knowledge, impressions, wants, beliefs) from the users; 2) to increase the chance to sell the system to users. However, in most of the JAD meetings “operational employees are overlooked as participants” (Camel 1993, p. 46), since mostly managers and workers with extensive experience in the work process were invited. Therefore, although JAD tried to integrate users into the design process, it did not succeed to change the practices and political organisation of the design and development process, since they limited the voice of users and promoted the authority of technical experts (Asaro 2000).

At the same time, European researchers who were concerned with the “workplace democracy and the humanization of work” (Asaro 2000, p. 265) established relationships with the trade unions in order to address the issue of the balance of power between management and workers. Both researchers and workers were determined to find out ways of developing technologies that give attention to the workers’ needs and interests. The main expectation was to provide workers with more control over their working conditions, by creating knowledge about work and technology, and promoting their goals and interests.

In 1981, in the Swedish-Danish UTOPIA project, researchers and workers collaborated in the first known PD project, using a range of research techniques, such as: low-fidelity prototypes, mockups, and organisational toolkits (Bødker et al. 1987). Although this project was not successful, it produced new approaches and techniques under the umbrella of PD, such as PICTIVE and contextual design (Muller et al 1993).

According to Spinuzzi (2005, p. 164) “participatory design is research [...]. As the name implies, the approach is just as much about *design* - producing artefacts, systems, work organizations, and practical or tacit knowledge—as it is about *research*. In this methodology, design *is* research. That is, although participatory design draws on various research methods (such as ethnographic observations, interviews, analysis of artefacts, and sometimes protocol analysis), these methods are always used to iteratively construct the emerging design, which itself simultaneously

constitutes and elicits the research results as co-interpreted by the designer-researchers and the participants who will use the design”.

The PD paradigm is constructivist in the sense that knowledge is not considered as residing in the head, but it is related to a specific context. Therefore, the creation of knowledge occurs “through the interaction among people, practices and artifacts” (Spinuzzi 2005, p. 166). According to Spinuzzi (2005), the essential feature of PD is the bridge between researchers-designers and users, created by a common “language” that makes them interact comfortably. Participatory designers play the role of facilitators who empower users to take decisions (Clement 1994). Sanders and Stappers (2008) also emphasise that PD is important not only when generating ideas, but also when taking decisions.

3.2.2 Participatory Design Principles

There are three common tenets which guide any PD approach: the goal is to improve the quality of work life, the orientation is collaborative and the process is iterative (Bloomberg and Henderson 1990; Spinuzzi 2005; Elis and Kurniawan).

PD is considered not only an ethical way to build a system, but also the best way to produce an efficient system (Schuler and Namioka 1993). As Carroll and Rosson (2007) state, the users have a right to get a “voice” in the process of design as they are to be directly affected by a design outcome. Moreover, since the users need to adopt the outcome of the design, they have to be included in the design to be able to express their perspectives, needs and preference which consequently will increase the chance for the developers to build a successful outcome.

3.2.3 Participatory Design Stages and Methods

Spinuzzi (2005) identifies three stages (usually iterated several times) which are common in PD research:

Initial exploration of work. Designers meet the users and get information about the work procedures, teamwork, routines, and other aspects related to work.

Discovery processes. Designers use various techniques to understand work organisation, to clarify the users' goals and to agree on the project outcome. Several users are usually involved at this stage and the studies are held either in site or in a conference room.

Prototyping. Designers together with the users iteratively build technological artefacts based on the results obtained in the second stage. Prototyping sessions can be conducted on site or in a lab.

Stage	Methods and Techniques
Initial exploration of work	Observations, interviews, walkthroughs and organizational visits, examinations of artefacts.
Discovery processes	Organizational games, role-playing games, organizational toolkits, future workshops, storyboarding, workflow models and interpretation session
Prototyping	Scenarios, mockups, paper prototyping, simulations of the relation between work and technology, case-based prototyping, cooperative prototyping

Table 3.1: Methods employed in PD – compiled from Spinuzzi (2005) and Kensing and Blomberg (1998)

Various methods and techniques (Table 3.1) are usually employed at each of these three stages. Some of them are drawn from ethnography (e.g. observations, interviews), but they are more focused on interaction and oriented towards design, while others are more PD specific (e.g. scenarios, cooperative prototyping). All of these methods and techniques have the purpose of giving the participants access to each other's experience and to connect "current and future work practices with envisioned new technologies" (Kensing and Blomberg 1998, p. 177).

In PD projects, researchers have two main aims: 1) to design experimental technologies and practices that are informed by the users' experience through direct interaction with them; 2) to develop effective PD methods and practices that might be useful to designers (Kensing and Blomberg 1998). Therefore PD research has two groups of beneficiaries: users and designers.

PD-based Methodology Frameworks

In recent years, the PD approach has gained much attention within HCI and has led to novel systems and methodology frameworks, such as: cooperative inquiry (Druin 1999), CARSS (Good and Robertson 2006), mixing ideas (Guha et al. 2004), comicboarding (Moraveji et al. 2007), IDEAS (Benton and Johnson 2014). For example, Druin and her team (Druin 1999) created and developed a framework called cooperative inquiry to enable children to have a voice in design. This framework, which allows children to be design partners for developing software, includes three key aspects: 1) multidisciplinary research partnership with children; 2) field research focused on understanding activities, context and artefacts; 3) iterative prototyping including both low-fidelity and high-fidelity prototypes. Reflecting on her work, but also on the research literature, Druin (2002) comes up with four main roles that children can play in

designing technology: user, tester, informant and design partner. As a *user*, the child's contribution is only to use the technology, while researchers make observations to understand the impact of the technology on children with the purpose of enhancing or creating better technology. As a *tester*, the

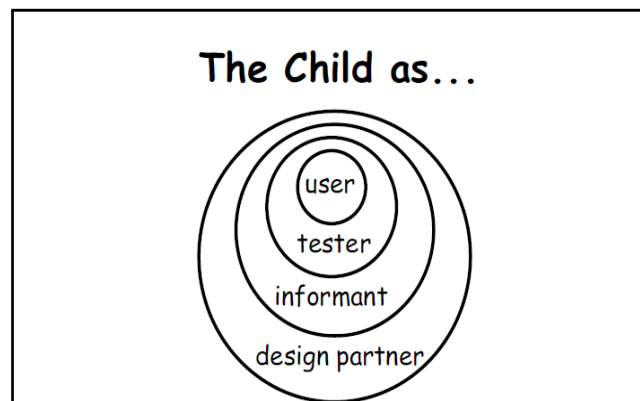


Figure 3.2: Children's roles in design – after Druin (2002, p. 2)

child tests prototypes and researchers make observations or ask for comments. The role of *informant* requires the child to be part of the design process at certain stages, according to their abilities, and to offer input and feedback regarding the emerging technology. As a *design partner*, the child is considered as an equal partner throughout the entire design process of the new technology. These roles are seen in an historical perspective, where each role includes the aspects of the previous roles (see Figure 3.2).

Good and Robertson (2006) designed and applied a framework for a participatory, learner-centred design (LCD) approach which can be adopted in building interactive learning environments (ILE) for children. Their framework, called CARSS (Context, Activities, Roles, Stakeholders and Skills) includes:

- *Context* - referring to the context in which the activities take place;
- *Activities* - describing the events that occur in the common learning environment design with a special attention to those relevant when working with children;
- *Roles* - reflecting the functions which the team members have within the team;
- *Stakeholders* – including people who have direct or indirect stake in the system;
- *Skills* – referring to the abilities needed to successfully participate in the design stage.

The benefit of this model is that it considers the specific issues which appear when children are the end-users. The model is mainly based on three methodologies, as follows:

- *Persistent Collaboration Model* (Conlon and Pain 1996) which implies active and continuing collaboration between researchers, programmers and practitioners during the design and evaluation stages;
- *Cooperative Inquiry* (Druin 2002) which advocates for involving the children in the design of new technologies;
- *Informant Design Framework* (Scaife et al 1997; Scaife and Rogers 1999) which provides information about how children contribute to the design process for ILE, along with teachers, software designers and psychologists (see section 3).

3.2.4 Benefits and Limitations of Participatory Design

As an approach that focuses on users' needs, wants and abilities PD has all the benefits that UCD has. However, PD comes with new benefits which reside in the several noticeable differences that distinguish it from UCD. First of all, UCD is focused on the technology being designed, whereas in PD the motivation is to empower the users to take control over their work lives and hence to create a more democratic work environment. Secondly, UCD does not necessarily require direct participation of users in the design. Conversely, direct participation of users in the design is the central key of the PD approach. Thirdly, although UCD researchers are interested in developing methods and techniques to support the system development, this is not the main aim in UCD. PD researchers, as was mentioned before, put an emphasis on developing effective PD methods and techniques that can be used by others. Finally, as Kensing and Blomberg (1998, p. 181) highlighted, "PD research has an explicit organisational and political agenda". This is achieved through the explicit commitment to worker participation in design and "an effort to rebalance the power relations between users and technical experts, and between workers and managers".

The PD approach also has some limitations. These can be grouped into three categories which refer to methodology, methods, and practical limitations (Spinuzzi 2005).

Limitation of methodology. Some researchers argue that PD cannot lead to radical changes since the approach is grounded in traditional skills with the purpose of empowering workers. Another limitation is given by a predisposition to concentrate only on artefacts and to forget the overall workflow which appears in later PD work, such as cooperative prototyping.

Limitations of methods. Some researchers (Forsythe 1999; Cooper et al. 1995) consider that PD researchers often apply ethnographic methods in an inappropriate way which makes questionable whether they really understood the users or just project their own assumptions about users. Moreover, since the participants take

considerable control over the design, and the researchers strive to find a common language which is by its nature imprecise, then the research rigor is difficult to be achieved.

However, the limitations can be avoided if PD is properly applied, which implies that the results of the data analysis are continuously shared with the participants who co-analyse them and co-design the system accordingly.

Practical limitations. These limitations are given by the huge amount of time and resources, as well as the users' commitment required by PD. Since the researchers cede substantial control to users, PD seems to lose the structure and control on deadlines. Bertelsen (1996) reports how some of the users who failed to participate in a future workshop compromised the outcomes of that workshop.

While reflecting on a PD project, Blomberg and Henderson (1990) demonstrate how easily a design project can fail at all the three tenets mentioned in Section 3.2.2, even if it looks like a PD. Therefore, Spinuzzi (2005, p. 169) states that "Participatory design projects, despite their ceding of power and analysis to users, still must rigorously apply these criteria [*the three tenets mentioned in 3.2.2*] to have internal integrity".

3.3 Informant Design

Informant Design (ID), an approach situated between UCD and PD, was introduced by Scaife and Rogers (1997) to describe the child-designer relationship in their ECOi project focused on designing an interactive learning environment for teaching ecology.

3.3.1 The Informant Design Concept

ID empowers children and teachers with the role of informant at different stages in the design of an interactive learning environment. This means that children and teachers are not only users or simple participants, but they "are aware of aspects of learning/teaching practices that we are not and which we need to be told of" (Scaife

and Rogers 1997, p. 344). The role of informant maximizes their contributions without limiting them to a passive role.

3.3.2 Informant Design Stages

Scaife and Rogers (1997) introduce an ID methodological framework which contains four phases: *define domain and problems*, *translation of specification*, *design low-tech materials and test*, *design and test high-tech materials*. A summary of the roles of various contributors and the methods used is presented in Table 3.2.

Phase of Design	Informant/Design Team Contributor	Input	Methods
Phase 1 – Define Domain & Problems	Teachers	Specify learning goals; Identify teaching practices/difficulties; Compare conventional & multimedia materials	Teacher interviews Curriculum requirements Teacher Panel
	Children	Explain difficulties with learning particular topics for identified goals	Talk with pairs of children in school context with existing materials
	Psychologists	Analyse learning goals	Cognitive-Developmental analysis
	Design team (all)	Explore and define scope of interactivity	Theoretical analysis of external representations
	Software/graphic designer	Begin prototyping	Preliminary sketches and ideas for representing domain
Phase 2 – Translation of specification	HCI analyst and psychologist	Target high-level functionality of multimedia implementation	Cognitive and interactivity analysis
	Software/graphic designer and HCI analyst	Turn requirements into software specification and determine feasibility	Storyboarding, sketching, scenario creation
Phase 3 – Design low-tech materials & test	Psychologist and Designer	Work to create low-tech materials	Cognitive analysis
	Software/graphic designer	Flesh out spec. and test design assumptions	Make low-tech materials - paper cut-outs, etc.
	Psychologists and designer	Test validity of cognitive assumptions	Facilitate child design and evaluation
	Children	Provide insight on building interface and motivational factors	Design through scenarios, games, etc.
Phase 4 – Design and test hi-tech materials	Software/graphic designer	Flesh out and validate design aims based on output from above phases	Prototype hi-tech designs using multimedia programming environment
	Psychologist and HCI analyst	Test validity of cognitive and pedagogical aims	Cognitive analysis and pre-, during and post-tests
	Children	Evaluate interactivity and iterating designs	learning tasks
	Teachers	Verify whether prototypes are an improvement over existing methods	Try out the prototype, suggest how could be used in teaching contexts

Table 3.2: The methodological framework employed in Informant Design (after Scaife et al. 1997, p 345)

Phase 1: Define domain and problems. The activities at this stage were designed to understand the domain and the problems that children and teachers encounter, as well as the current computer-based technology and its potential benefits.

Phase 2: Translation of specification. At this stage the researchers were concerned with translating the problems identified in the first stage to afforded possibilities of the interactive software.

Phase 3: Design low-tech materials and test. Paper prototypes were built and explored with children in order to test a number of assumptions about the project. The designers' ideas were validated and a number of suggestions were collected.

Phase 4: Design and test high-tech materials. At this stage children and teachers provided feedback on a wide range of interface issues, such as the benefit of better narration, and cues for possible actions.

3.3.3 Benefits and Challenges of Informant Design

The ID methodology has been used in a number of projects (Xu 2005; Mazzone et al. 2008; Kim et al. 2011). The researchers emphasised the benefits of using ID, including: better understanding of users (children), their preferences and needs, collecting a number of suggestions which other groups of participants (e.g. teachers) did not mention.

One of the main challenges in applying ID is the children's inhibition created by talking to unfamiliar adults. Scaife et al. (1997) suggest working in pairs to help shy children to begin commenting on other children's ideas rather than starting from scratch. Another important challenge is related to the need to avoid making children feel as if they are not listened to, when the facilitator needs to join the discussion.

Finally, Scaife et al. (1997) are concerned about the effort spent in following every step in the framework. Although they are aware of their limited experience in using

this framework, they warn about the fact that omitting or spending less time on some stages (e.g. stage 1: define domain and problems) might compromise the process.

3.4 Action Research

Action Research (AR) is another participatory approach which researchers usually employ when trying to support practitioners who face a problem or a dilemma. AR is a well-known research methodology which links research and practice.

3.4.1 The Action Research Concept

AR has evolved from a broad range of disciplines such as education, economics, philosophy, psychology, sociology, and political science (Brydon-Miller et al. 2003). A commonality among action researchers is the collaboration between researchers and practitioners in a committed effort of bridging theory and practice “through change and reflection in an immediate problematic situation within a mutually acceptable ethical framework” (Avison 1999, p. 94).

Reason and Bradbury (2001, p1) define AR as: “a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities”. Another broadly accepted definition is provided by Carr and Kemmis (1986, p. 162): “Action research is simply a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out”.

The foundations of AR were set by the psychologist Kurt Lewin (Hockley et al. 2012) and became popular among USA researchers in the middle of the 20th century. Lewin defined AR as a spiral of cycles each containing planning, acting, observing and evaluating. He emphasised that the focus should be on a practical improvement:

“Research that produces nothing than books will not suffice” (Lewin 1948 quoted in Hockley et al. 2012, p. 4). AR was immediately adopted in the UK by a number of researchers who were interested in integrating theory and practice.

3.4.2 Action Research Principles

In a survey of the AR literature, Peters and Robinson (1984) identified four common principles which characterise this approach:

1. An orientation toward action and change;
2. A focus on problem solving;
3. A process which is organic, involving systematic and iterative stages;
4. A collaborative process among participants.

Self-reflective practice is an essential concept in AR, as AR involves practitioners and researchers reflecting on their own work. According to McNiff (2002, p. 6), AR is “a practical way of looking at your own work to check that it is as you would like it to be”. The AR process is seen as a helix that is directed to reach a higher level of understanding and achievement with each helix-coil. Hayes (2011, p. 4) states that “AR researchers are committed to the idea that knowledge evolves”. She describes the AR methodology as being iterative and open-ended with a main focus on implementing action (e.g. a process change, a new technology) and reflecting on the results of the change and emerged solutions’ feasibility. “The goal is not to arrive at the solution to a given problem, but to attempt to create a solution that is some way “better” than previous solutions and helps actors to learn through the action they take” (Hayes 2011, p. 7).

Foth and Axup (2006) reveal the similarities and the differences between AR and PD based on a design study that employed PD and a sociology study guided by AR principles. The main similarity identified by the researchers was the emphasis on collaboration through participation. However, PD and AR have different strategies and goals. Thus, while the PD study was classified as a targeted research toward the goal of understanding the needs of users and involving them in a collaborative process of design, the AR study was classified as immersive research which focused on inviting participants to critically reflect on a situation, and to collaboratively

improve it in an iterative way. Foth and Axup (2006) conclude that combining PD and AR may be useful as a study can benefit from the strengths of both of the approaches.

Persistent Collaboration Methodology

Persistent Collaboration Methodology (PCM), which combines UCD and AR, was introduced by Conlon and Pain (1996) to provide a framework for projects in applied Artificial Intelligence and Education (AIED). They argued that PCM is beneficial both for projects aiming to develop theories and techniques and for those aiming to build effective educational tools. PCM is conducted in four stages: *reflecting* on the problems and context, incrementally *designing* systems and practices (including goals and actions), *acting* through implementing the design, and *observing* the effects.

The methodology highlights three important dimensions in the development process: a strong relationship between theory and practice, ensured by the parallel development of the design and knowledge acquisition, an iterative approach to design, and an active and continuous collaboration between researchers, programmers and practitioners during the design and evaluation stages. At each stage, the participant groups bring distinctive contributions to knowledge and practice.

3.4.3 Benefits and Limitations of Action Research

The most important benefit of AR is that it bridges practice and theory by combining action and research (Brydon-Miller et al. 2003). Through collaboration among participants, AR can lead to a better understanding of practices and the context in which these practices are carried out. Another particular benefit of AR is given by the concept of reflection. Having practitioners and researchers reflect on problematic situations and contexts, leads to improvements both in practice and theory.

As in the case of the other approaches that involve participation, one of the limitations of AR is that it is time consuming (Kjeldskov and Graham 2003).

Another limitation comes from the immersion into the study, which makes it difficult for the researcher to remain objective (Brydon-Miller et al. 2003; Kjeldskov and Graham 2003). Also, since AR is focused “on local solutions to local problems” it becomes problematic for the action researcher to generalise the study outcomes (Hayes 2011, p. 16).

3.5. Methodology Framework

As mentioned at the beginning of this chapter, two main concerns were considered in devising the appropriate methodology for building the social story authoring tool: involving the users in the design and evaluation, and bridging the practice and theory related to social story interventions and autism. Nevertheless, the methodology has to take into account project constraints, the most important ones being those related to time and access to users.

3.5.1 The Rationale of the Methodology Framework

From the description of AR (section 3.4), it appears that this approach is a good one for solving a specific problem by engaging participants to critically reflect on their practices and improve them in a collaborative and iterative way. In order to improve the practitioners’ current approaches, it is necessary to find a way to inform the practice from theory and conversely. AR is suitable for bridging together theory and practice, when focusing on solving a problem.

This research created a framework of social story intervention based on research and practice with the purpose of informing the design of an authoring tool that enhance practitioners’ activity. The resulting tool was expected to introduce new features informed by theory. Therefore this is expected to create a change in practices. AR, through its orientation toward action and change, offers a framework for progressively introducing changes and reflecting on the results, but also for eliciting new solutions through reflection.

As mentioned in section 3.2.4, PD has its own advantages, as it focuses on understanding the needs of the users and empowering them to become equal partners

with developers in the design process. Moreover, it seeks for maximising the users' contribution through existing tools and methods, as well as creating new ones, in order to permit a common language that makes the interaction comfortable, and to blur the differences between users and developers/researchers.

Combining the two approaches, AR and PD, seemed to be the most appropriate methodology solution for the present project. Because of the project constraints it was clear from the beginning that it would be difficult to apply a full PD approach across all the project stages, for all the participants. Practitioners are people with a very busy agenda, being available only at certain times. This makes it difficult to include them in the design team for every design decision. Therefore, it was decided to create a framework that combines AR, PD and UCD, and which is inspired by the ID and PCM.

The focus on a specific problem (designing and implementing an authoring tool to support practitioners in social story interventions), the orientation towards action and change (by introducing a new technology) and the reflection on changes (through a number of studies with practitioners and researchers) were borrowed from the AT methodology. The focus was to equally create a usable tool (similar to the UCD approach) and to maximise the empowerment of the participants (as in PD). The methods and techniques from UCD and PD were carefully chosen, taking into account the available time, resources and access to the participants (practitioners and researchers).

Similar to PCM, the framework ensures a strong relationship between theory and practice, an active and persistent collaboration between practitioners and researchers, and an iterative approach to design and evaluation at each research stage. As inspired by the ID methodology, the degree of participation was somewhere between UCD and PD. Thus, the practitioners were empowered with the role of informant, when it was not possible to involve them as design partners (see the roles described in section 3.5.2). Researchers were involved persistently throughout the entire design process and evaluation. Thus, regular meetings with three experts in HCI, Education and ASC (E1, E2 and E14 - Appendix F) were conducted throughout all of the

design phases. The expert researchers team (ERT), which included also the PR analysed the results of the studies and took further decisions for the design.

3.5.2 Description of the Methodology

The authoring tool ISISS (Improving Social Interaction through Social Stories) was developed in a five-stage process. Figure 3.3 shows the five stages of the methodology framework: *define problem space*, *pre-design*, *design and explore low-fidelity prototypes*, *design and explore high-fidelity prototypes*, and *summative evaluation*. Except for the first stage, each of the other four stages is represented as a circle containing the four AR phases: *design*, *act*, *observe* and *reflect*. The evolution of the system (the outcome at each stage) is illustrating along the vertical coordinate. Each cycle can be iterated several times.

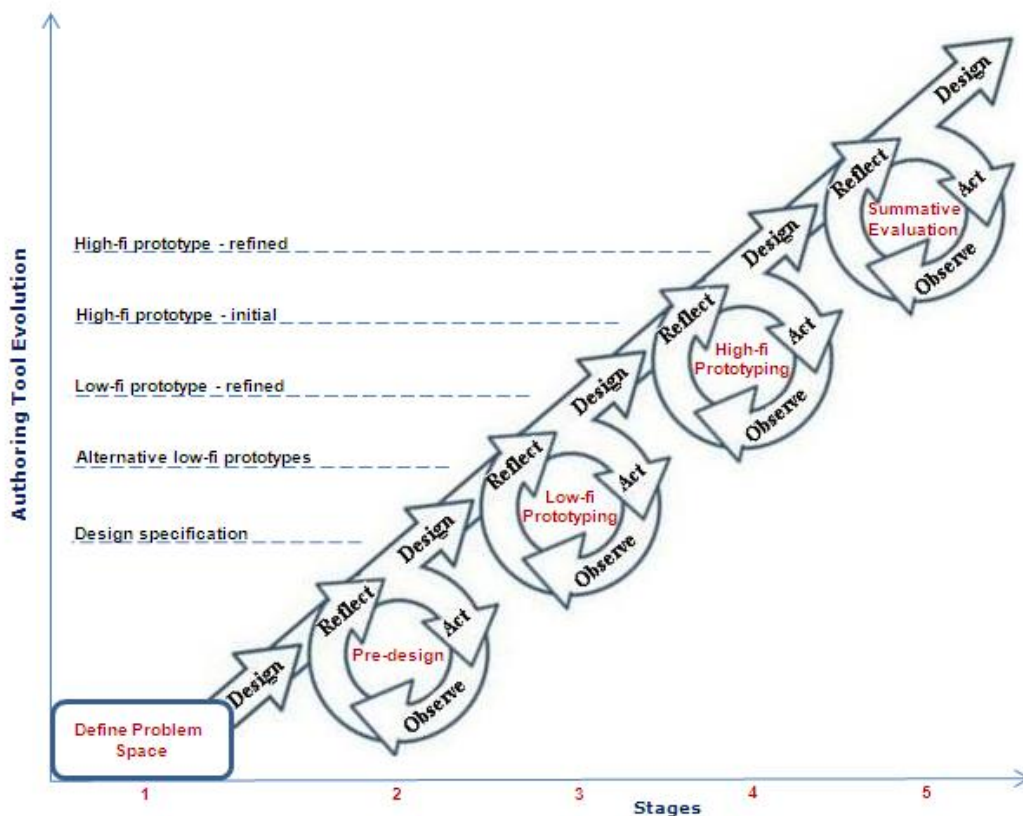


Figure 3.3: Methodology framework

Although the stages are represented sequentially, this is not the case in reality as the stages can overlap or even run in parallel. Also, in practice the phases are not distinct

as represented in Figure 3.3, but more fuzzy. For example, the reflection phase does not necessarily stop before the design phase begins.

The remainder of this section provides a high level description of the stages of the development process.

Stage 1: Define the problem space

At this stage a clear picture of the problem space was created before starting the exploration of the design space. This stage comprised:

1. a review of the relevant literature about social story interventions, the cognitive theories of ASC and their relations with social stories;
2. a review of the existing computer-based applications for social stories along with their benefits and limitations;
3. the identification of technological alternatives;
4. the identification of user groups and the problems they might encounter.

The outcomes of this stage were the identification of the scope of the problem space, and a set of initial ideas about the problems that have to be addressed and the ways in which they might be addressed. The research questions were also formulated at this stage. This stage is covered in chapters 1, 2 and 3.

Stage 2: Pre-design

The second stage was focused on understanding the current practices in social story interventions and the exploration of possible future practices. This stage involved 16 practitioners with experience in social stories and an expert researcher team (ERT) consisting of three researchers with experience in ASC, Education and HCI (E1, E2, E14-see Appendix F).

An initial focus group workshop involving 12 practitioners (see Appendix F) with experience in social stories was conducted to gain initial insight into the practitioners' procedures while working with children with ASC and developing social stories. The main aims were to understand the context of use, and to identify

whether there is a need for technology to support practitioners in social story interventions. Additional aims were to establish relationships with practitioners and to motivate them to participate in future studies. This workshop is described in detail in section 4.1.

An exploratory study with 4 practitioners (see Appendix F) was conducted in order to understand practitioners' procedures and practices during social story interventions. Think Aloud protocol (TA), observations and semi-structured interview were employed in this study. An additional purpose was to find out what technologies practitioners currently use for social story interventions and their benefits and limitations from the practitioner's perspective. This study is described later in section 4.2. The data collected were analysed using the Grounded Theory Methods which led to a framework for social stories. Scenarios, storyboards and use cases were employed in order to extract the initial high level requirements. The outcomes of this stage consisted of a set of design guidelines, and an initial set of requirements (see section 4.3.2).

The contribution of the participants at this stage of the project are summarised in Table 3.3.

Phase	Practitioners' contributions	Researchers' contributions
Design	Set or revise social story intervention Contribute to the revision of existing social story tools Discuss potential problems with researchers and technologists	Contribute to the revision of existing social story tools Support practitioners to understand the possibilities of the technology
Act	Develop social stories Use existing tools for social stories	Facilitate the development of social stories Support practitioners verbalise their thoughts
Observe	Look for patterns, exceptions and interesting cases	Observe tools in use Look for patterns, exceptions and interesting cases
Reflect	Evaluate current practices Identify problems in social story intervention Relate practice and theory	Support technologists in understanding practitioners' procedures, and problems encountered by practitioners and children Support technologists in understanding the theories behind social stories Relate theory and practice Devise design guidelines Devise requirements for social story authoring tool

Table 3.3: The contributions of the participants at the *Pre-design* stage

This stage answered the first research question: “*How do practitioners develop, present and assess social stories?*” A detailed description of the second research stage is presented in chapter 4.

Stage 3: Design and explore low-fidelity prototypes

Based on the design principles and the requirements obtained in the previous stage, two low-fidelity prototype alternatives were developed. The purpose of these prototypes was not to limit the design space, but rather to create starting points for exploring the space together with the practitioners. These prototypes were explored in 5 sessions involving 10 practitioners, each having experience in social story intervention for children with ASC (see Appendix F). The study was conducted in two phases. The first phase employed constructive interaction and observational methods, whereas the second stage employed brainstorming (see section 5.5.2). The main aims here were to explore the design space with the practitioners, to discover usability problems, as well as solutions for these problems, and to refine the requirements. Additionally, the study sought to elicit suggestions for further design and development. In order to make sense of the data collected, scribbles, scenarios, and use case refinement were used (section 5.5.6). The outcome of this stage was a set of decisions for design and refined requirements (see section 5.5.6).

Phase	Practitioners' contributions	Researchers' contributions
Design	Contribute to the design of the new social story tool Validate the requirements	Contribute to the design of the social story tool Support practitioners to understand the possibilities of the technology
Act	Perform tasks using the low-fidelity prototypes	Facilitate the use of the low-fidelity prototypes Support practitioners create scribbles for new features
Observe	Observe and discuss problems with other practitioner and with the researcher	Observe practitioners while using the low-fidelity prototypes
Reflect	Evaluate low-fidelity prototypes Relate theory and practice	Suggest solutions for problems Relate theory and practice Support practitioners to relate theory and practice Refine requirements

Table 3.4: The contributions of the participants at the *Design and explore low-fidelity prototypes* stage

The contributions of the participants at this stage are summarised in Table 3.4.

A detailed description of this stage is presented in chapter 4. This stage and the next one were conducted to answer the second research question: “*Can we develop computer-based technology that enables the development, presentation and assessment of social stories? If so, in what ways?*”

Stage 4: Design and explore high-fidelity prototype

Based on the outcome of the previous stage, a high-fidelity prototype was implemented. The formative evaluation was conducted in three iterations, involving practitioners with experience in social stories, and HCI, Education and ASC researchers. In the first iteration the study involved 5 practitioners (see Appendix F) and the main aims were to assess the users’ ease of use while interacting with the tool, to discover to what extent the designer’s mental model coincides with the user’s mental model, to identify any problems with the design which cause confusion both in functionality and usability, to find solutions to solve the problems and ideas to improve the application. The other 2 iterations involved 12 researchers in HCI, education and ASC (see Appendix F) and were focused on the usability problems,

Phase	Practitioners’ contribution	Researchers’ contribution
Design	Contribute to the design and refinement of the new social story tool	Contribute to the design and refinement of the new social story tool Support practitioners to understand the possibilities of the technology
Act	Perform tasks using the high-fidelity prototypes	Help practitioners introduce change Support practitioners verbalise their thoughts Help technologist implement the tool
Observe	Observe and discuss problems with the researcher	Observe practitioners while using the high-fidelity prototypes
Reflect	Evaluate high-fidelity prototypes Suggest solutions for problems Relate theory and practice Envision new practices	Evaluate high-fidelity prototypes Suggest solutions for problems Relate theory and practices

Table 3.5: The contributions of the participants at the *Design and explore high-fidelity prototype*

solutions, and suggestions to improve the tool (section 6.4). The methods used at this stage were cooperative evaluation, observation, and semi-structured interview.

Table 3.5 shows the contribution of the participants at this stage in each of the four AR phases.

The outcome of this stage was a working prototype to be used as a ‘proof of concept’ for how an authoring tool can be built in order to support practitioners in social story interventions better than current approaches (see section 6.5). This stage is discussed in chapter 6.

Stage 5: Summative evaluation

The high-fidelity prototype was evaluated as a ‘proof of concept’ to demonstrate that a social story authoring tool can be built and evaluated by experts as an improvement over the practitioners’ current approaches.

The summative evaluation study was conducted with 12 practitioners having experience in social story interventions with children with ASC (Appendix F). The authoring tool was evaluated against seven dimensions: *practitioners’ workload*, *social story customisation*, *child’s engagement*, *ease of use*, *effectiveness*, *efficiency*, and *user satisfaction*. This study was conducted in two phases as follows:

Phase I: At this phase the social story authoring tool was evaluated against all of the seven evaluation dimensions (see section 7.2). Cooperative evaluation, task-based evaluation, observations, SUS questionnaire and semi-structured interview were employed in this phase.

Phase II: The second phase consisted of a comparative study between the authoring tool and the other tools that the practitioners are currently using for developing social stories (see section 7.3). At this phase *workload*, *customisation*, *engagement*, *ease of use*, *efficiency*, and *user satisfaction* were considered. This phase employed scenario-based evaluation, and questionnaires.

Table 3.6 presents the contributions of the participants in each of the four phases of the summative evaluation stage.

This stage answered the third research question: “*Does the computer-based technology enhance the practitioners’ activity of developing, presenting and assessing social stories?*” and is covered in chapter 7.

Phase	Practitioners’ contributions	Researchers’ contributions
Design	Revise educational goals	Gather suggestions for further improvement of the design
Act	Perform tasks/scenarios using the ‘proof of concept’ prototypes	Help practitioners introduce change Support practitioners verbalise their thoughts
Observe	Observe and discuss changes with the researcher	Observe practitioners while using the ‘proof of concept’
Reflect	Evaluate the ‘proof of concept’ Relate theory and practice Envision new practices	Evaluate high-fidelity prototypes Support practitioners to relate theory and practices

Table 3.6: The contributions of the participants in the *Summative evaluation* stage

During the research stages the practitioners and researchers were empowered with different roles in order to maximise their contributions to the development process. Table 3.7 presents the roles played by participants as well as the methods employed at each stage of the project.

Stage	Participant	Roles	Methods
Define the problem space	Researchers	Investigator	Literature review Evaluating existing systems
Pre-design	Practitioners	Informant	Focus Group Think aloud Observations Interviews Literature review Review of existing social story tools
	Researchers	Design partner	Grounded Theory Methods Scenarios Use Cases Storyboarding Requirements meeting
Design and explore low-fidelity prototypes	Practitioners	Design partner	Paper Prototypes Constructive Interaction Interviews Brainstorming Observations Scribbles Scenarios
	Researchers	Design partner	Use cases refinement
Design and explore high-fidelity prototypes	Practitioners	Informant	High-fidelity prototyping Cooperative evaluation Interviews Observations
	Researchers	Design partner	Scribbles
Summative evaluation	Practitioners	Evaluator	Cooperative evaluation Tasks-based evaluation Observations SUS questionnaire
	Researchers	Evaluator	Scenario-based evaluation Comparative questionnaire Interviews

Table 3.7: Participants' roles and methods employed at the different research stages

3.6 Summary

This chapter discussed the research strategy for the design, implementation and evaluation of an authoring tool to support practitioners in social story interventions for children with ASC. The tool has been built with the participation of practitioners, and researchers in HCI, Education and ASC, who were empowered with different roles in different stages of the research project. The methodology employed AR, UCD, and PD approaches and was inspired from the ID and PCM. The next chapter describes the second research stage: Pre-design: Defining the Domain and Problems.

Chapter 4

Pre-design: Defining the Domain and Problems

This chapter describes the second stage of the research. The primary aim at this stage was to understand the current approaches in social story interventions and to bridge practice with research with the purpose of informing the design of the social story authoring tool. A focus group was conducted to get an initial insight into social story practices. This is reported on in section 4.1. Section 4.2 describes an exploratory study with four practitioners which aimed to get a better understanding of the current practices in social story interventions. Based on the empirical data collected in the exploratory study and on the research literature a framework of social story interventions was developed. Section 4.3 explains how the framework of the social story interventions was translated into a set of design guidelines and a set of initial requirements for the social story authoring tool. A short analysis of the authoring tools for social stories that practitioners currently use is presented in section 4.4. Finally, the roles and the contributions of each group of participants to this research stage are presented in 4.5.

4.1 Focus Group

4.1.1 Aims of the Study

An initial focus group workshop was conducted to get insight into social story interventions as they are currently used, and to identify if there is a need for technology to support practitioners in these interventions. Additional goals were to establish relationships with practitioners and to motivate them to participate in future studies.

4.1.2 Study Design

4.1.2.1 Participants

The participants were twelve practitioners (teachers, speech and language therapists and nursery nurses), all experienced in using social stories with children with ASC (see Appendix F for participant details). These practitioners work for VTSS (Visiting Teachers and Support Services), a service which aims to support children and young people with disabilities and their families, in Edinburgh. The participants in this focus group were part of a VTSS group which was focused on giving support to the practitioners who work with children with ASC in the schools in Edinburgh. The focus group was led by the Principal Researcher (PR)², supported by a second researcher.

4.1.2.2 Materials

All the participants received a leaflet with details about the project, a Discussion Questions Sheet, and a Consent Form (Appendix G). A presentation was prepared in order to give participants information about the main aims and motivation of the PhD research project.

4.1.2.3 Procedure

The workshop was conducted at the centre for VTSS centre in Edinburgh. This study lasted for 40 minutes and included:

- a. an introduction - PowerPoint presentation (5 min)
- b. a questionnaire (5 min)
- c. discussion (25 min)
- d. conclusion (5 min)

² The author

After a short presentation of the present project aims and motivation, practitioners were invited to answer a short questionnaire. The discussion, led by the PR, was centred on the questions they answered in the short questionnaire, which are:

1. Do you use social stories? If so how often?
2. When do you use social stories and what for?
3. What materials and technology do you use?
4. How could it be made easier for you to do this?

The workshop ended with a summary of the main discussion points by the PR.

4.1.3 Findings and Discussion

From the discussion and notes taken by a second researcher, the following conclusions were drawn:

1. A large number of practitioners use social stories in the schools in Edinburgh;
2. Practitioners use social stories often (at least once per week);
3. Usually they write social stories after completing the child's assessment based on information from teachers, parents and carers;
4. Some social stories, such as those addressing staying in line or taking turns are frequently used;
5. Sometimes practitioners re-use social stories written by themselves or by their colleagues;
6. All the practitioners tried existing computer-based tools for social stories, but they found them not flexible enough and user friendly (e.g. the language is too Americanised, the tool does not allow the user to customise the font size, customisation of the social stories is very limited);
7. Because of the difficulties encountered and the lack of support in the process of developing social stories, all the practitioners use now paper and pencil or Microsoft Word to edit social stories;
8. Boardmaker (Boardmaker 2014) and Comic Life (Comicliffe 2014) are two of the technologies practitioners use for social stories. These tools are built for visual educational materials and not specifically for social stories. Practitioners use them mainly for adding symbols to the social stories;

9. Practitioners are aware of Gray's guidelines for social stories, but they do not follow all of them. Some of the practitioners are not convinced of the effectiveness of some of the guidelines. Other practitioners, although they consider all the guidelines are important, cannot follow all of them because of the lack of standard tools to support their work. For example, although practitioners consider that checking the child's comprehension is very important, they find it difficult, partly because of the lack of a standard tool to do so.

10. Practitioners would value a computer-based technology to support and enhance their work while developing and using social stories.

This study confirmed that existing technologies do not meet practitioners' expectations and do not fully support social story interventions.

The results of this focus group suggest that, to better support practitioners, research is needed to systematically explore the current practices in social story interventions. Research is also needed to investigate whether a computer based tool could be developed to support these practices, incorporating existing research related to social stories.

4.2 Exploring Practitioners' Current Practices

An exploratory study with 4 practitioners was conducted in order to identify practitioners' procedures and practices during social story interventions, including the development, use and assessment of social stories.

4.2.1 Aims of the study

The main aims of this study were the following:

1. to better understand the process of developing social stories;
2. to identify the challenges encountered by practitioners in doing so;
3. to collect examples of social stories developed by practitioners, and typical content;
4. to identify the tools currently used to support social story development.

4.2.2 Study Design

The study was divided in two phases. The first phase used a Think Aloud (TA) protocol. Practitioners were asked to write a social story and verbalize their thoughts. Ericsson and Simon (1993) consider that the most objective way for data-gathering is to ask people to describe their actions during task completion. A key idea in TA is to have the participants express their thoughts without any change of the thought process. In the second phase of the study, the participants were invited in a semi-structured interview to clarify aspects related to the social story intervention. Practitioners answered a number of questions focused on their practices in developing social story interventions. A study session lasted for 2 hours (with 1 hour for each phase). All sessions were video recorded and the videos were transcribed for analysis.

4.2.2.1 Participants

The candidates for this study were chosen based on their experience in working with children with autism and experience in writing social stories. All four participants (P9, P13, P14 and P15-see Appendix F) had considerable experience in developing social story interventions for children with ASC (between 3 to 14 years). They frequently use social story interventions with their pupils. Practitioners P9 and P15 are visiting teachers working under VTSS. They are allocated to work in various schools in Edinburgh where the permanent teachers need their support for working with children with ASC. P13 and P14 work permanently in a primary school having a mixture of mainstream classes and special classes for children with ASC. All of the practitioners had participated in extensive professional development in the educational and autism fields.

4.2.2.3 Materials

Each participant received an information sheet and a consent form (Appendix H). Three of them used paper and pencil to write social stories during the study. One of the teachers wrote the social story on her laptop using *Communicate: In Print* software (Widgit 2013). This is a desktop application for visual materials with

symbol support from Widgit, a software company that promotes inclusion and accessibility through the use of symbols in learning and communication.

4.2.2.4 Procedure

Two weeks prior to the study the participants were informed about the study and asked to reflect on their practices and procedures in developing social story interventions. Specifically, they were requested to focus on a particular child and plan a social story for that child. P9 and P15 participated individually, while P13 and P14 preferred to work together, as they found it more natural to express their thoughts talking to each other, rather than verbalizing their thoughts alone. According to Als et al. (2005), having two participants at a time collaborating on the same task and verbalising their thoughts (which is known as constructive interaction, a version of TA), appears to be more natural than TA. Moreover Als et al. (2005) reported that the participants in constructive interaction were more productive than those in TA, especially when in pairs of individuals knowing each other.

On the day of the study, after each participant read the information sheet and read, completed and signed the consent form, she proceeded to write the social story and verbalise her thoughts. A fixed-position video camera was used to record the practitioners' activity, explanations and answers during the entire session. The researcher also wrote notes based on her observations during the first phase of the study.

First Phase

P9, P13 and P14 wrote their stories using paper and pen. They edited the stories later using the Microsoft Office Word editor and sent them through email to the PR. P15 preferred to write the story using Communicate: In Print (Widgit 2013) as she was

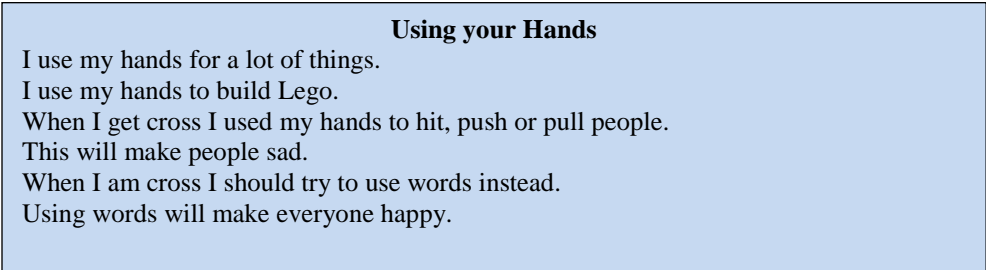


Figure 4.1: A sample of social story collected from the first exploratory study

familiar with this tool. Figure 4.1 shows an example of a social story written in this study.

Second Phase

The semi-structured interview questions were mainly focused on:

- i. the steps practitioners follow in social story interventions, from the initial preparation for writing a social story to the decision to end the intervention, including the assessment of the social story impact;
- ii. the challenges the practitioners encounter during social story interventions (development, use and assessment of social stories);
- iii. materials and technologies they use in social story interventions;
- iv. social stories format, content and length (number of sentences);
- v. most frequently used social stories.

The list of the questions asked in this interview can be seen in Appendix H.

4.2.3 Data Collection

During this exploratory study the data were collected from the following sources:

- video recordings during each session;
- social stories written by the participants. Details about the stories produced in this study are summarized in Table 4.1.

The data collected during this study along with a set of social stories provided by practitioners from their own archives, were analysed using Grounded Theory Methods.

Story Title	Target Behaviour	School Level	Number of Sentences	Story Layout
It's not appropriate to hit	Hitting people	Primary 4	12	Text and pictures
Soft play is fun	Promoting positive behaviour in soft play	Primary 1	15	Text and photos
Using your Hands	Aggressive behaviour	Primary 4	6	Text and symbols

Table 4.1: Social stories collected in the first exploratory study

4.2.4. Short Overview of Grounded Theory Methods

Design activity requires getting insights into the problem and the context. “Therefore, designers and design researchers alike might have a natural affinity towards qualitative methods” (Khambete and Athavankar 2010, p.10). According to Gay and Airasian (2003) a study about *how* and *why* things happen in a specific way would suggest that a qualitative approach would be appropriate.

However, there is a large range of methods to be applied in a qualitative analysis approach, such as Grounded Theory Methods (GTM), the general inductive approach, discourse analysis, phenomenology, and others. The choice of one or another method depends on the analysis goals and researcher’s position regarding the “theory” about the context of the research problem. Here, “theory” means a collection of concepts and relationships between them that give a broad explanation of the phenomenon or process (Saldaña 2013).

As a qualitative method Grounded Theory (GT) aims to create a theory emerging from data. It is usually employed when there is no theory or the existing theories are limited, or even when a new perspective to the existing understanding about a phenomenon is needed (Saldaña 2013).

GTM “consist of systematic, yet flexible guidelines for collecting and analysing qualitative data to construct theories ‘grounded’ in the data themselves...” (Charmaz 2006, p.2). According to Glaser and Strauss (1967) Grounded Theory Methods (GTM) represent a rigorous set of practices for exploring a new domain or a domain which lacks a dominant theory. However, Grounded Theory (GT) is not just a set of procedures to be followed in a study, but an approach which supports the researcher making sense of data (Charmaz, 2006) and offers methods to think about data (Glaser and Strauss, 1967) in an iterative way. Since Glaser and Strauss (1967) introduced GT in sociology, it has been adopted in other domains, being remodelled and adapted for various specific purposes. For example, in their study on various GT uses in Information Systems (IS), which included 126 empirical GT papers, Matavire and Brown (2008) identified four different approaches, as follows:

- a) “*Glaserian*” – a traditional inductive approach, that aims for extracting the theory from data, without pre-established ideas and processes;
- b) “*Straussian*” – which introduces preconceived frameworks and theories, as well as more directed research questions;
- c) *mixed methodology* – which aims to combine GT with other research methods (e.g. activity theory or action research);
- d) *technique application* – does not fall in any of the previous categories, but makes sense of data by applying GT methods, such as open coding, axial coding, selective coding, memos and diagrams.

4.2.4.1 The Reasons for Using GTM

One of the reasons for using GTM was that it allows the use of one or more types of data source, giving the researcher flexibility, an advantage these methods bring to a study. According to Furniss et al. (2011, p121): “More modern constructivist revisions of GT move away from traditional data-driven approaches, which seek to capture an objective view of the world. Instead they offer flexibility to co-create understandings with users and can employ HCI theories to explore and elaborate findings in a more top-down fashion.” (Furniss et al. 2011, p. 121).

Thus, it is possible to adapt the questions in an interview according to the information extracted from previous interviews. Also, data collection, analysis and coding can be conducted in parallel. So, the first chunk of data can be analysed and coded immediately, and the results can inform the next chunk of data, as well as the future analysis. However, the initial codes, categories and concepts have a provisional status, being subject to change, merge or discharge. The initial categories and concepts can be part of the theory only if they frequently appear in the following chunks of data. In GT constant comparison of the codes, categories and concepts is crucial in order to guarantee the rigour of the coding process.

Moreover, previous researchers' knowledge can be used to inform the development of the theory, although the theory should not be forced to fit pre-defined patterns. In order to produce a theory from data, the researcher should have a theoretical sensitivity which mainly consists of the capability to derive concepts from data and interconnect them (Glaser 1978). Thus, the literature review plays an important role in GT. In the early version of Grounded Theory it was thought that theoretical concepts should come only from data. Later approaches recommended that the researcher should have an open mind, with no requirement for the researcher to be a *tabula rasa* (Kelle 2007).

Another advantage of using GT is that it permits concepts extracted from data to be compared with those resulting from the research literature, yielding a unique theory based on practice and research.

GT has been increasingly used in HCI research for data analysis (Muller and Kogan 2010). GT has been used in a similar way in this study, that is, as a technique of analysing data which has been already collected. Therefore, all the GTM were utilized in this study (e.g. open coding, axial coding, selective sampling, memos, and diagramming) except the extent of theoretical sampling (see 4.2.4.6), as the number of participants was pre-determined.

The remaining of this section describes the essential concepts and methods which are used in GT, such as open coding, axial coding, selective sampling, memos, theoretical sampling and diagramming.

4.2.4.2 Open coding

Open coding, called also initial coding (Charmaz 2006, Saldaña 2013), seeks to identify concepts in data by closely examining discrete parts. According to Glaser and Strauss (1967), open coding uses constant comparison which is a parallel process of coding and analysis. As codes and categories become more and more numerous, constant comparison requires the researcher to think about data and to start conceptualising. In this process memos play a central role (section 4.2.4.5).

4.2.4.3 Axial coding

In axial coding the similar open codes are grouped into conceptual categories, based on the relationships between them. The concept of “axis” is understood as a category, “like the axis of a wooden wheel with extended spokes” (Saldaña 2013, p.218). The data may need to be re-coded after discovering a new category.

4.2.4.4 Selective coding

Selective coding draws the focus to a few more relevant codes which can grasp what “this research is all about” (Glaser and Strauss 1967, p.146). Saldaña (2013) also states that theoretical coding (which is another name for selective coding) consists of finding the core categories which capture the gist of the research.

4.2.4.5 Memos

Memos are essential in GT in order to develop the theory, to lead the researcher to the level of abstraction and to relate the emerging theory with other theories (Corbin and Strauss 2008, Glaser, 2004, Charmaz 2006, Stern 2007). “Theory articulation is facilitated through an extensive and systematic process of memoing that parallels the data analysis process in GT” (Glaser 2004, section 3.14).

Memos are not simple notes written by the researcher, but a means to reflect on data, categories and connections and to develop abstract thoughts about data. They prevent the analysts drawing premature conclusions about the new theory by slowing their pace and forcing them to reason throughout the research. Memos can be classified as:

- **code memo** - a note regarding an emerging code or category;
- **theoretical memo** – a note about the conceptual connection between categories;
- **operational memo** – refers to future directions of the research study and data collection strategies.

4.2.4.6 Theoretical sampling

Theoretical sampling refers to the collecting of new data which is relevant to the developing theory. The main idea in GT is that the concepts that emerge from previously collected data guide the researcher in the selection of the sources, type and sampling strategy for the future data. The reason is to narrow the focus on the emerging categories. According to Charmaz,, “Consistent with the logic of grounded theory, theoretical sampling is emergent. Your developing ideas shape what you do, areas you tap and the questions you pose while theoretical sampling” (Charmaz, 2006, p. 108).

4.2.4.7 Diagramming

Diagrams are useful for clarifying the relationships between categories. The use of diagrams during the axial coding can help the researcher find and explain the data patterns (Strauss and Corbin, 1998).

4.2.5 Data Analysis and Findings

For analysing large amount of text in GT it is necessary to break it into smaller chunks (samples) and work on each chunk separately (Saldaña 2013). In this case, it was naturally done, as the transcripts for each participant along with the social story created by that participant were comprehensible and meaningful chunks of data.

All the transcripts of the video recordings were carefully read and coded using Grounded Theory Methods (GTM): open coding, axial coding, selective coding, memos and diagrams.

The research literature was reviewed before this study, in order to prepare the researcher’s mind rather than to force the data into a pre-set framework. Having a theoretical understanding of the social story interventions was helpful for example in preparing the questions for the semi-structured interview.

According to Saldaña (2013), in addition to coding with labels or phrases the researcher should not rule out pre-coding the text using highlighting, bolding, underlining, coloured text or circling words or passages that are important for the emerging theory. These quotes can serve as examples to support future assertions. Bernard and Ryan (2010) suggest using rich text features of word processing software (e.g. bold, italics or underline) for the initial coding and categorization.

Now I will refer back to the first sentence about 'feeling angry' and give suggestion about **what he can do when feeling angry, things he can do instead of hitting.**

[the practitioner is writing the sentences for the social story]: 'When I feel angry I could go to my quiet corner. I could squeeze my bear.' (P9-teacher)

[**Comment:** *Replace the bad behaviour with something that the child likes*]

Figure 4.2: Sample from the initial coding

The coding process started by systematically reading each sample of data, identifying key words or phrases and highlighting them (Fig 4.2). Preliminary jottings were then added by using the “Comment” feature. Memos were useful to crystallise raw data into codes (see Fig 4.3).

In this study the open coding was conducted by using eclectic coding which usually combines two or more coding methods which are appropriate for the initial coding of the data (called the first cycle). In the present study eclectic coding combined attribute, descriptive, process, in vivo, and causation coding (see Table 4.2).

Attribute coding encodes the information about the data and demographic characteristics of the participants. Descriptive coding is a basic label that summarises

Finding alternatives/incentives

When writing a social story about negative behaviours the practitioner works for finding out alternatives to substitute that behaviour. For example, if the child hits other children and the story is meant to stop this behaviour, then the practitioner thinks of how to replace this behavior. In the first story, hugging the bear toy appeared to be an alternative, as the boy is fond of his toy. If the story is about positive behaviours, incentives are what practitioner is looking for by analysing the child's abilities and interests. "Finding alternatives/incentives" seems to be an appropriate name for open code.

Figure 4.3: Example of code memo

in a word or a phrase the topic of a passage. Process coding uses the gerund verb form to capture an activity/action contained in the data. In vivo coding uses the participant's own language to illustrate the main idea in the data. Causation coding captures the causal explanation for an outcome.

Practitioner statement	Open code
I am going to write a story for a boy who is in primary four,	1 Child class [attribute]
his age is 8.	2 Child age [attribute]
This boy has challenging behaviour.	3 Identifying the problem [process]
He often hits other children when he is stressed.	4 Stress > "hits other children" [causation] [descriptive]>[in vivo]
So, I am going to call this story " It's not appropriate to hit ".	5 Title [descriptive]
I always like to have a title for the social story so they know that this is what the story is going to be about.	6 Teaching with a title [process]

Table 4.2: Examples of open codes

An Excel table was used, with the labels/codes in the first column and the samples of data for each practitioner in the other columns. Once the open coding for a chunk of data was applied, the codes and the samples of data were written in the table. The table permitted easy comparison between labels and helped the researcher to find similarities and differences among practitioners. Some of the labels were merged while others were changed into more appropriate ones. The process was not linear. Thus, whenever a new code appeared, it was compared against the other codes and often the data was coded again to confirm that the codes were close to the data.

61 initial codes were produced in the open coding stage. Based on the relationships between them, these codes were then grouped under a small number of categories using axial coding (Fig 4.4). In this stage the aim was to look for patterns which cluster codes. According to Glaser (2004) the return to data is crucial in order to

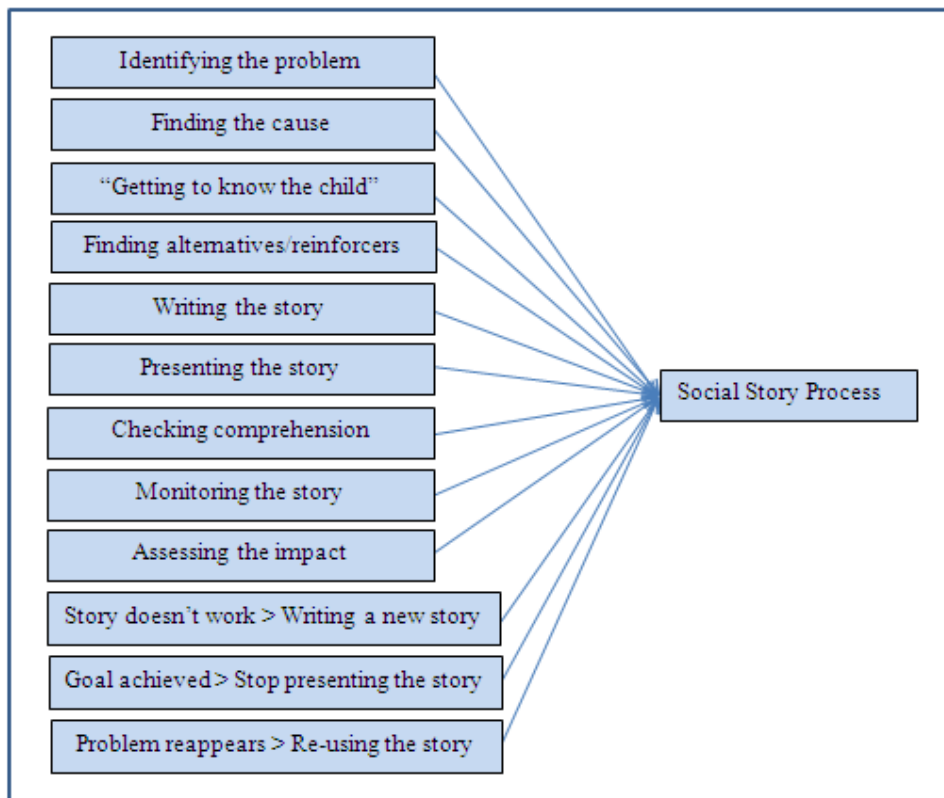


Figure 4.4: Example of axial coding

know the data very well. Thus, the data was re-coded after discovering a new category. Memos were written to help the researcher identify and reflect on the emerging categories (Fig 4.5).

The research literature related to social story interventions was reviewed and included in the analysis to create links between research and practice. In this case the role of the literature was that of ‘data’ which was coded in a similar way to the data collected from the exploratory study and integrated into the framework.

How STRUCTURE category is related to the other categories?

STRUCTURE appears to be a category that describes the format and length of social stories, as well as the types of sentences and the ratio among various sentences types. Presumably STRUCTURE can appear as a core category in the final cycle of coding. The length, format and content are related/determined by some of the subcategories in STEPS (see code/label “Getting to know the child”). STRUCTURE should also be connected with the category GOALS – these determine the content of the story, but also the format of the story and/or the length.

Figure 4.5: Example of theoretical memo

Memos were used to compare the codes and categories extracted from data with those that resulted from the literature review and were then used in creating a unique framework based on research and practice. Also, the similarities and discrepancies were highlighted in these memos (see an example in Fig 4.6).

Checking comprehension – theory and practice

The literature suggests that partial sentence in social stories may be used to make guesses about the next step in a situation or to anticipate what another will respond or what the child should respond, but also to check the child’s comprehension (Reynhout and Carter 2009). The teachers don’t have the technology to create partial sentences, although they use questions to get an answer from the child.

“... it's really good to get it from the child: 'What can we do when you're angry? We don't want you to hit! Ok, well, I know what you can do! You could squeeze something? What can you squeeze?' And then the child might say 'my bear!' So, you can get it from the child and it would be very rewarding for them because it's very much their story. I think, in fact, they've done it personally. [...] But, I think that's [*an application to create partial sentences in a social story*] a very good system way of doing it.” (P9)

“I would imagine this [*pointing to the story*] with gaps and Jack will fill out the words. Especially with “it’s ok to ...” and he gets the picture and he will be saying ... “run”. “It’s ok to ...” [*pauses*] “climb”. “It’s ok to ...” [*pauses*]. So, I would imagine this even with this story.” (P13)

These examples show that teachers appear to appreciate “that sort of technology” (P14).

Figure 4.6: Theoretical memo which reflects on the link between theory and practice

The main aim of axial coding was to find the core categories that describe social story interventions with the purpose of informing the design of an authoring tool that can support practitioners in social story interventions.

Category	Description
Steps	Steps followed in the process of social story interventions
Challenges	Practitioners’ challenges/concerns while working with social stories
Structure	The structure of the social story, including the format, length and content
Goals	The goals that social stories address

Table 4.3: Core categories in social story interventions

Finally, four core categories that describe social story interventions were identified using selective coding (see Table 4.3): steps, challenges, structure, and goals. These core categories cluster into 21 subcategories (see Fig 4.8). Since the purpose of this

analysis was to inform the design of a tool that supports practitioners in social story interventions, the selection was mainly based on how often the codes occur across different informants. For example, all the informants emphasised the importance of following certain steps in the process of social story interventions. Therefore, it became obvious that an appropriate core concept is “Steps”.

During the entire coding process memos were also written to envision future research or to think about the answers to various questions (see Fig. 4.7).

25 October 2012-Diagramming & Questions

After finally discovering the core categories I should think how to represent them in a diagram and to include the relationships among them. Diagramming is important (see examples in “The Coding Manual for Qualitative Researchers” - Saldaña)

Questions to think about:

- What are their implications on the present research?
- What are the main changes in the present research determined by this study? Why? ...

Figure 4.7: Example of operational memo

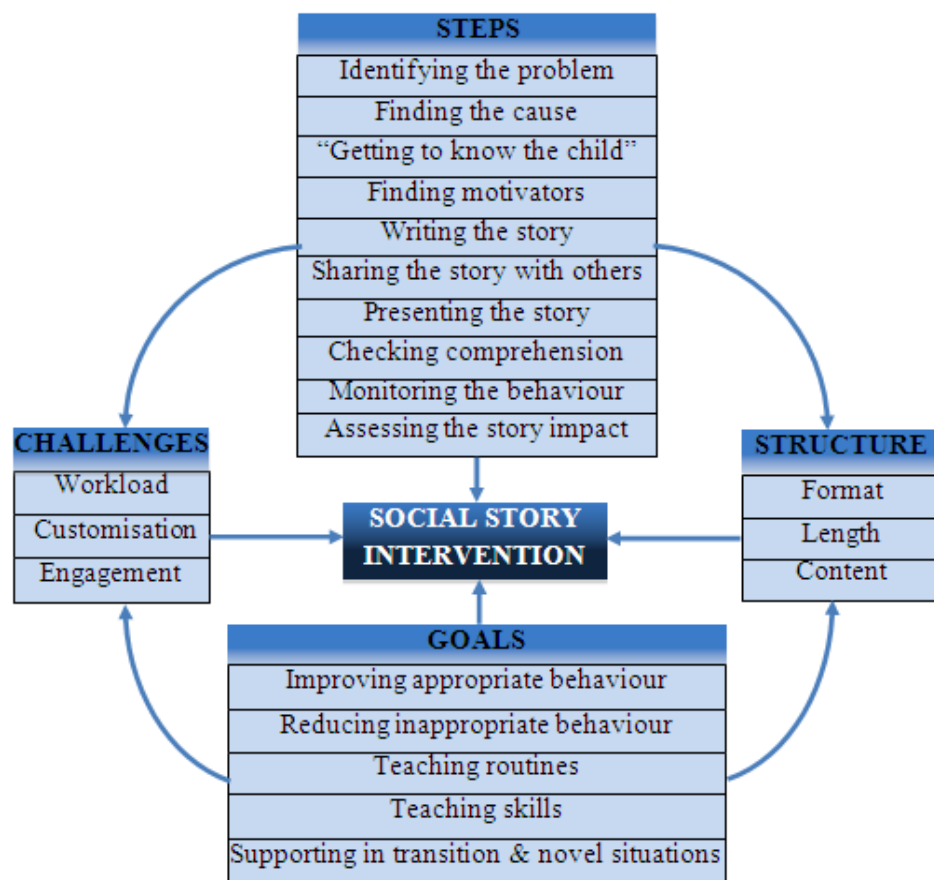


Figure 4.8: The framework of social story interventions

Based on the four core categories and the subcategories, as well as the relationships between them, a diagram was designed (see Fig 4.8). Since the purpose of this study was not to build a theory, but a framework of the social story interventions to inform the system design, the central core category was naturally chosen to be “Social Story Intervention”. All the four core categories are part of/included in “Social Story Intervention” which is illustrated through the central arrows. The exterior arrows suggest that “Challenges” and “Structure” are determined by “Steps” and “Goals”.

4.2.6 Discussion

This section discusses and exemplifies the four core categories which resulted from the analysis of data in this study, including the 21 subcategories and their connections. The discussion will also emphasize how these findings are reflected in the research literature.

4.2.6.1 Steps

The present study revealed 10 steps that practitioners follow when developing a social story intervention:

1. identifying the problem;
2. finding the cause;
3. “getting to know the child”;
4. finding motivators;
5. writing the story;
6. sharing the story with others;
7. presenting the story;
8. checking comprehension;
9. monitoring the story;
10. assessing the impact.

1. Identifying the problem

All the practitioners start by identifying the problem to be addressed in the social story. That is usually done either by the practitioner’s own observations or by others’

observations (e.g. staff members). Referring to how she identifies the problem to be addressed, a VTSS teacher reports:

“prior to ever writing this story, I often have contact with child, with the school staff and we have meetings where I take notes and this has to go into our files or records.” (P9)

Another teacher explains the negative behaviour of the boy for whom she writes the social story:

“We observed that Jack really enjoys soft play and, so, he is very motivated to do his work and then have his soft play as the reward, but our problem is that, once he is in the soft play, he’s not coming out. And that’s where we get a lot of negative behaviours; we get a lot of shouting, a lot of swearing.”(P13).

“The other thing I found out with Jack often is that what he is verbalizing is not the same as he is doing.”(P13)

About the same child, P14, the speech and language therapist, says:

“I have noticed that he tends to say something in a negative way while actually he is doing the positive. He might be doing the right thing, but saying no, no.” (P14)

P15 also describes the problem to be addressed in her social story:

“he’s using his hands a lot when he’s angry; he’s pushing and pulling people’s hair.”

Crozier and Sileo’s (2005) also outline this step in their six-step social story checklist (see section 2.3.2.1).

2. Finding the cause

After identifying the problem, a further step is to find the cause of that problem. That helps the practitioners to find out how to address it in the social story. For example, a teacher explains:

“I would get my information from talking with members of the staff and from getting to know the child so that I know that the reason he hits all

the children is when he is angry rather than he is doing because it is funny or any other reason.” (P9).

Teacher P15 also describes how she got information about the child and the cause that determined the negative behaviour:

“Joe was doing really well in the class. But H [a teacher] then got a frightening phone call saying: ‘Can you come and see him? His behaviour has taken a real nosedive we’ve got a review next week. Can you come?’ So H passed over to our team because it was more behaviour based [unintelligible] this time. Then I went into the class. I went and did two-hour observation of him in the afternoon. Then I attended his review straight after that. I gathered loads of information from that and there were loads that could be put in place. And H had done a quite a comprehensive program of support and strategy for him that had work, but the school, they had stopped using them because they felt he didn’t need it anymore. So loads of it is putting back in place what H already had in place, but trying to do it quite rapidly because his behaviour is at that point of being at the risk of exclusion. So that’s how I would gather information, mainly through observation at the moment.”(P15)

The speech and language therapist talks about the cause that determines the problem which is addressed by the social story:

I have noticed that he tends to say something in a negative way while actually he is doing the positive. He might be doing the right thing, but saying no, no. Perhaps he is using some learned behaviour about the situations, while still doing the right thing, which is good.”(P14).

Teacher P15 discusses how she collects data about the child’s behaviour:

P15: I’d been looking for them [incidents] to give me a baseline of behaviours; so counting how many behaviours or incidents they [children] had.

R: So, do you count this or somebody else counts the frequency?

P15: Usually the learning assistant or the teaching assistant.

However, as teachers acknowledge, the information about the behaviour frequency is not always recorded: *“They [learning assistants] are not always recording it.” (P9).*

Similarly, Crozier and Sileo (2005) identifies “Conducting Functional Assessment” as the second necessary step for effective social stories. This step consists of understanding the picture of the behaviour and finding the cause of the target behaviour (the behaviour which is addressed by the story). They suggest that an

accurate way of assessing the behaviour is to find the frequency of that behaviour and its duration over several days. This can serve as a baseline to compare with the frequency and duration of the child's behaviour in different moments during the social story intervention and to determine the effectiveness of the social story.

3. "Getting to know the child"

All the practitioners mentioned that an important step before writing the story is to collect data about the child in order to know him better. In other words at this step the practitioner attempts to create a profile for that child. This is usually done by observing what the child likes or dislikes, what are her strengths and weaknesses or talking to other staff members. One of the teachers reports what information she gathers about the child:

"I think that assessing the strengths and weaknesses in this situation is about getting to know the child, getting to know what makes the child tick, what do they like, what do they enjoy doing, when are they happy and when are they unhappy, what do they not like." (P13)

She also emphasized the importance of communication with the other members of the staff in order to get an accurate 'picture' of the child:

Well there is a lot of communication between people that are working. So, for instance, we got a speech therapist coming in, we've got nurses, learning assistants, class teachers, so keeping communication, making sure we are sharing all the information gathered. There might be particular members of the staff, so for instance the person that generally goes to toilet with Jack ... assists Jack at the toilet ... She might know the behaviours there. It's a case of trying to bring all the pictures together. (P13)

The visiting teacher from VTSS P9 explains that she tries to know the child, but she also discusses the child with the other staff members in order to get the necessary information to put in the story:

"... if I think the information is not [enough] I would get my information from talking with members of the staff and from getting to know the child" (P9).
"It could be parents, teachers and other staff in the school who are involved. Sometimes maybe the deputy teacher or the support for

learning teacher or other teachers who aren't always in the classroom might have a large involvement with the child. They might be involved in planning, or discussing, observing.” (P9)

“When I work with the child in a group of one-to-one I write notes and this also go into my file. So, I draw on all this information from different areas of my file. So, it is recorded somewhere but, not necessarily for the social story.”(P9).

Teacher P15 emphasises the importance of creating a clear profile for the child, including her academic and language skills, by consulting other members of the staff:

“You would have to know the child really, really well I think, before you start to implement that kind of story” (P15)

“It's by observing him in the class, what's the sort of things he likes to do, it was quite obvious from watching him. He is quite an active child; he likes to learn by doing. I would like to eventually get some more information from other agencies for example his speech and language therapist, [...] to get some more standardised data on him, as well just to see where his levels are academically and his language skills.” (P15)

4. Finding motivators

Based on the child's profile, the practitioners determine how the negative behaviour can be replaced (finding alternatives), or what can be the reward for the child (finding reinforcers) in order to motivate her to follow the story. In the next excerpt the teacher writing a story for a child who hits other children when he is angry, explains how she found an alternative to that inappropriate behaviour:

“Now that I've described the situation I might have suggestion (maybe) about what they can do instead. Now I will refer back to the first sentence about 'feeling angry' and give suggestion about what he can do when feeling angry, things he can do instead of hitting. [writing]: 'When I am feeling angry I could go to my quiet corner. I could squeeze my bear'. These are things I might know about because through talking to the staff in the school we have agreed he will have these things.” (P9)

Practitioners P13 and P14 who participated together in the study discussed finding a “motivator” for the child:

P13: *Could we think of some kind of motivating thing that he can do in between?*

P14: *Absolutely!*

P13: *So, between the ball pool and get back in the classroom, if there was something ...*

P14: I think you could have something motivating on the spot and then go to the classroom ...

P13: Even if it was some sort of reward sticker or something...

P14: (interested) Is he motivated by stickers?

P13: Yes, he likes stickers, or tokens ... So stickers and tokens.

P14: So we've got our motivator immediately to get him out of the ball pool which is a token or a sticker and then we will need a timer and then when the time is down ...

P13: He is also quite motivated about the timer sound because he likes watching them and he likes calling out with: Timer is up, timer is finished.”(P13 and P14)

5. Writing the story

After getting a full ‘picture’ of the behaviour, but also the ‘picture’ of the child (including his strengths, weaknesses, likes, dislikes, etc.), practitioners start writing the social story. The practitioners in this study highlighted the importance of having an appropriate title for the story, specific to the child which clearly represents the content of the story:

“I always like to have a title for the social story so they know what the story is going to be about. When I begin, I make it very specific to the child. “(P9).

The importance of having a clear meaningful title is also included in the Gray’s guidelines (Gray 2004). In her guidelines about writing a story Gray (2010) considers “Teach with a title” as being an important step: “Whether as a statement or a question the title identifies and reinforces the most important information in the Social Story” (p. 113).

When writing the story, the practitioners adapt the font family and size to the child’s needs and skills (see also section 4.2.6.2).

While writing the story the practitioners consider the ‘5Wh and H’ questions: where, when, what, why and how. These are reflected into the story content, though not all ‘Wh’ questions are answered:

Sometimes when I am angry (when) I hit other children (what). If I don't hit other children they might want to play with me.' (why)

'When I am feeling angry (when) I could go to my quiet corner (where). I could squeeze my bear' (how) (excerpts from the social story written by P9)

This observation is also in line with Gray's guidelines described in section 2.2.1.

The social stories are tailored to the child's needs, skills and interests in terms of content, length and format (see sections 4.2.6.2 and 4.2.6.3).

Talking about the language used in the social story, the speech and language therapist says:

"It depends how able the child is with reading and understanding language. I try to keep the sentences very simple so the message is very clear."(P14)

Teacher P15 warns about the literal interpretation of the sentences: *"you would have to be so careful about the literal interpretation of things [...]. That's why I tend to stick to quite factual things"*.

Some of the practitioners prefer to write the story with the child:

"We usually have the child and talk about it [story] together. [...] the teacher and the child, sitting together and you write it with the child and you find out how the child relates or is thinking about that situation." (P14 referring also to P13)

while others prefer to write it alone:

I would probably think it's a good thing to do that [to write the story with the child], but generally I don't. It's something I write myself. (P9)

6. Sharing the story with others

Practitioners prefer to edit existing social stories rather than write one from scratch, if appropriate. Teacher P9 commented:

"Sometimes I adapt one I have already written. So maybe, now that I have this story I go to another school and there will be another child who has similar difficulties or maybe they are younger or older or do something that is different than this situation and then I can just adapt

something I have already written. This makes my work a lot easier than starting from scratch.” (P9)

Teacher P15 admits that she prefers to re-use existing social stories, adapting them when necessary:

“If I can find one that’s already been written and I agree with the way it’s been written I will use it. I don’t try and reinvent the wheel really if I don’t have to. So I always do a quick research on the internet to see if there’s a decent story out there and adapt it if necessary. Otherwise I do my own one.”(P15)

7. Presenting the story

Usually practitioners print the story, laminate it, and present it to the child. Sometimes social stories are presented on the computer if the child has affinity for it. The visiting teacher P15 emphasises that: *“if they had a particular interest in computers would seem silly to not use it”*. However, a hard copy is available in case there is no access to a computer:

“I would also have a paper copy available as well because the kid might be out and about and not have access to a computer so I would have the paper copy as well. I tend to take a copy in to the school and give it to the teacher and the learning assistant.”(P15)

The practitioner reads the story if the child is not able to read himself. If the child has the ability to read, then they will encourage him to read it. However, practitioners take into account the child’s preference, as P9 and P13 commented:

“With an older child who's more able and I might gave them the option to read it: "Would you like to read it to yourself quietly?" or "Shall I read it to you? Some children find it funny when I read because I'm reading my name is...and I'm saying the child's name so that makes them laugh. I don't know what's recommended there, that's just how I approach it. I'm not sure if it's right or wrong but that's how I'll do it.”(P9)

“The other thing that he really likes is that he likes us reading social stories to him.” (P13)

The story is often presented to the child once and sometimes even more times per day around the time when the behaviour is likely to appear. One of the teachers reported:

“I have used the story twice on Friday. Both occasions have been at times when a motivating activity followed so increasing the chance of a successful outcome. I will continue with the story this week and stick with times when he is most likely to want to comply.” (P13)

Another teacher explains that they used to present a social story twice or even three times per day in moments when the child was calm and could ‘process the information’:

“So we thought about presenting it at more neutral times when he can actually process the information that’s in the story and then perhaps afterwards when he’s calmed down from having a challenging incident. Then revisit the story again and talk about how that relates to what’s just happened, but to wait until he calmed right down again rather than just giving it to him.” (P15)

“I would usually advise to read it at key times for example in the morning after break and the afternoon...twice, even three times per day.”(P15)

The length of the intervention varies widely from only two times (in exceptional cases) to months or even the whole year. The teacher P15 summarises her experience:

“... when I was a class teacher, I had children who would maybe have their social story for the whole year. Just read to them in the morning to sort of set them off for the day and it became part of their routine that they would search it out as well. [...] the shortest one was a little girl who was eating play dough and she read it twice and stopped. She understood it. Nothing else would work. The social story just seemed to work. She read the social story twice and she’s never eaten play dough again. The play dough was available there for her, but she just never did it. It was bizarre. I’ve never seen it work that fast but it did in that case. It was amazing. (P15)

Gray and Garand (1993) also emphasized that some children may have the story daily during more weeks or even months, while others may learn very fast and then they do not need the social story anymore. Some children need occasionally to revisit the social story over some time.

8. Checking comprehension

Practitioners check the child's comprehension after they introduce the social story. A teacher reports how she checks if the child understands the social story:

"... by asking questions about the story, checking that they have understood. For example: 'If hitting other children, how you think they will feel? What can you do to make yourself feel better?' and they could hopefully refer back to this things that you have mentioned in the story and the more you read the story the more familiar they come with the words and the pictures are very clear, too. So, when you ask them they can quickly glance and see the picture and say 'Well, I can squeeze the bear'. So, that will make me check their understanding that way if the message is getting through them." (P9).

Crozier and Sileo (2005) suggest checking comprehension by asking the child a few questions after the first presentation of the social story. Gray (2003) recommends partial sentences story to check child's comprehension.

11. Monitoring the behaviour

Once the story is introduced, practitioners collect data on the target behaviour through observations. One of visiting teacher from VTSS explains how she collects these data:

"In my case it's often monitoring the child's behaviour through the members of staff that are working with that child every day and they will tell you when it's appropriate to stop." (P9).

Teacher P15 describes how the story is monitored by using a tally mark sheet:

"We usually put in quite a lot [tally] ... but then seeing if it reduces down the behaviour we're using the same sort of tally mark sheet then slowly, if it's effective, fading out gradually." (P15)

Crozier and Sileo (2005) recommend collecting data immediately after the social story is implemented. If possible data should be collected by more people to ensure they are reliable and objective.

12. Assessing the story impact

Based on the data collected during the social story intervention, practitioners assess the story impact on the child's behaviour. They decide to stop the story if the story was successful, for example if a negative behaviour does not appear for a while. They keep observing the child behaviour after they stop presenting the story. If the behaviour reappears the story is presented again. A teacher describes how the story is assessed:

"... we just monitor and if it hasn't happened for two weeks then maybe we don't need the story and maybe if that happens again than after another week after we stopped we'll return to the social story. So, it's really about observing the child and monitoring that way." (P9).

If the story does not work the practitioners write a second version of the story:

"if it doesn't work, we would have to revise it." (P14)

"And then, if we use the social story and has no results, we will have a social story number 2" (P13).

When the story is effective (the behaviour disappeared), practitioners do not stop the story, but increase the time between two successive presentations of the story:

"I would keep using it. I would maybe start to reduce how often the story was read. I would fade it out rather than stopping it dead. If it started to fade out and you start to see the behaviour increase again we would fade it back in. So it's quite negotiable where it stops, if it stops." (P15)

Gray and Garand (1993) suggest fading the social story by increasing the periods of time between readings or by rewriting the story and omitting or modifying some sentences. This is done taking into account the child's needs and skills.

4.2.6.2 Challenges

This study revealed three common challenges encountered by practitioners when developing social stories: practitioners' workload, story customisation and child's engagement.

Workload

Practitioners' workload was defined as the effort expended (both mental and physical) to achieve certain goals (e.g. developing a social story, or assessing a social story). Practitioners describe the process of building a social story as being demanding. They spend sometimes hours to collect materials, to write the story and to refine it not only in terms of content but also in format, font features, pictures size and position. The mental effort is also very high as they have to keep in their mind a lot of information: *"So, you have to do a lot of thinking before you start writing it."* (P14). A teacher explains:

"there's a lot that goes on in my head but it's very much thinking about that child, what works for them, what their occupations are, what their needs are, what situation is, why it's happening and all of these things. So, yes, that's part of the process I think." (P9)

Customisation

Customisation refers to tailoring the social story (e.g. pictures, font features) to the child's needs and skills. A teacher explains how she adapts the font features and the story format:

"What I'll do next is I would probably type it and use fonts which are easy for the child to read. Depending on the child age I will type bigger or smaller. Sometimes, if there is a very young child there will be a sentence with a big picture on each page or for other children I might have a page of writing with small pictures beside the sentences." (P9)

The pictures are chosen to be appropriate for that child, and children are asked to choose the picture themselves:

"... they can choose the picture, you can say you want this one and this one, and then they can make it personalized, individualizing it themselves" (P14)

The language is made specific to the child:

"I might amend my language depending on the child and how old they are, as well. [...] Jack doesn't have very good language, which is roughly the two word level, so we should keep it quite simple." (P14)

“If a child was at nursery or maybe knew a few words then I make it very very very simple.” (P9)

Customisation can be sometimes more specific, addressing the child’s feelings:

“it really depends, you can make it more specific depending on how they are feeling.” (P9)

In order to motivate the child to follow the story, it has to include elements (images or words) that the child likes, recognises, or are in his range of strengths:

“In this case, for example, I used things I knew he liked like rabbit, Lego, and star wars, which I actually got from his parents. I said: what are his predictable strengths, what he enjoys working with? So it’s more personalised for him so that he has, he recognises something of himself in the story because otherwise it could quite cold, quite dull, so I was looking for that.” (P15)

A teacher reports that: *“I am using a reward system in conjunction with this [the social story]”* and then she explains:

“... he can earn up to six tokens. And these tokens are going to be exchanged for a half an hour or however, each token will be worth 5 minutes of an activity of his choosing.” (P15)

According to Gray’s (2004) guidelines the social story should be highly customised both in format and content to the individual abilities and interests.

Engagement

A common concern is to create social stories which are motivational for children and which engage the child. This is done by rewards or by customising the story to the child’s interests and familiar context. A teacher commented:

“we think about something that motivates the child and add it to the social story such as my previous suggestion of a .. hitting chart as an reward, and if I have 3 smiley faces on my chart I can have a play time or something that they will like, or something of soft play or some time with a friend, or extra time at the computer, something like this. This will be their motivation so, if I don’t hit I might get one of this wonderful things. Often, this is how we might see the ways of motivating them in pictures.” (P9).

Gray (2004) suggests using partial sentences to increase children motivation. Practitioners confess they sometimes attempt to use partial sentences stories, but only orally, mostly to check child's comprehension on social story. They recognize the benefit of having partial sentence stories which gives the child the sense of ownership. For example, one of the teachers said:

"... it's really good to get it [the word] from the child: 'What can we do when you're angry? We don't want you to hit! Ok, well, I know what you can do! You could squeeze something? What can you squeeze?' And then the child might say 'my bear!' So, you can get it from the child and it would be very rewarding for them because it's very much their story." (P9).

The speech and language therapist envisions the potential of technology in support partial sentence stories:

"...sometimes you can leave spaces such that the child writes the word... I think they have a better sense of ownership of the story [...] if you have that sort of technology" (P14).

Teacher P13 suggests how the story they have just created can be developed further by introducing partial sentences:

"I would imagine this very quickly with gaps [missing words] and Jack will fill out the words. Especially with 'it's ok to' and he is got the picture and he will be saying ... 'run'. 'It's ok to' [pause] 'Climb'. 'It's ok to' [pause]. So, I would imagine this even with this story." (P13)

4.2.9.3 Social Story Structure

The structure of the story came up as another core concept which includes: format, length and content.

Format

The format refers to the layout of the page, in other words, how the text and the pictures are presented on the page. From the interviews and from the social stories collected four formats of social stories were identified:

1. ***book story*** which usually contains a sentence and an image per page.

A teacher reports: “*For example, we make books for children who come from nursery to primary school.*” (P9)

2. ***text only*** which contains only text. This is usually used for elder children with a high level of understanding;

Teacher P9 comments: “*I think that with older pupils, secondary maybe, I would just have a page of writing.*”

3. ***more sentences and images on one page*** which might have different layouts. Teacher P13 explains that: “*I think I would always have 2 – 3 pictures in [the story]*”. Analysing the social stories collected, two layouts appears to be more frequently used and these were called:

- a. “*Stacked pictures*” – where the picture is above the sentence and is followed by one or more sentences;
- b. “*Parallel pictures*” – where the picture appears aligned with the sentence on the right side.

4. ***pictures only*** which is rarely used.

Teacher P9 explains: “*I have used it less [pictures only stories], but it may be only a series of pictures.*”

Length

The length refers to the number of sentences contained by a social story. By definition, a social story is a short story (Gray and Garand 1993). Practitioners reported that they try to keep the social stories as short as possible, but the length of the story depends on the situation and child. When asked what the minimum number of sentences she used in a social story, a teacher answered: “*probably three sentences*” while for the maximum number of stories she said she uses seven sentences. The stories collected from the participants had a number of sentences between 4 and 28.

In their review on 18 studies on social story interventions, Kokina and Kern (2010) found that the number of sentences ranges between 6 and over 30 sentences, with 50 % of the stories having 10 or fewer sentences.

Content

The content refers to the type of sentences used (according to Gray's guidelines), the language (e.g. literally accurate), the richness of the vocabulary used, and the use of flexible words (e.g. *sometimes* instead of *always*, or *I would try to walk in line* instead of *I will walk in line*).

During the social story writing, one of the teachers kept tracking the types of sentences and calculated the ratio between the sentences:

So far I've got three descriptive, one perspective, one directive; so I've got two [two directive/control sentences to be in the Gray's ratio] I can play with. (P15)

She acknowledges that she trusts Gray's recommendations: "*they've obviously done studies on it and found that that's the ratio that works and I think for that reason, that's good enough for me to follow that ratio to be honest.*"(P15).

Three of the practitioners said they try to think about Gray's guidelines regarding the ratio between the different types of sentences, but they do not stick to that rule as sometimes may be very hard to respect it:

"I think that makes it quite powerful. Keeps it tighter and gives the right sort of balance. So, I try to, I am not sure that I always stick to it [smiles], but I try to be in that sort of ratio. I like the balance of descriptive, directive, perspective, but that's the one that can be sometimes hard to write ... and then the affirmative. The affirmative clause is also important."(P14).

The other practitioner commented that she does not consider necessary to respect this ratio:

"I wonder sometimes if it worth doing that [respecting Gray's ratio]."(P1)

The language should be simple in order not to produce confusions, and literally accurate. Thus, using flexible words like ‘sometimes’ or ‘usually’ is recommended:

“good to use words like 'sometimes' or 'might' or 'usually' because this is a suggestion” (P9)

Teacher P9 explains further:

“And I am using 'I will try' instead of saying 'I will not hit other children' because if they fail [the children], and some of them will fail, it will make it easier for them. Some children with autism might put pressure on themselves, they will fail sometimes at the beginning and this makes it easier for them until they learn and they stop pitying.” (P9).

4.2.6.4 Goals

According to Kokina and Kern (2010), the social stories they examined address four goals:

1. improve appropriate social behaviours;
2. reduce inappropriate behaviours;
3. teach academic/functional skills;
4. assist in transitions, novel situations, reduce anxiety.

Based on the practitioners’ answers and the social stories collected, the social stories were classified in five groups with respects to the goal addressed:

1. Improving appropriate behaviour (e.g: lining up, sharing);
2. Reducing inappropriate behaviour (e.g. hitting other children, licking people);
3. Teaching routines (e.g. washing hands, going to bed);
4. Teaching skills (e.g. how to be flexible, self-control)
5. Supporting in transitions and novel situation (e.g. nursery to primary school transitions, transition between classes at school).

4.3 Informing the Design of Social Story Authoring Tools

From the exploratory studies described before resulted that **practitioners would value a social story tool to address their challenges encountered in social story**

interventions and to support them during the writing, assessing and presenting social stories. Therefore, the framework for social story intervention, developed in section 4.2.5, has been translated into a set of design guidelines and a set of high level requirements of the social story authoring tool (see Fig 4.10). A set of conceptual scenarios has been created, with the aim of covering the major uses and functionalities of the emerging tool. A conceptual scenario is a story of users performing tasks expressed at a relatively abstract level (Johnson and Henderson 2011). Here is an example of conceptual scenario for the social story tool:

Mrs Brown created a story called “Sharing” for John Smith in a book story format. She decided to present it to the child, based on a daily schedule on computer. She starts the social story tool. She looks for the individual stories written for John Smith. Next, she selects the story “Sharing”. She needs the story to be read by computer. She adjusts the volume before she starts presenting it. Then, she presents it to John. John goes through the story page by page. Each sentence is read with a Scottish female accent.

4.3.1 Social Story Design Guidelines

The three main challenges for practitioners were translated into design guidelines to guide the design of tools for social story interventions, whereas the other three core concepts were used to derive the requirements to address these guidelines (see Fig. 4.10).

- 1. Ease the Practitioners’ Workload.** A major challenge that practitioners encounter is the time spent in preparing educational materials. Although social stories seem to be less demanding than other educational strategies, the whole process of preparing, writing, presenting and assessing a social story is labour intensive. Therefore the practitioners need the social story tool has to be simple and intuitive, and has to help them organize their work and support the steps in the development process. Also, social stories have to be developed with less effort and in less time compared with the current approaches. The practitioners identified that the tool should allow them to reuse social stories, symbols and photographs and to monitor the impact of social stories on children. Data about the child’s progress should be accessed and presented in various ways, enabling practitioners to get new insights into

the child's behaviour and assess the success of the social story. Practitioners can choose to annotate the sentences according to the six types of sentences

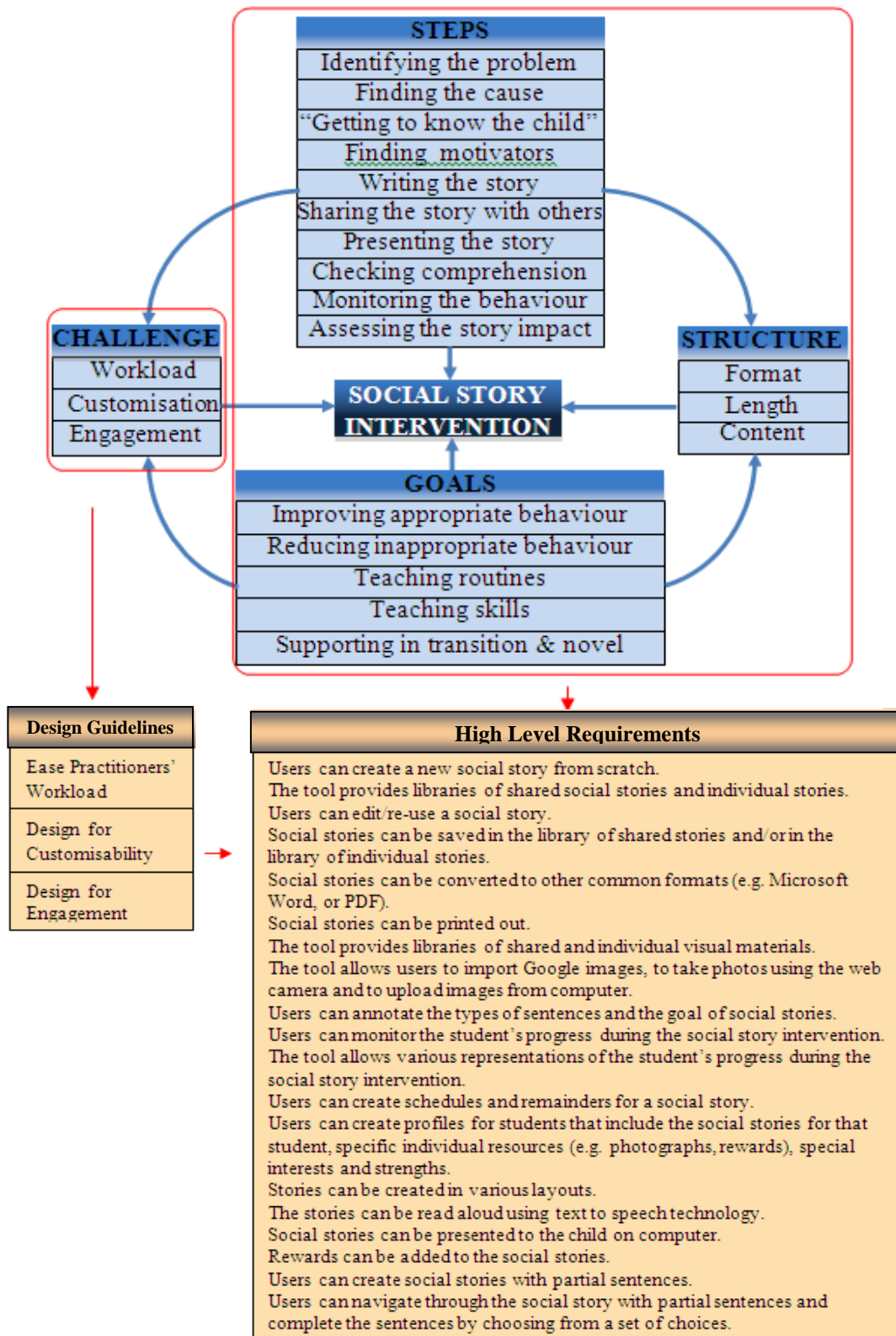


Figure 4.9: Design guidelines and initial set of high level requirements for social story authoring tools

introduced by Gray (2004). Optionally, they should get feedback to show whether or not their story respects Gray's recommended ratio.

- 2. Design for Customisation.** A common desire of practitioners is to quickly customise newly created or re-used social stories. To address this principle, users should be allowed to create resources for each child, to add their own social stories, symbols, photographs, rewards, as well as interests and strengths. The stories should also be customisable to the story topic content, be re-usable and sharable with other practitioners and children. Text to speech capabilities should be added to accommodate children with reading difficulties. Options to choose between various layouts and to automatically convert the story from one layout to another should be provided.
- 3. Design for Engagement.** Engaging the child with the social story is a common concern of practitioners. This could be addressed by customising the story to the child's interests and familiar context (e.g. images of familiar people). Practitioners could add rewards at the end of social stories (e.g. animated characters, songs) adapted to each particular child. Social stories with partial sentences are employed to check the child's comprehension, but may also make the system more interactive, potentially improving the child's engagement with the tool.

A UML use case diagram was used to capture the system functionality and the interaction between the users and the system (see Appendix I).

The next step was to derive and organise the requirements for the social story tool. These requirements are grouped into five categories: users' requirements, task requirements, learning requirements, data requirements and interface requirements, and are described next, in section 4.3.2.

4.3.2 High-level Requirements

This section presents the initial set of requirements.

User Requirements

The tool is mainly addressed to practitioners (e.g. teachers, nursery nurses, learning assistants, and speech and language therapists) who work with students with ASC. Students with ASC can also use the tool either accompanied by the practitioner (e.g. when creating a social story) or independently (e.g. when visiting a social story written for that particular child). Therefore the users' skills are in a very broad range. Consequently, the tool has to be very simple and intuitive. Practitioners and students should be able to use the tool without any training. However, users are assumed to be familiar with computers, including the use of mouse and keyboard. They are assumed to know how to select an object by clicking on it and how to perform drag and drop operations using a mouse.

Practitioners should be able to utilize a minimum core of features, avoiding the ones which are optional (e.g. creating a shared story, creating a partial sentence story). Setting preferences should be introduced to allow practitioners to select the features they want to use.

Students should be able to easily navigate through the story and complete the partial sentences stories with minimum effort. Since some of the students might have special needs (e.g. caused by visual or motor impairments) the tool should be flexible to adapt to these needs. Read aloud feature has to be enabled or disabled according to the child's needs.

Task requirements

The main task requirements for practitioners are as follows:

1. Create/edit social stories

A social story should be written from scratch or by re-using an existing story. When writing a social story, practitioners should be able to set up the font features (e.g. family, size, colour), and the background colour. Practitioners should be able add images to the social stories, either by importing images from the internet,

taking photos with the web camera, importing images from the computer, or adding to the story from existing libraries of resources.

2. *Save social stories*

Practitioners should be able to save social stories either in the shared library (to be accessed by other practitioners) or in their private library. These options allow them to re-use their stories but also stories written by other authors.

3. *Convert a story to other formats*

The tool should allow practitioners to convert a social story to other file document format (e.g. PDF). This allows practitioners to modify the story using traditional editors, but also send a generically readable copy of the story through email.

4. *Print a story*

A social story can be printed out. This allows practitioners to hand out the story to the students or parents to have it at home, or to put it in an accessible place, so that the students can read it whenever they need.

5. *Present a story*

Practitioners should be able to present a social story to a child on computer. The interface for presenting the story (child's interface) should be simple, without elements to distract the child's attention.

6. *Read aloud*

The tool should provide the option of reading aloud a story by using text to speech technology (TTS).

7. *Change story layout*

A social story should be automatically converted from a layout to another without requesting user to work on it (e.g. from a book story layout to a text only layout).

8. *Monitor progress*

A social story should be monitored by recording the frequency of the target behaviour. The progress of the student should be visualised in various formats. This feature helps practitioners assess the impact of social stories on the student's behaviour.

9. *Create/edit student's profile*

Practitioners should be able to create and edit profiles for their students. A profile contains information about the student (e.g. likes, dislikes, etc.), social stories

written for that student and resources to be used in social stories (e.g. photos, symbols, rewards).

10. *Schedule a story*

The tool should allow practitioners to create a plan for the social story intervention.

11. *Add/edit a reminder*

Practitioners should be allowed to add or edit a reminder to remember when a story has to be presented to particular child as planned.

12. *Register/Log in*

All practitioners should be able to access the libraries of shared stories and shared resources. However, practitioners must register and log in their own account in order to access the individual stories and resources (which were created for their students).

Learning requirements

One of the primary purposes of this research was to design a computer-based tool for social stories based on research and practice. The requirements were elicited mainly from the research in social stories and were intended to help practitioners extend their practices.

1. Partial sentences stories

Practitioners should be able to create a partial sentences story. In a partial sentences story some sentences have missing words and for each missing word users are presented with a set of choices to complete the sentence. Children should be able to complete partial sentences.

2. Sentences annotation

Practitioners should be able to annotate the sentences according to the six types of sentences recommended by Gray (see section 2.2.1).

3. Feedback for story content

Practitioners should be able to get feedback that informs them whether or not the social story respects Gray's recommended ratio between different types of sentences.

4. Monitor the student's progress

This is a similar requirement with the task requirement 6.

5. Information about the types of sentences

When creating a new social story or editing an existing social story, practitioners should be able to refresh their knowledge or to learn more about the types of sentences according to Gray's guidelines.

Data requirements

1. Libraries of social stories

The tool should contain a library of shared social stories and a library of social stories written by a practitioner for his own students. Shared stories are available for any practitioner, whereas the social stories which are written for particular students are available only for the practitioner who created these stories. Practitioners should be able to browse the social stories or search for a particular social story.

2. Libraries of visual resources

The tool should provide libraries of visual resources: a library with sharable resources and a library with resources which are specific to students.

3. Logging

The tool should be able to maintain a log file for every practitioner for research purposes. The data collected might be used to evaluate the tool. Practitioners can also use the log file to reflect on their practices.

Interface requirements

The tool should start with a simple home interface which allows practitioners to see the main features available. Those features which are not applicable should not be visible or should be inactive. When the social stories are presented to the children the interface should be very simple in order not to distract their attention.

4.4 Current Authoring Tools for Social Stories

Authoring tools enable users to create structured material using an intuitive interface. An example of an authoring tool is MS PowerPoint, which allows users to create slide-show based presentations that can include images and sound. In his analysis of the state of art of authoring intelligent tutoring systems, (ITS) Murray (1999) notes that authoring tools:

- a. reduce the effort used in creating ITS;
- b. reduce the necessary skill threshold for developing ITS;
- c. support the author in articulating or organizing her work;
- d. scaffold good design principles;
- e. facilitate rapid prototyping.

Many of these attributes match with the design guidelines and requirements for social stories tools, and thus support the use of an authoring tool to help practitioners in their work, enabling rapid customisation, flexibility and requiring no programming skills.

The existing applications for creating social stories were considered in relation to the need to support the steps proposed for story development, the design guidelines and requirements, as above. These are: Story Builder (Usability North 2014), Story2Learn (App Store 2014), Pictello (AssistiveWare 2014), Social Stories (Apps For Children with Special Needs 2012), StoryMaker (Dentremont 2014), Sandbox Learning (Sandbox-learning 2014), React (Entertainment Intelligent Lab 2014), Stories in Motion (StoriesInMotion 2014), Stories about Me (App Store MeS 2014) , iCreate...Social Skills Stories (iCreate 2014), and My Pictures Talk (Talk 2014). These applications focus on building, editing and presenting social stories. They do not support checking the child's comprehension, and monitoring the progress of the child during the social story intervention. None of the applications provides an option to annotate the type of sentences, as Gray defines them. StoryMaker's developers promise an update with social stories and other content from Carol Gray, but currently there is no feature that incorporates Gray's research work. With the exception of Stories in Motion, none of the applications supports assessing social

stories. Most of the applications are presented as allowing customisation, but this consists largely of changing font sizes and colour, changing backgrounds and choice of the type of voice to use for text to speech technology (e.g. Pictello). None permits the customisation of the story layout, nor provides the option of creating and storing resources for a particular child, to reuse when creating new stories for that child (e.g. favourite pictures, symbols or rewards). The existing applications do not offer the option to create a profile of a child, or to store information about the social stories created. Also, they do not permit users to create and present social stories with partial sentences.

Anecdotal evidence shows that practitioners sometimes use generic tools to create social stories: Communicate: In Print (Widgit 2014), Boardmaker (Boardmaker 2014), or Comic Life (Comiclif 2014). These tools are for creation of visual educational materials, but they do not satisfy the requirements mentioned in section 4.3.2.

The limitations identified means that further research is needed to investigate whether a computer based tool could be developed that satisfies the requirements and design guidelines identified through studies with practitioners.

4.5 Participants' Involvement

4.5.1 Roles and Contributions

At this stage of the research 16 practitioners and 3 researchers were involved (besides the PR). The role of the practitioners was that of informant. The researchers (the members of ERT) played the role of design partners.

The practitioners offered input for the emerging technology and feedback for the technologies they are familiar with. They revised and evaluated their practices in social story interventions and identified and discussed potential problems with the PR who played also the role of technologist. The practitioners developed social stories using their current approaches and looked for patterns, exceptions and interesting cases. They also contributed to relate practice and theory, by providing

input for creating a framework of the social story interventions, but also by reflecting and discussing how theory can be integrated into the emerging tool.

The researchers supported practitioners to understand technology possibilities and also technologist to understand the theory behind the social stories, as well as practitioners' procedures and problems encountered by both practitioners and children with ASC. These contributed to bridge theory and practice. During the study, the PR facilitated the development of the social stories and encouraged the practitioners to verbalise their thoughts, and observed the tools in use. Researchers devised the design guidelines, and the requirements to meet these guidelines.

4.6 Summary

This chapter reported the studies conducted in the pre-design stage. The primary aims of these studies were to uncover the practices and procedures used by practitioners in social story interventions, to relate current practices to the research literature, and to define the design specification for a social story computer-based technology.

The first section in this chapter described a focus group which was conducted to gain initial insight into the current approaches of social story interventions. The second subsection presented an exploratory study with practitioners with experience in social stories aiming to better understand the practitioners' procedures and practices in social story interventions. The data analysis used Grounded Theory Methods, and included both empirical data and the literature related to social stories. This has yielded a framework of the social story intervention highlighting four concepts which appear to be essential in social story interventions:

- 1. steps** which refer to the steps that practitioners follow in social story interventions;
- 2. challenges** which refer to the difficulties and concerns that practitioners encounter;
- 3. structure** which includes the story format, length and content;
- 4. goals** which mean the objectives that are addressed by social story interventions.

A detailed discussion on each core category and the subcategories they include has been presented along with evidence from the empirical data.

Based on the framework of social story intervention, a set of three social story design guidelines and an initial set of requirements for social story authoring tools have been devised. The analysis of the existing tools for social stories revealed a number of limitations. These led to the conclusion that none of these tools fully support practitioners in developing social stories. Therefore research is needed to investigate whether a computer-based tool could be developed that satisfies more of the requirements and design guidelines identified through studies with practitioners.

Chapter 5

Designing and Exploring Low-fidelity Prototypes

The second stage of the current research produced three design principles and a set of requirements for the social story authoring tools which were presented in the previous chapter. Since the analysis of the existing tools for social stories concluded that none fully supports practitioners, the next stage of this research focused on building and exploring low-fidelity prototypes for a new social story -computer-based tool. The first section of this chapter explains how the two versions of low-fidelity prototypes were designed. A description of the prototype versions is presented in section 5.2. Section 5.3 provides the justification for the design decisions based on the three design principles and on accepted HCI principles. The low-fidelity prototypes were explored with practitioners (teachers, nursery nurses and speech and language therapists) in order to discover their preferences and usability problems, and to refine the system specification. This study, its results and their impact on the design are presented in section 5.4. In section 5.5 the roles and the contributions of the participants to the third stage of the present research are discussed.

5.1 Designing the Low-fidelity Prototypes

Beaudouin-Lafon and Mackay (2003) define a prototype as a tangible representation of a whole or partial system. They consider that successful prototypes “support creativity, helping the researcher to capture and generate ideas, facilitate the exploration of a design space and uncover relevant information about users and their work practices” (p. 122). Prototypes allow the researchers to interact with the users in early stages of the design and to discuss various options.

“Low-fidelity prototyping is characterised by a quick and easy translation of high-level design concepts into tangible and testable artefacts” (Tiainen 2014, p. 170). In

most cases low-fidelity prototypes require: paper, stick-on paper notes, cardboard, and acetone sheets.

Paper-based low-fidelity prototypes are often used in iterative design as they are quick and inexpensive, emphasize the big picture with minimal detail, and foster design thinking (Beaudouin-Lafon and Mackey 2003). Paper prototypes have a rough appearance which encourages users to suggest essential conceptual or structural changes that might be difficult to elicit with a working system.

Paper prototypes can be successful when employed with real users to explore the design space, to discover possible design problems at an early stage, to provoke new and original ideas to be incorporated in the design, and to develop products that are “more useful, intuitive, efficient, and pleasing” (Snyder 2003, p. 3). However, because of their roughness, paper prototypes are not helpful in exploring some design details. Some kinds of problems cannot be explored using paper prototypes, such as scrolling, download time, and others. Therefore, it is expected that some changes will be applied in the next stages of the project.

In order to design the paper prototypes a number of scenarios have been created based on the tool requirements. Obviously, the more scenarios that are utilised the better the decisions for the design. However, since the prototypes had to be explored with practitioners who are people with a very busy agenda, this imposed a serious time limitation. Therefore, it was decided to allocate no more than one hour to walk through each scenario. Four scenarios were chosen to fit within this interval of time. The four scenarios were selected based on two criteria: 1) they represent one of the most common activities that the practitioners are expected to perform with the authoring tool and 2) they cover the highest number of requirements.

The scenarios selected for exploring the prototypes are as follows:

Scenario 1: Mrs Wilson created a story called “Sharing” with complete sentences for John Smith. She decided to present it to the child, based on a daily schedule. She will present it to John on a computer. She needs the story to be read by the computer.

She adjusts the volume before he starts presenting it. Then, she presents it to John, page by page.

Scenario 2: *Mrs Wilson created a story called “Sharing” with partial sentences to check John’s comprehension. She opens the application and searches for the story. Once she finds it, she asks the child to go through the story and to complete the partial sentences.*

Scenario 3: *Mrs Wilson has to write a social story about sharing. She decided to customize an existing social story. Thus, she searches through social stories library in order to find out a story about sharing and quickly customize it for John Smith. She chooses a story called “Sharing” with complete sentences. Then, she changes the title into “Sharing Things it’s OK” and adds a new page after the title page, on which she writes “My name is John”. Finally she saves the story.*

Scenario 4: *Mrs Wilson must create a new social story in a book story format, for a child called Derek Leeds. She already has the content (see below Figure 5.1) and she just needs to edit it and add suitable pictures/symbols using the application. At the end, she saves the story.*

Sharing

I may try to share with people. Sometimes they will try to share with me.

Usually sharing is a good idea.

Sometimes, if I share with someone they may be my friends.

Sharing with other people makes them feel welcome and may make me feel happy.

Figure 5.1: Social story to be created in scenario 4

Before building the low-fidelity prototypes, storyboards were designed for each scenario to better understand the interaction between the users and the tool (see an example in Appendix J). These storyboards were hand-drawn by the author. They were useful in illustrating the flow of user’s experience. Also they provide a visual support for the scenarios to discuss with the other researchers aspects related to the user and system interaction. According to Truong et al. (2006), storyboarding has the

advantage of facilitating the mapping between the human activity and the technology, as well as the understanding of the user's reaction to the system.

Two versions of paper-based low-fidelity prototypes were created for each scenario using Balsamiq Mockups, version 2.2.5 (<http://www.balsamiq.com>) and then printed out. Balsamiq is an application to create graphical user interfaces. This was used for the following reasons:

1. It contains a drag-and-drop WYSIWYG (What You See is What You Get) editor which allows the user to easily arrange and customize pre-built features (such as buttons, menus or panels) which are stored in its libraries;
2. It is less time consuming: one can easily re-use and modify an existing screen, whereas sketching by hand, each screen has to be drawn from scratch;
3. The mock-ups look more like software screenshots which makes easier for users to achieve their tasks, but they are also rough enough, with sketchy elements to encourage them to come up with suggestions;
4. A free licence for university students can be quickly obtained.

The two alternative paper prototypes differ in their interfaces, but offer the same functionality.

5.2 Prototypes Description

Five basic 'screens' were designed to support the scenarios mentioned above: *Homepage*, *Create Story*, *Shared Stories*, *My Stories*, and *Present Story*.

5.2.1 Homepage

While in the first prototype an MS Word like appearance was used, which grouped the main functionalities under a set of menus, the interfaces in the second prototype were built based on buttons (see Figure 5.2).

This screen needs to allow the user to choose any of the following main options: create a social story, browse the library of social stories, present a story which was written for a particular child, visit a particular child's profile, and schedule a social story. Both prototype versions provided these options.

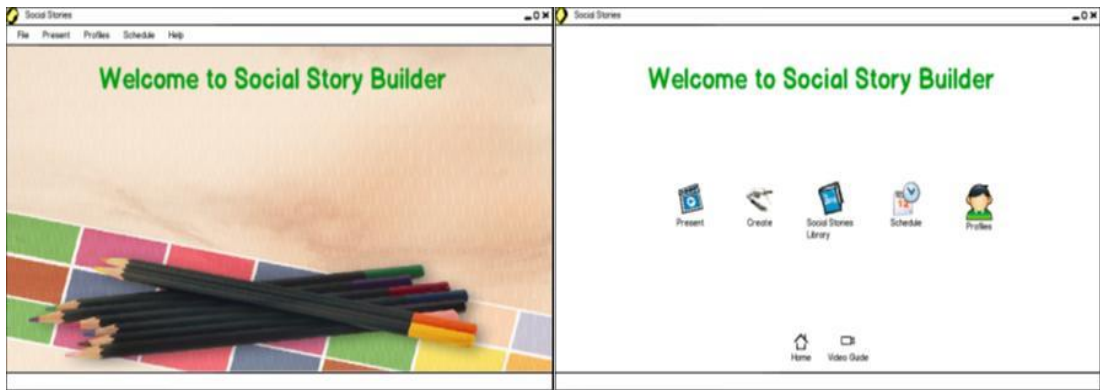


Figure 5.2: Homepage: [left] prototype version 1; [right] prototype version 2

5.2.2 Create Story Screen

Create Story screen in the first version is accessible through the *File* menu, by selecting the item *New*, while in the second version this can be open by clicking the button *Create* on *Homepage* (see Figure 5.2). Figure 5.3 presents the *Create Story* screen in both prototype versions.

A story can be edited in a book format layout (see *story area* in Figure 5.3, a). The layout of the story can be changed automatically by selecting one of the available layouts in the *resources area* (Figure 5.3, b). The number of the current page and the total number of story pages are made visible in the story area. *Add Page* and *Delete Page* buttons allow the user to append, respectively delete the current page of the

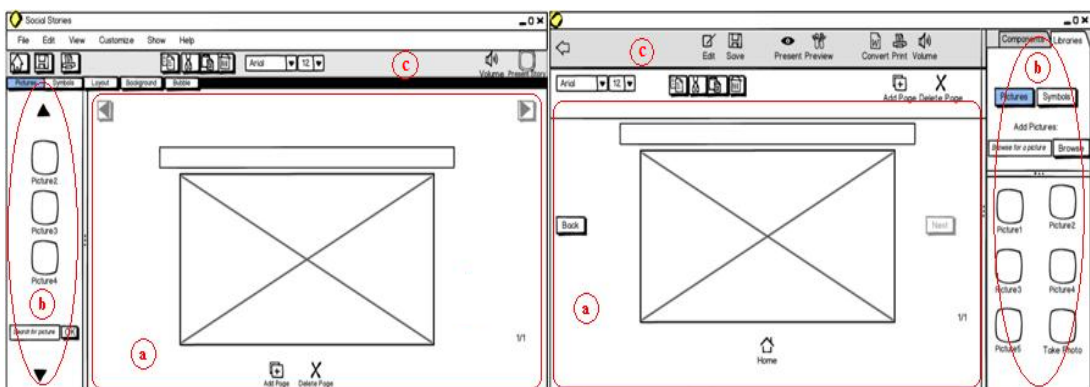


Figure 5.3: *Create Story* screen: [left] prototype version 1; [right] prototype version 2

story.

The vertical panels with *resources* (e.g. images, symbols, layouts, etc.) are placed in two different positions: on the left-hand side in the first prototype version, and the right-hand side in the second prototype version (Figure 5.3, b).

Tools to edit the story (copy, paste, delete text or modify font features, such as size, colour, etc.) are provided in the tools horizontal bar(s) above the story area (Figure 5.3, c). Both prototype versions provide options to save, print, convert to another format (e.g. MS Word), present the story (display the story in a new window to be shown to the child), and read the story aloud.

5.2.3 Shared Stories Screen

In the first prototype version the *Shared Stories* screen can be accessed by clicking the item *Open* in the *File* menu, while in the second prototype this page can be reached via *Social Story Library* button from the homepage (see Figure 5.2). The *Shared Story* screen for the two prototypes is shown in Figure 5.4.

From this page users can browse the library of shared social stories, according to some criteria of filtering (e.g. story topic). A generic criterion called *level* was introduced to filter social stories. The idea was to generate discussion in order to discover if the practitioners have any specific level to classify the social stories, such as language/communication level, or understanding level. A search option allows users to find a story using the title or a word which is contained in the title.

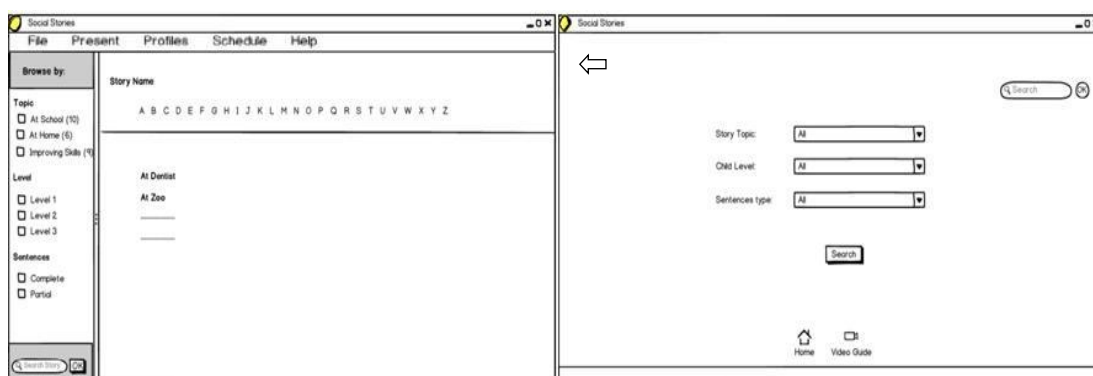


Figure 5.4: *Shared Stories* screen: [left] prototype version 1; [right] prototype version 2

5.2.4 My Stories Screen

In order to access the stories written for a particular child the user should follow *Present* > *My Stories* and then select either *Complete Sentence Stories* or *Partial Sentence Stories* in the first prototype version.

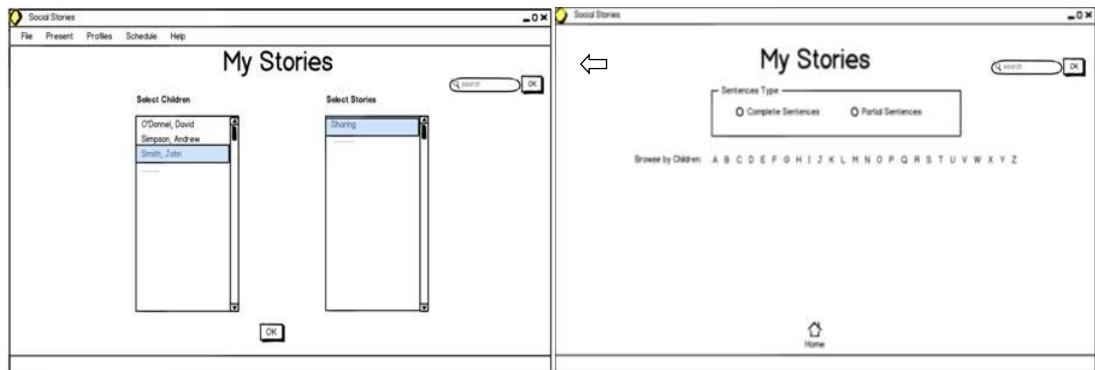


Figure 5.5: *My Stories* screen: [left] prototype version 1; [right] prototype version 2

In the first version, when clicking on a child's name the list of the stories written for that child appears. Once the story is selected it can be opened by clicking the button *OK* (Figure 5.5, left). In the second prototype, the selection of a letter in the alphabet list brings out a list with all the children whose name starts with that letters with a sub-list of the corresponding story links (Figure 5.5, right). In order to open a story the user should double click on the story link.

5.2.5 Present Story Screen

Present Story screen can be opened in both versions when clicking on the *Present* button in the *Create Story* screen (Figure 5.3).

This screen displays the story for the child. The navigation through the story can be done by using *Next* and *Back* buttons (Figure 5.6).

When presenting a story with partial sentences, the two versions offer different options to complete the sentences. In the first version the user has to type the missing word, whereas in the second version the word is chosen from a drop down list with three items.

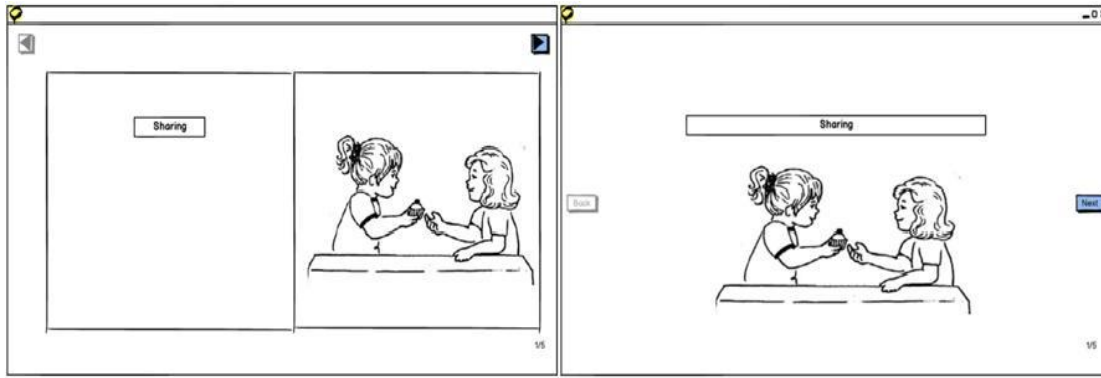


Figure 5.6: *Present Story* screen: [left] prototype version 1; [right] prototype version 2

5.3 Justification for Design Decisions

The design of the low-fidelity prototypes was guided by the social story design principles presented in section 4.3.1, as well as by accepted HCI principles. This section explains how these principles are reflected at this level of social story authoring tool design.

5.3.1 Design Guidelines

Guideline 1: Ease practitioners' workload - reduce the effort expended (both mental and physical) to achieve certain goals (e.g. editing a social story).

The following features were introduced at this stage in order to support this principle by reducing the practitioners' effort and helping them organise their work (see 4.3.1):

Shared story library - providing a large sharable library of social stories gives the users the chance to find an existing social story which is appropriate for specific target behaviour, skill or concept that can be re-used after a quick re-editing, or used as an inspiration for a new story (see Figure 5.4). Tools to filter the shared stories and to search a certain story are also provided to minimise practitioners' effort.

Shared Resources - contain images (e.g. pictures, symbols) organised in categories that can be easily added to the social stories. Options to add various backgrounds for the story, to change the layout of the social story, or to add speech bubbles were added (see Figure 5.3).

Library with individual social stories - contains the social stories written by a practitioner for her students. These stories can be accessed only by their author and can be presented to a child or re-edited and saved in another version. This feature provides an easy way of organising the social stories authored by a practitioner.

Tools to create/re-edit a social story - allow practitioners to create a story from scratch or to re-edit an existing story. A story can be written in a standard book story format in order to ease practitioners' workload in choosing and adapting the images sizes and text position, but can be then converted automatically to another layout.

Save a story for a particular child - allows practitioners to save the story for a particular child, choosing a name from an existing list or adding a new name. This feature provides an easy way to organise social stories which then can be visited by accessing *My Stories* screen (see Figure 5.5).

Present a story to a child - this feature displays the social story in a simple interface to be read for a child (see Figure 5.6). The child can navigate through the story using *Next* and *Back* buttons or the practitioner can do that for the child.

Read out loud - enables the story to be read out loud. This feature eases practitioners work, allowing the child to independently work on the social story.

Guideline 2: Design for customisation - provide options for tailoring the social story (e.g. pictures, font features) to the child's needs and skills.

Tools to adapt font features - permit practitioners to select the appropriate font family, size, and colour.

Shared Resources - allow fast story customisation in terms of images and symbols.

Read aloud - provides customisation to the child's preferences of reading the social stories. The tool may allow a range of voices (e.g. male, female, or various accents).

Various Story Layouts - are available to give the practitioners a quick way of automatically customising a social story to the most appropriate layout for a particular child.

Guideline 3: Design for engagement - offer the children opportunities of engaging in the social story presentation.

Partial sentence social stories - this feature allows practitioners to present stories with partial sentences stories. These stories contain sentences which miss a word (partial sentences). The students are requested to complete the sentence by adding the missing word. Partial sentence social stories engage them with the story and increase their motivation, as suggested by Gray (2004) and also by practitioners (see section 4.2.9.2).

Rewards - were added at the end of partial sentence story to reward the children for correctly completing all partial sentences in a story. This is not a usual feature in social stories, but it was considered helpful to engage students with the story according to the findings in the previous exploratory studies with practitioners.

5.3.2 HCI Principles

Many overlapping sets of rules for good design have been developed in HCI based on empirical data, best practice, as well as cognitive psychology. Their target is to increase the software usability. Principles are abstract design rules with high generality (which means that they can be applied to many design situations), but which are to be followed as suggestions rather than compulsory rules (Dix et al. 2004).

Dix et al. (2004) divide the design principles in three main groups:

***Learnability** - defined as how effortlessly beginning users can learn the system and reach highest success.*

***Flexibility** - described by the variety of ways through which the information is exchanged between the user and system.*

Robustness - means how supportive the system is for the user in completing and assessing the goals.

The principles that fall into the learnability category, which were considered to guide the authoring tool design, are as follows:

- *Predictability*) refers to the “deterministic behaviour of the system from the perspective of the user” (Dix et al. 2004, p. 261). In other words, the system should be designed in such a way that the users should be able to determine the effect of their actions. Another form of predictability consists of the user’s ability to determine the availability of the operations that can be performed at any moment (operation visibility). Also, the user should be able to understand if the operation she intends to perform is not available.
- *Familiarity* ensures the correlation that a new user can make between her existing knowledge and experience in the real world or through interaction with other systems and the knowledge necessary for effective interaction with a particular system.
- *Consistency* ensures that the system reacts in the same way in similar situations.
- *Generalizability* refers to the extent to which the system supports the users in applying their knowledge to other similar situations.

The following design principles from the flexibility category were applied to the design (see also Table 5.1):

- *Substitutivity* ensures that the input and/or output can be provided using equivalent values.
- *Customisability* was considered from the user perspective, also called adaptability. It refers to the system capability to allow users to adjust the form of input or output to their needs.

Two principles, recoverability and responsiveness, that fall in robustness category were considered in the design:

- *Recoverability* ensures that the user can reach a desired goal after an error has been made.
- *Responsiveness* which ensures that the system provides feedback as a response to the users' action.

Principles	Implementation of the principle
Predictability	<ul style="list-style-type: none"> • prompt text in the text fields to indicate the user where to type (e.g. “Write a title here”) • items (in the first version) and buttons (in the second) corresponding to operations that are not applicable are dimmed to indicate the user that action is not available.
Familiarity	<ul style="list-style-type: none"> • standard icons for actions like save, home, add page, delete page, etc. • the tools for changing text features (e.g. font family, size, and colour) are similar to the ones in MS Word which is an editor that practitioners are familiar with • using familiar terms and concepts for practitioners, like: open library, create, schedule, profile, etc.
Consistency	<ul style="list-style-type: none"> • same concepts or terms were used in every window for the same operations, buttons, or items • same icons were used throughout the different windows for the same features • the overall ‘look’ of the windows was kept consistent in layout, font family, font size and colour of similar features.
Generalizability	<ul style="list-style-type: none"> • similar actions are activated in similar ways. For example, a ‘click’ on a letter in the shared stories leads to the display of the social stories starting with that letter. Similar, a click on a student’ name displays the list of the social stories for that student
Substitutivity	<ul style="list-style-type: none"> • the user can display the story in various layouts, such as text only, book story, etc.
Customisability	<ul style="list-style-type: none"> • the font features (e.g. font family, size and colour) can be adapted according to the user preference • more layouts for social stories
Recoverability	<ul style="list-style-type: none"> • when users write a text (e.g. a sentence, or story title) they can use undo or redo options
Responsiveness	<ul style="list-style-type: none"> • pop-up windows confirm that actions were completed (e.g. saving a story)

Table 5.1: Implementation of the HCI principles

The design of the authoring tool was also guided by the HCI principles of universal design. According to Dix et al. (2004, p. 366) is defined as “the process of designing products so that they can be used by as many people as possible in as many situations as possible”. The following general principles for developing universal designs were considered in the present project (Dix et al. 2004):

- *Equitable use* - ensures that the design is for people with a range of abilities.

- *Flexibility in use* - allows users to adapt the system to the users' abilities and preferences.
- *Simple and intuitive to use system* - irrespective to the users' experience, knowledge or level of concentration.
- *Tolerance for errors* - ensures that the impact of the errors or unintended behaviours is minimised.
- *Low physical effort* - refers to the minimisation of the physical effort and fatigue.

Table 5.2 illustrates how these principles were applied.

Principles	Implementation of the principle
<i>Equitable use</i>	See section 5.4.6
<i>Flexibility use</i>	the font features (e.g. font family, size and colour) can be adapted according to the user preference more layouts for social stories
<i>The system should be simple and intuitive to use</i>	clear terminology inspired from the studies with practitioners simple way to navigate through screens minimise the number of windows
<i>Tolerance for errors</i>	Po-up windows to prevent accidental delete actions Undo/redo options
<i>Low physical effort</i>	See section 5.4.6

Table 5.2: Implementation of the HCI of universal design

5.4 Exploring Low-fidelity Prototypes

The paper prototypes were evaluated in an exploratory study involving 10 practitioners with experience in social story interventions. The two versions of paper prototypes were described in section 5.2.

5.4.1 Study Aims

The aims of the present study were as follows:

1. to explore the design space and find out practitioners' preferences;

2. to discover usability problems and solutions to overcome them;
3. to generate new ideas to improve the systems' features and interaction;
4. to validate and refine the system specification.

5.4.2 Study Design

The study was conducted in 5 sessions, each session having two phases. Constructive interaction, which is a version of the TA protocol, was used in the first phase, while the second phase employed brainstorming techniques. Although in both phases findings to address all the four aims were elicited, the first phase was more focused on aims 1, 2, and 4, while the second phase was directed to aims 3 and 4.

Phase I: Constructive Interaction

In constructive interaction two users collaborate (co-discovery learning) in performing some tasks using a system together and verbalizing their thoughts. The advantage of constructive interaction over think-aloud is its naturalness, as people are more familiar with expressing their thoughts when working together, rather than speaking alone (Holzinger 2005). "Therefore, users may make more comments when engaged in constructive interaction than when simply thinking aloud for the benefit of an experimenter." (Holzinger 2005, p. 73). Nielsen (1993) suggests that constructive interaction should involve subjects with the same level of expertise, while Kahler (2000) argues in favour of subjects who are familiar with each other (e.g. friends, co-workers, or family members). In order to have maximum benefit from the study, the pairs were created to include colleagues working in the same school with similar experience in social stories.

Phase 2: Brainstorming

Brainstorming is a problem-solving technique based on a list of ideas which are spontaneously produced by a group or an individual. People are encouraged to come up with ideas whether they are realistic or not. The central key to this study is to create a relaxed, informal atmosphere for getting rid of inhibitions and fostering creativity and originality, with the purpose of going beyond the conventional ways of thinking.

In order to break down the pre-set limits of the problems, ideas are not judged or criticized during the brainstorming session. A way to ensure that everyone contributes is to ask people to write down their ideas on stick-on paper notes.

Usually brainstorming consists of a small number of people attempting to produce as many ideas as possible on a certain topic, with the emphasis on the ideas' quantity and not quality. It takes place in two steps: firstly the ideas are generated, and secondly the group reflects on them.

5.4.2.1 Participants

Ten practitioners participated in this study: seven teachers, two nursery nurses and a speech language therapist (P9 and P13-P21, see Appendix F). The practitioners work in special schools and have extensive experience in working with children with ASC (between 5 and 25 years) and also in developing social stories (between 3 and 15 years). Eight of the practitioners are permanently employed in special schools for pupils with complex, long term additional support needs. Two of the teachers work for VTSS.

5.4.2.2 Materials

All participants received an information sheet and a consent form (see Appendix K). Papers, stick-on paper notes, and pencils were provided to the participants to write down and to draw their ideas. A list of predefined topics was prepared for the brainstorming phase (see Appendix K). In all the sessions a video camera was used to record the activity, with the participants' consent.

5.4.2.3 Procedure

In each session of the present study two practitioners were invited to explore the two prototypes alternatives presented in section 5.2. At the beginning, each participant read the information sheet and filled in the consent form. Each session lasted for 120 minutes, almost equally divided between the two phases.

Before the exploratory study took place, a pilot study was conducted with three researchers for the first phase, with a purpose of improving the study design, to determine any technical and usability problems, to refine the interface (e.g. by

finding out missing features/pieces), and to check if the study was feasible in the limited time available. The pilot study revealed several problems which were solved before the exploratory study started. For example, some screens missed the buttons which allow the user to return to a previous screen. Also a pop-up window which permitted the user to input the child's name to save the story for was missing. Other problems were related to consistency of the screens, such as the positions of buttons, or using different terms for the same action (e.g. present and show to display a social story in the children interface). The pilot study was also useful for the researcher who played the role of the computer to become familiar with the prototypes and with manipulating them smoothly, as well as for the PR who played the role of facilitator and observer to rehearse her roles before the study.

Phase I: Constructive Interaction

For the first phase the practitioners were presented with four scenarios (see section 5.1) and invited to follow each scenario using the prototypes, pressing the buttons and menus, and simulating typing as if that were a working system. Besides the practitioners, a researcher having both the roles of observer and facilitator and another researcher

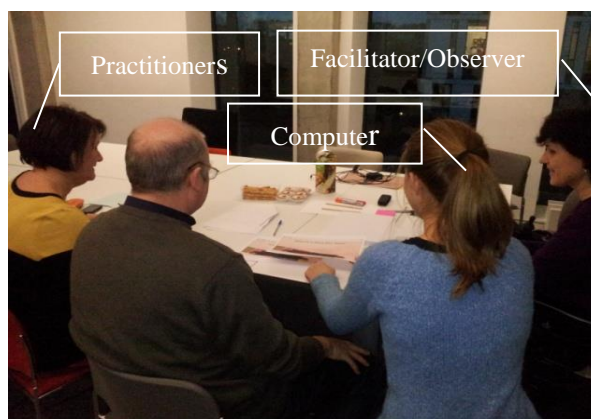


Figure 5.7: Exploring the low-fidelity prototypes

playing the role of the “computer”, were present and sat around the table (see Figure 5.7). The second researcher manipulated the pieces of paper (“screens”) according to the practitioners’ actions, while the first one took notes and guided the users’ through the tasks, encouraging them to express their thoughts and prompting them whenever needed. The presentation of the prototypes was balanced, in order to avoid the learning effects. Thus, for the scenarios 1 and 3, the participants worked through version 1 and then version 2, whereas in scenarios 2 and 4, the order of the versions was switched.

During the practitioners' walk-through of each scenario, their behaviours and attitudes toward the two design alternatives were observed and noted down. For each main feature practitioners were asked about their preference. However, the two prototypes were not supposed to limit the design alternatives, but they were utilised as incentives to foster practitioners' imagination and creativity. The facilitator asked practitioners which prototype or part of the prototype they like/dislike and what they prefer to change after each task. Paper, stick-on paper notes and pencils were on hand and the practitioners were encouraged to draw their own suggestions either on the prototypes or on a new piece of paper. Sometimes, the facilitator suggested other solutions, based on her experience, but also on the solutions collected from the previous participants. Practitioners were prompted to ask questions when they seemed to be confused. When problems were encountered, they were encouraged to talk about them in order to understand what caused each problem.

Phase II: Brainstorming

The first step in the brainstorming phase addressed those problems encountered in the exploration of the prototypes for which the practitioners did not come up with solutions in the first phase. The discussion was then initiated around pre-defined topics (Appendix K), but was extended to include other topics when the practitioners came up with new ideas. The practitioners were advised to generate and write down their ideas, either on a suggested topic or on a new topic, without thinking of their achievability. The practitioners used stick-on paper notes, paper and pencils and worked individually to bring up a number of ideas, or collaborated in writing



Figure 5.8: Brainstorming session – practitioners collaborating to create the user's interfaces



Figure 5.9: Brainstorming session – samples of interfaces and suggestions

together suggestions (Figures 5.8) or sketching screen interfaces (Figure 5.9).

5.4.3 Data Collection

During this study the data were collected from the following sources:

- Video recordings during each session;
- Stick-on paper notes and sketches produced during the brainstorming;
- Observer's notes.

5.4.4 Data Analysis

The video recordings were carefully watched, following the practitioners' expressed thoughts, as well as their actions, and behaviours. For each of the four scenarios in the first phase of the study an Excel table was created. The table header contains the topic addressed and the five sessions of the study, each of them divided into three sub-columns: prototype version 1 (PV1), prototype version 2 (PV2) and suggestions (S). While watching the video recordings for the first phase, the preferences for one of the two prototypes and the comments were recorded in the corresponding sub-column (PV1 or PV2) for that particular topic. When practitioners did not agree with any of the prototypes solutions and had different suggestions these were written down. The Excel document allowed the researcher to compare and contrast the preferences of the participants for one or another prototype and to gather the suggestions and comments for each discussed topic, comparing and contrasting them.

Following Snyder's (2004) recommendations for what paper prototyping is appropriate for, the major topics discussed in the present study have been grouped into five categories: 1) Page Layout; 2) Navigation/workflow; 3) Concepts and Terminology; 4) Content; 5) Functionality.

5.4.5 Results

This section discusses the results obtained in the analysis of the data collected in the exploratory study of the low-fidelity prototypes according to the categories mentioned above.

5.4.5.1 Page Layout

The topics in this category refer to what practitioners need to see on their screens, whether they can easily discover the information they need, and where they expect to find it. The overall impressions were positive toward the pages layouts. The practitioners found it relatively easy to discover the information they needed for completing their tasks.

Homepage Design

Nine out of ten practitioners expressed their preference for the second prototype version. Although they are familiar with menus (they usually work with MS Word to edit the social stories) they considered the second prototype to be simpler and more intuitive. Practitioner P20 explains: “*This one is simpler. It is more obvious, you have everything here, whereas in the other one [pointing to the first version] you have to search inside for an item. I prefer this one [pointing to the second prototype]*”.

Position of Panels with Visual Resources on Create Story Screen

Several practitioners (4 out of 10) discussed the position of the vertical panel containing the images, and symbols. In one of the prototype versions it was placed on the left side, whereas in the other its position was on the right side. Practitioners realised they prefer it to be in the left side. They commented that this preference is explained by the fact that they are right-handed, and expressed their opinion that the left-handed people would probably feel more comfortable to have it in the right side. One suggestion was to place it on the left side by default, since people are predominantly right-handed and to give the user the option to change it on the right side.

Shared Stories Screen

All of the participants preferred the design of the Shared Story screen in the first prototype version (5.3, left). They found it simpler than in the second version where drop down boxes were used. Also, they preferred to have the stories displayed on the

same screen (like in the first version) rather than in a different one (as it was designed in version two).

My Stories Screen

Figure 5.4 presents the two alternatives for displaying the social stories for a particular child. In the second prototype an alphabetic list was used to select the name of the child. This model raised two problems. Firstly, some of the practitioners were tempted to search for the last name, while the others for the first name. That can create confusion if the way the names are listed do not correspond with the user's model. The practitioners also noticed that this alphabetic list is not really useful, since most of the names (first of last) might start with only few letters (e.g. C, M and W). In addition, the number of the children they work with at a moment is small, so an alphabetical classification is not appropriate. The first prototype presents two panels: one containing the full names of children and the other the corresponding social stories for a selected name. Thus, once the name of the child is selected in the first panel, a list with the corresponding social stories for that child appears in the second panel. All the participants preferred the first prototype version for this screen design. Two practitioners suggested eliminating the OK button and replacing its functionality with a click on the story link.

Present Story Screen

Both prototype versions were designed to present the story in a book format layout, though the first version presented two pages on the screen, while the second version only one page was presented. One practitioner commented she liked the first version more as it seemed more like an open book. However, most of the practitioners (6 out of 10) preferred the second representation which allows more space for the image and displays the text close to it.

Background Colour

The discussions about the background colour of the social stories concluded that in general practitioners use a white background for the social story. They commented that keeping the option to change the colour when necessary would be also desirable.

Story Layout

As noted in the first exploratory study, but also in the social stories collected from the practitioners and in the social stories available on the Internet, various layouts for social stories are used for presenting social stories. Although in the present study only the story book layout was represented (which means that the story is presented like a book containing one sentence and one image on each page), all the participants suggested that the tool should provide more types of layouts. The available layouts should at least allow the users to display the story in a story book format, text only, and more sentences and pictures on the same page.

Position of Navigation Buttons

Most of the practitioners (7 out of 10) expressed their preference for the position of the navigation buttons in the bottom left for *Back* button and bottom right for *Next* button. They came up with two reasons for their choice. One was that it is more similar to the way that is used in reality when skimming through a book. Another reason was that it is safer to have these button far from the 'Close' button (placed in the right up corner) when presenting the story to students, to avoid accidentally closing the window.

Display Current Page Number

Only a few practitioners (3 out of 10) discussed the position of the page number. They considered that the position below the story area and in line with the navigation buttons appears to be more visible for them. They also remarked that a bigger font should be used to make it more visible.

Position of Add Page and Delete Page Buttons

In one of the prototype versions the *Add Page* and *Delete Page* buttons were placed above the social story area, while in the other they were placed below this area. The opinions were divided: some of the participants (3 out of 10) considered that placing the buttons on the top make them more visible, whereas others (3 out of 10) considered that it seems more natural for them to have these buttons in line with the page number as it makes more visible the result of their actions when clicking this buttons. For example, when clicking *Add Page* button it is easier to see its effect (e.g. the increase of the number of pages) since the display of the current page number is close to that button.

Display of Navigation Buttons

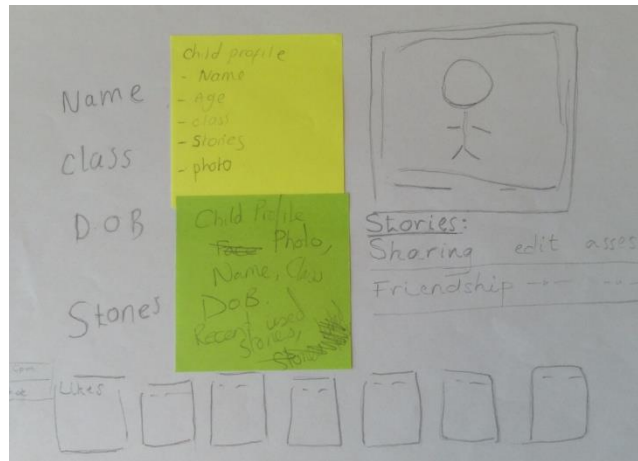
Two options were also presented for the navigation buttons display: icons and text. Some teachers suggested that, taking into account the high heterogeneity of the children with ASC, it is more appropriate to add both icon and text on each button.

Search Field Position

All the participants agreed that a quick search is useful when looking for a social story, in the library of shared stories. Most of the participants (6 out of 10) did not notice the *Search* field when it was placed in the bottom left corner. They said that, as they noticed, the top right corner is the most common position, as they are accustomed to look for it in that corner.

Layout of the Student Profile Page

The prototypes exploration did not include scenarios involving a *Student Profile* screen.



**Figure 5.10: Scribble of *Student Profile* screen –
designed by practitioners**

Therefore, one of the topics in the brainstorming phase was focused on designing the *Student Profile* screen. The participants were asked to write down on stick-on paper notes what information is needed to appear on the screen. After that they were invited to sketch the page layout and discuss that. The general consensus was that the screen should not contain too much information, since practitioners are used to recording various data about children in school folders (see *Content of the Student Profile Interface* in section 5.4.5.4). Figure 5.10 is an example of scribble for the student’s profile page collected from practitioners.

5.4.5.2 Navigation/Workflow

The navigation category refers to the sequence of steps to be followed in order to complete a task and how that matches practitioners’ expectations. In general, there were no problems with navigation, the ‘walk through’ being quite smooth, without flipping back and forth between various screens.

Start Navigation through My Stories

On *Homepage* in the second prototype version (which was preferred by practitioners), the access to the stories created by a practitioner (*My Stories*) was possible via a button called *Present* (see Fig 5.2, right). Most of the practitioners (6 out of 10) said that they would prefer to enter the libraries of social stories, then to

select if they want go to the library of shared stories or to the stories they authored for their students. Therefore, on *Homepage*, in the second prototype version, they suggested replacing the buttons *Present* and *Social Stories Library* with a button *Libraries*. After clicking on it the users are taken to a new screen where they can select either to visit the library of shared social stories (*Shared Stories*), or their own social stories (*My Stories*). Although this solution implies one additional click, it seemed to offer a more intuitive way to access the social stories than the proposed one.

5.4.5.3 Concepts and Terminology

This category addressed the problems regarding the comprehension of the terms and concepts employed in the interfaces. Most of the concepts and terms were intuitive and easy to work with for practitioners. A few changes were suggested which are further discussed in this subsection.

Names of Buttons

One of the names that practitioners found difficult to understand was *Present* for accessing the social stories they authored for their students. Several practitioners (4 out of 10) suggested using *My Stories* which refer to all the social stories created by a certain user (see Figure 5.4). Also, as discussed before, it was suggested that the *Social Story Library* and *My Stories* (initially called *Present*) buttons on the homepage be replaced with a button *Libraries*.

Most of the practitioners (7 out of 10) suggested that the name of the button on the *Create Story* screen that allows practitioners to present the story in the student's interface be changed from *Present* to *Show*. They argued that it is more intuitive for them, being similar to the slide show button in MS PowerPoint, software they are familiar with.

5.4.5.4 Content

The topics grouped under this category were discovered by asking the following questions:

- Does the interface offer enough and correct information for the practitioners to take decisions?
- Is there too much information or information that irritates the practitioners?

Filtering Social Stories

Discussions were raised around the criteria necessary to filter the social stories. The practitioners agreed in unanimity that *level* is not a good criterion. The name was intentionally chosen to be generic. The idea was to generate discussions in order to discover if the practitioners have any specific level to classify the social stories, such as language/communication level, or level of understanding. However, all the participants commented that it is very difficult to have such a classification. A practitioner stated:

“It is hard to determine a certain level. For example, a child can have low communication level, but in fact his level of understanding can be higher. I don’t think that it is useful to classify the stories. No, I don’t really think it helps” (P14).

Several practitioners (3 out of 10) appreciated that the topic of the story may be a good criterion for selecting the stories, although they warned that some of the social stories might fall into more than one topic. A suggested criterion was the goal of the story, which was inspired from the first exploratory study. Most of the practitioners (8 out of 10) agreed that it is helpful to organise the library of shared social stories according to the goals addressed by social stories.

Edit Button

In one of the prototype versions a button called *Edit* was introduced in order to access the tools for editing a social story (Figure 5.3, right). Most of the practitioners said they prefer to have all the editing tools from the start, as they are more familiar

with this kind of interface for editors. This also simplified the interaction since by eliminating the *Edit* button, one click was eliminated, too.

Pop up Window before Saving a Story

When saving a social story for a child a pop-up window was introduced in both design alternatives (Figure 5.11). Two of the practitioners suggested introducing a drop down box to select the name of the child, rather than fill in a text field, in order to avoid the errors generated by misspelling. Also, this reduces the practitioners' effort. If the child is a new one, then a text field area should allow the user to introduce the name of the child (Figure 5.13).

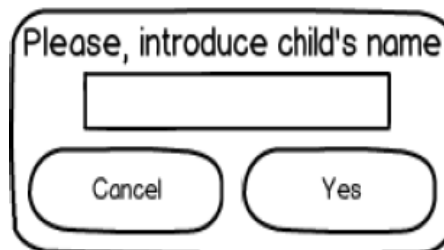


Figure 5.11: Pop-up window to enter the child's name before saving a story

Content of the children profile interface

From the practitioners' stick-on paper notes and from their sketches, it was determined that the following items should be included in the child profile screen: name, photo, date of birth, age, class, social stories associated with that child, corresponding behaviour addressed by each story and initial frequency of behaviour (when applicable), story assessment, and information about resources for social stories (including likes, dislikes, etc.).

Boardmaker symbols

In both stages of the exploratory study, most of the practitioners (7 out of 10) said that they use the symbols provided by Boardmaker software when building social stories. They were also noted in the social stories collected from practitioners (sent via email). Therefore, the idea of including the library of symbols from Boardmaker in the present authoring tool could be useful, given permission from the company which produces this software, Mayer-Johnson.

5.4.5.5 Functionality

The topics in this subsection discuss the functionality that practitioners would like to have but are missing, and the functionality that were considered, but that the practitioners do not need.

Filling in the Partial Sentences

Neither of the two alternatives for filling in the partial sentences were considered appropriate by the practitioners. In the prototype versions the solutions suggested were either to type the missing word or to choose from a drop down list. For the first alternative the practitioners argued that some of the children might not be able to type, while in the second case they said that some children may have also other physical disabilities, and in some cases they might skip the intended item, and click on an incorrect one which may be annoying. All the practitioners suggested that the three options should be displayed under the sentences and that the child should be able to use drag and drop to fill in the partial sentence. This solution is suitable for all ages as can be applied either if the missing item is a word or a picture. Figure 5.12 shows how two practitioners imagine this feature.

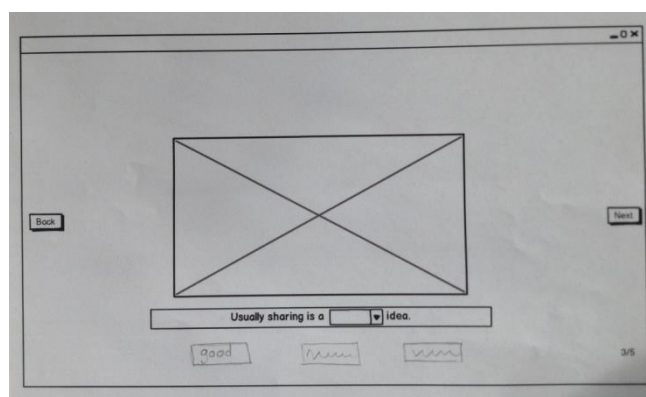


Figure 5.12: *Partial Sentences* screen redesign by practitioners

Drawing Tools

During the brainstorming discussions, a practitioner suggested that the system might provide a set of drawing tools. These can be useful for practitioners while editing a social story. She also added that some drawing tools might be available from the

children's interfaces, to allow them to build or colour some images. She considers that “*this will give children the sense of ownership on the social story*” (P14).

Templates

The exploratory studies revealed that some stories are more frequently used, for example the stories targeting circle time, staying in line, or bedtime routines. The discussions led to the idea of creating templates for frequently used social stories. However, since the tool comes with a library of shared social stories, the practitioners remarked that examples of stories on frequently used topics can be found there. These stories can be edited and re-used, so it would not be necessary to “*complicate the design with a new feature*” (P16).

Organiser for Social Stories

Initially an organiser for the social stories was included in the social story authoring with the purpose of scheduling the social story presentation and also reminding the practitioners when they have to present a specific social story to a particular student. There was a consensus among the participants that the organiser is not an important functionality. They commented that most of practitioners would probably not use it, either because they keep in mind when a story has to be presented to a child (as they work with very few students at a time), or write it down in the student’s folder.

Adding Rewards at the End of Story

Adding rewards at the end of a social story, in the form of text, pictures, animated characters, movies or songs is a new feature which was introduced in this authoring tool. Based on the literature review and previous exploratory studies it was considered to be an appropriate feature to engage the children with the story. Most the practitioners (8 out of 10) considered it to be helpful especially for the partial sentence stories. Practitioners commented that these rewards could improve the engagement and motivation of children.

5.4.6 The Impact of the Study on Design

The results in the exploratory study with the paper prototypes entailed a number of decisions for the design of the social story authoring tool. A summary of the decisions is presented in Table 5.3. The priority of the decisions was taken by consulting the ERT.

Decision	Justification for the decision (Design guidelines; HCI principles which support the decision)	Priority
<i>Homepage</i> design – second prototype	Most of the practitioners liked it. (HCI principle: ‘simple and intuitive to use system’)	High
Position of panels with visual resources on <i>Create Story</i> screen on the left side by default	(HCI principle: ‘flexibility in use’)	High
<i>Shared Stories</i> screen – first prototype	Most of the practitioners preferred it. (HCI principle: ‘flexibility in use’, ‘familiarity’)	High
<i>My Stories</i> screen – first prototype	Most of the practitioners preferred it. (HCI principle: ‘simple and intuitive to use system’)	High
<i>Present Story</i> screen –second prototype	Most of the practitioners preferred it.	High
White was chosen as the default colour for the background with the option of changing the colour	(Guideline: ‘design for customisability’; HCI principle: ‘familiarity’)	High
More story layouts should be available for social stories	All the practitioners agreed with it. (HCI principles: ‘customisability’, ‘flexibility in use’)	High
Position of navigation buttons on the bottom left (<i>Back</i>) and bottom right (<i>Next</i>)	Most of the teachers suggested it (HCI principles: ‘familiarity’,	High
Display current page number under the story area and make the font bigger	(HCI principle: ‘predictability’)	High
Position <i>Add Page</i> and <i>Delete</i> page buttons under the story area	(HCI principles: ‘predictability’ and ‘familiarity’)	High
Display both icons and text on the navigation buttons	(HCI principle: ‘equitable in use’)	High
Search field position on the top right corner	(HCI principle: ‘familiarity’)	High
Layout of the student profile screen	The layout of the student profile screen was informed by the practitioners sketches (Figure 5.11) (guideline: ‘ease practitioners’ workload’)	High
Change the button name <i>Present</i> on the <i>Create Story</i> screen to <i>Show</i>	(HCI principle: ‘familiarity’)	High
Replace <i>Present</i> and <i>Social Stories Library</i> buttons by <i>Libraries</i> button and then select either <i>Shared Stories</i> of	Most of the practitioners considered it as being more intuitive (HCI principles: ‘simple and intuitive to use’, ‘consistency’)	High

<i>My Stories</i>		
Use <i>goal</i> as a criterion to select the stories in the shared story library	Most of the practitioners agreed with it.	High
Exclude <i>Edit</i> button	Most of the practitioners preferred it. (HCI principle: ‘predictability’)	High
Change the pop up window before saving a story	(HCI principles: ‘tolerance for errors’, ‘low physical effort’)	High
Boardmaker symbols	Most of the practitioners suggested it.	Medium
Use Drag and Drop for filling in the partial sentences	Most of the practitioners suggested it. (guideline: ‘design for engagement’; HCI principles: ‘flexibility in use’, ‘equitable in use’)	High
Provide drawing tools	It was considered of low priority since not many practitioners use drawing.	Low
Create templates	Shared stories can be edited and re-used as templates (see section 5.4.5.5)	Low
Exclude organiser for social stories	Most practitioners agreed with that.	High
Adding rewards at the end of the story	Most practitioners liked it. (guideline: ‘design for engagement’; HCI principle: ‘responsiveness’)	High

Table 5.3: Design decisions based on the exploratory study with the low-fidelity prototypes

According to the discussion about the pop up window before saving a social story, the design of this window was refined as can be seen in Figure 5.13.

Figure 5.13: The new pop-up window to enter the child’s name and story title before saving the story

Based on the practitioners' suggestions regarding the layout (section 5.4.5.1) and the content of the *Student Profile* screen (section 5.4.5.4), a paper prototype was created (Figure 5.14).

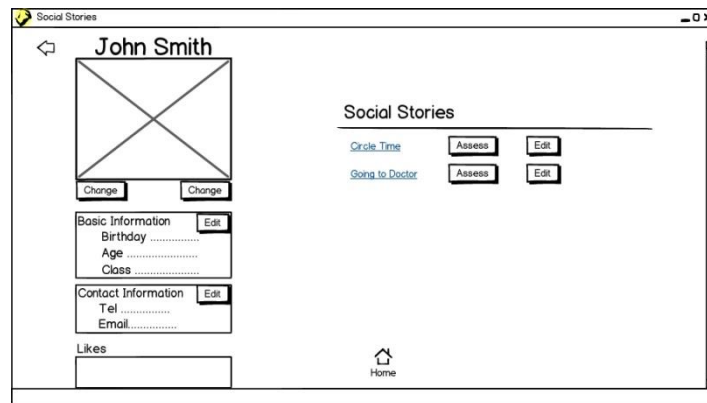


Figure 5.14: Student Profile screen in the low-fidelity prototype

After the present study only one major change in requirements was performed. According to the majority of the practitioners, the application does not need to provide an organiser for social stories; therefore the corresponding requirements were removed.

5.5 Participants Roles and Contributions

10 practitioners and 3 researchers (the ERT members) besides the PR and another researcher who participated in the study (playing the role of computer) were involved at this stage of research. Both groups (practitioners and researchers) play the role of design partner.

The practitioners performed a number of tasks using the low-fidelity prototypes, evaluating them, and validating the requirements at the same time. They either expressed their preference for a certain design idea or came up with their own ideas when none of the versions presented was acceptable. The usability problems identified during the task performance were discussed with the PR. The practitioners suggested solutions for these problems. During the brainstorming session, they contributed individually or in collaboration to the design of new features which were not included in the low-fidelity prototypes. Practitioners reflected on theory and practice and envisioned new practices. For instance, one of the practitioners stated that:

“I think that [the graph for the child’s progress during the story] may be motivating for the child. I would show the graph and say to the child: ‘We have to reach this point’ while pointing out where the graph should go. Then I imagine the child being more motivated to reach the target.”
(P13)

The researchers facilitated the use of the low-fidelity prototypes and supported the practitioners in creating scribbles for the interfaces. They also observed practitioners using the low-fidelity prototypes to identify possible usability problems and they suggested solutions for these problems. The researchers supported practitioners in understanding the technology affordances. Based on the results of the exploratory study, the researchers refined the requirements and contributed to the design of the social story authoring tool. The researchers supported practitioners to relate theory and practice.

5.6 Summary

This chapter reports the design and exploration of two low-fidelity prototype versions for the social story authoring tool. These prototypes were built based on the set of requirements and design guidelines elicited in the pre-design stage, as well as based on HCI principles. An exploratory study was conducted with ten practitioners with experience in social stories. Through this study the requirements were clarified, different design strategies explored, and interfaces and specification refined. Practitioners contributed in creating knowledge and showed interest and enthusiasm for the project.

The next step was to develop a high-fidelity prototype and to explore it both with practitioners and experts in HCI, Education and ASC. This is described Chapter in 6.

Chapter 6

Designing and Exploring the High-fidelity Prototype

This chapter shows how the results in the previous study were incorporated into an evolutionary prototype authoring tool and how it was further explored and refined with practitioners and experts in HCI, Education and ASC. After a brief presentation of the technical decisions for the implementation of the social story authoring tool ISISS (Improving Social Interaction through Social Stories), section 6.1 describes the first version of the tool. Section 6.2 reports a formative study with practitioners and its impact on the design. The second version of ISISS is presented in section 6.3. A formative evaluation study with experts in HCI, Education and ASC is then described in section 6.4. Section 6.5 discussed the roles and contributions that practitioners and researchers provided at the formative evaluation stage. The present chapter covers the fourth stage of the present research (see section 3.5.2).

6.1 Initial Version of the Social Story Authoring Tool

6.1.1 Technical Decisions

The high-fidelity prototype was developed with Adobe Flash Builder 4.6. This is an integrated development environment (IDE) which is built on the Eclipse platform and allows developing applications using Flex framework. A Flex application can be delivered for browsers, desktops and mobile devices and is played back in the Flash Player or AIR runtimes. Flex uses MXML, an XML-based mark-up language for user interface components, but also for non-visual static aspects (e.g. access to data sources on the server). ActionScript 3, which is an object-oriented language, is the second language used within Flex applications mainly for dynamic aspects, logical code, creating class definitions and other features. Whatever is coded in MXML can be also coded in ActionScript 3. MXML code is rewritten into ActionScript 3 at compile time. However, MXML is more convenient to use, making it faster to write an application compared with coding only in ActionScript 3. Usually, in Flex

applications, MXML is used for the visual static aspects of the application, whereas ActionScript 3 is used for its dynamic and logical aspects.

Adobe Flex was selected due to the following advantages:

1. allows faster building the user interface through the MXML language;
2. makes use of the rich libraries of ActionScript 3 which is a powerful and intuitive object-oriented programming language;
3. enables the separation between the front end interface coded in MXML and the back-end ActionScript code which allows modifications of the interfaces without affecting the underlying code.

The reason why Adobe Flash Builder was selected is that it comes with a WYSIWYG (“What You See Is What You Get”) editor which permits adding components in MXML Design mode, by simply using drag and drop. This is a powerful tool which permits the developer to see the graphical user interface while it is being built and speed up the coding process. These advantages were extremely useful in the process of prototype development, as a significant number of alterations were made to interfaces following the formative studies.

A student free licence was obtained for the Adobe Flash Builder 4.6 standard version. The authoring tool has been developed as a desktop application on a DELL Latitude E4300 laptop.

6.1.2 First Version Prototype Description

According to the decisions discussed in the previous exploratory study (section 5.4.6), a high-fidelity prototype was built. An evolutionary prototyping approach was adopted during the implementation. “In this case, the actual system is seen as evolving from a very limited version to its final release.” (Dix et al. 2004, p. 242). This approach was chosen because it permits immediate and effective feedback. The prototype is partially built, the users try it out, then the prototype is adjusted according to the users’ feedback and more features are implemented. The process is repeated while the prototype evolves towards its finished form. Another reason for

adopting an evolutionary prototyping approach was because it gives flexibility in choosing a convenient time to get feedback from users, being easier to synchronise the prototype development with the users' available time.

The requirements implemented in the first version were selected to support the most frequent tasks that practitioners follow in their social story interventions: browse for the social stories in the libraries, create/edit, present, and save a social story, import an image from the Internet (see the list of task in the formative evaluation with practitioners, section 6.2.2.3).

Additionally, two other tasks were considered: edit a profile of a student and annotate the story sentences. The first one was included to elicit more information about how the student profile page should be organised. The annotation of the sentences was introduced to get the practitioners opinion on this feature's ease of use, but also to understand if practitioners are open to using it.

Nine basic screens were implemented following the decisions in 5.4.6. A single window was used for all the screens, except the *Show Story* screen and the dialogue boxes (e.g. file browser window). The *Show Story* screen is designed for the students as an alternative to the hard story copy. It is necessary for this be in an independent window, so the students do not need to return to the other screens (such as create, libraries and others). According to the discussions with the practitioners during the low-fidelity prototypes exploration this window should be very simple, without features that might disturb student's attention from the social story.

6.1.2.1 *Login*

Figure 6.1 is a screenshot of the *Login* screen of ISISS. After introducing the username and password the user is presented with the *Homepage*. The user must be authenticated in order to have access to the shared social stories, and also to the social stories she authored.

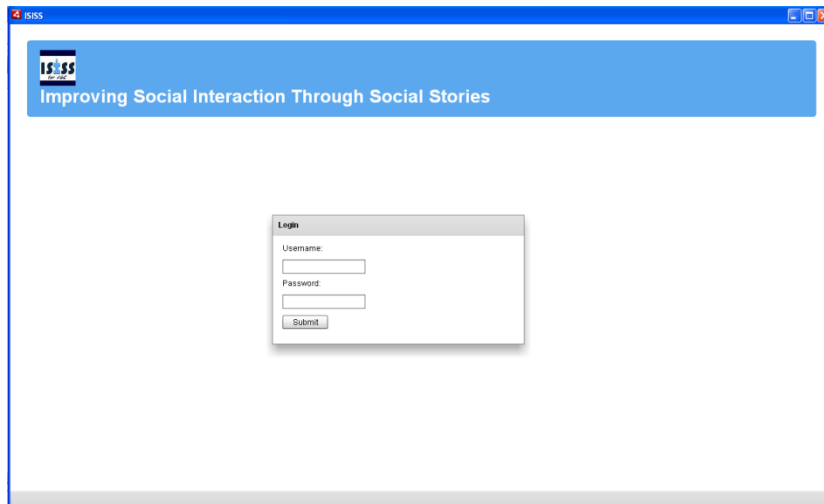


Figure 6.1: Login screen

6.1.2.2 Homepage

According to the decisions in section 5.4.6 the *Homepage* contains three main buttons: *Libraries*, *Create* and *Profiles* (see Figure 6.2). By pressing a button the user is prompted with a corresponding screen (e.g. by pressing *Libraries* button the *Libraries screen* is displayed).

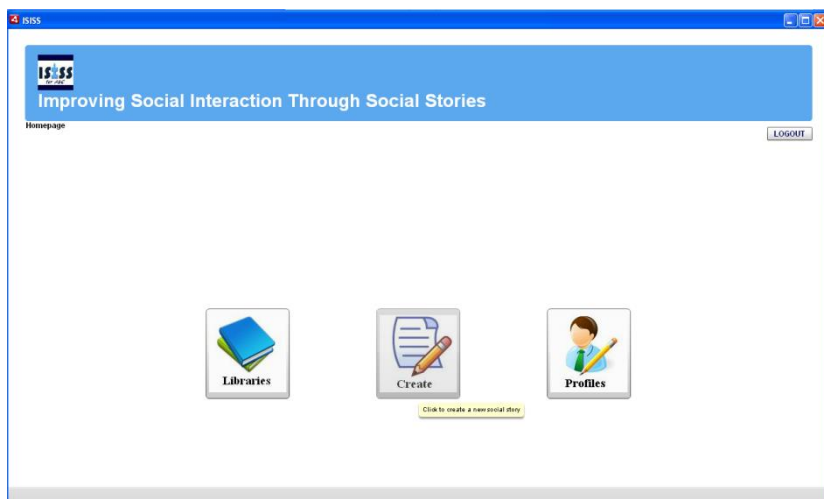


Figure 6.2: Homepage screen

6.1.2.3 Create Story Screen

Create Story screen is illustrated in Figure 6.3. This page is divided in four main areas: *story area*, *resources area*, *tools area* and *information area* (see Figure 6.3).

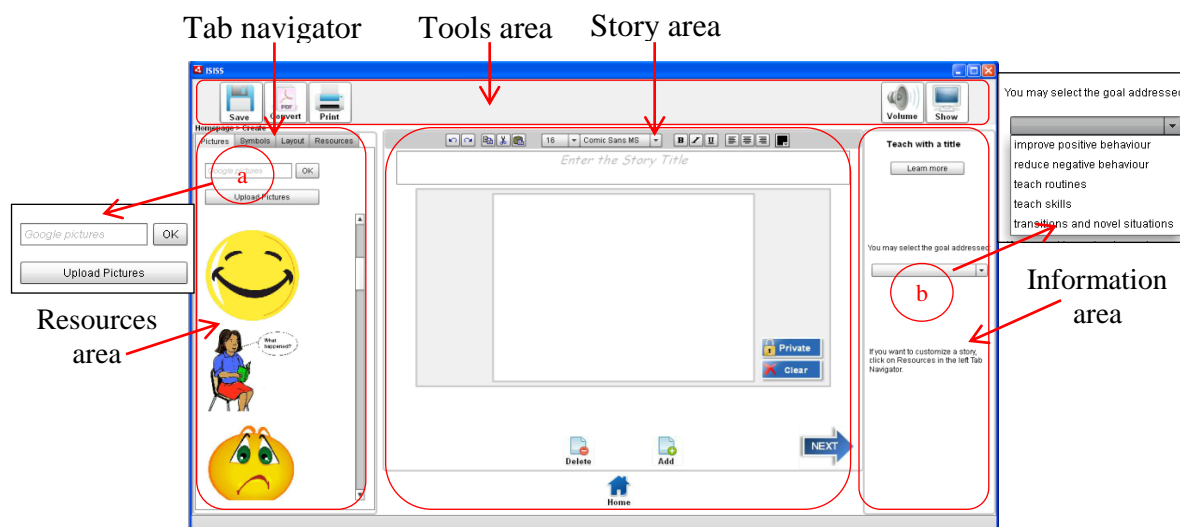


Figure 6.3: *Create Story* screen

Practitioners can write a new story or edit an existing story, page by page, in a book story format, and can manage resources (e.g. images that can be shared with other practitioners or images for their own students only). On the *Create Story* page, there is the option to choose the story goal, to annotate a sentence (according to Gray's guideline), or to get more information about Gray's guidelines (see 6.1.2.6). Options to save, convert to PDF format, and print the story, as well as to read it out loud and display it in the student's interface are provided.

6.1.2.4 Writing/Editing a Story

On the *story area* (Figure 6.3) the user can write the story by introducing the text in the corresponding text area which is made visible by using a prompt text. An image from the *resources area* can be added on the middle of the *story area* by using drag and drop. Tools are provided to change the text features and also to manage the text (copy, cut, delete and paste). Next to the image container, on the story page, two buttons are available. One of these buttons allows the user to select the image privacy (e.g. public, if it can be viewed by anybody if the story is saved in the shared story

library, and private, if it should be hidden when the story is saved for public use). The other button permits the user to clear the image if it was added by accident or if the user changes her mind.

A page can be added or removed. Automatically, the number of the current page, as well as the total number of pages is updated to make the effect of the user's action visible, being in accordance with the HCI 'predictability' principle (see Figure 6.4).

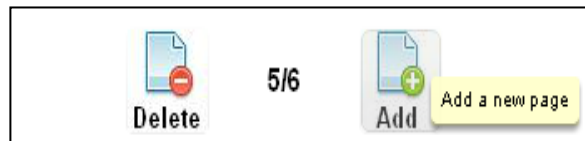


Figure 6.4: Adding and removing a story page

6.1.2.5 Managing Resources

Practitioners can add pictures from the library of shared resources on the *resources area*, but also specific pictures for a particular student. When clicking on a student name (see Figure 6.5, left), the resources for that student are displayed on the *resources area* (Figure 6.5, right).

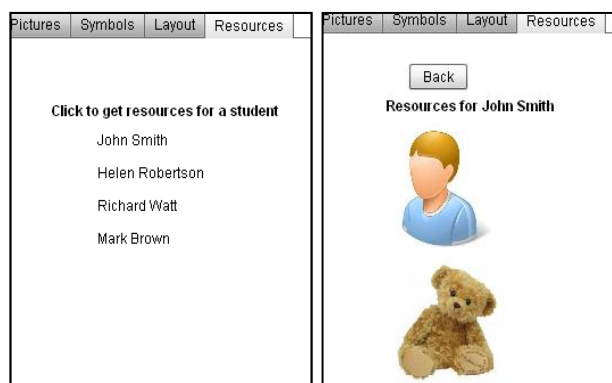


Figure 6.5: Managing the resources for a particular child: [left] list of students; [right] resources for a student

The *Back* button allows the user to return to the list of the students.

New images can be added by using an Internet search tool or by uploading them from the computer (Figure 6.3, a). Options to remove an image from the library of shared images or from the library with images for a particular student have been provided. The story layout can be changed when practitioners choose to present a story to the student. Although not functional yet in this prototype version, two examples of layouts were displayed on the *Layout* item of the *Tab Navigator* in *resources area* (see Figure 6.3) in order to spark discussion on this topic.

6.1.2.6 Information about Gray's guidelines

By clicking the *Learn more* button on the *Information* area on the *Homepage* (see

Figure 6.3), users can find information about how to select a title for the story and also about the types of sentences (according to Gray's guidelines), along with examples. This information appears in separate windows (Figure 6.6).

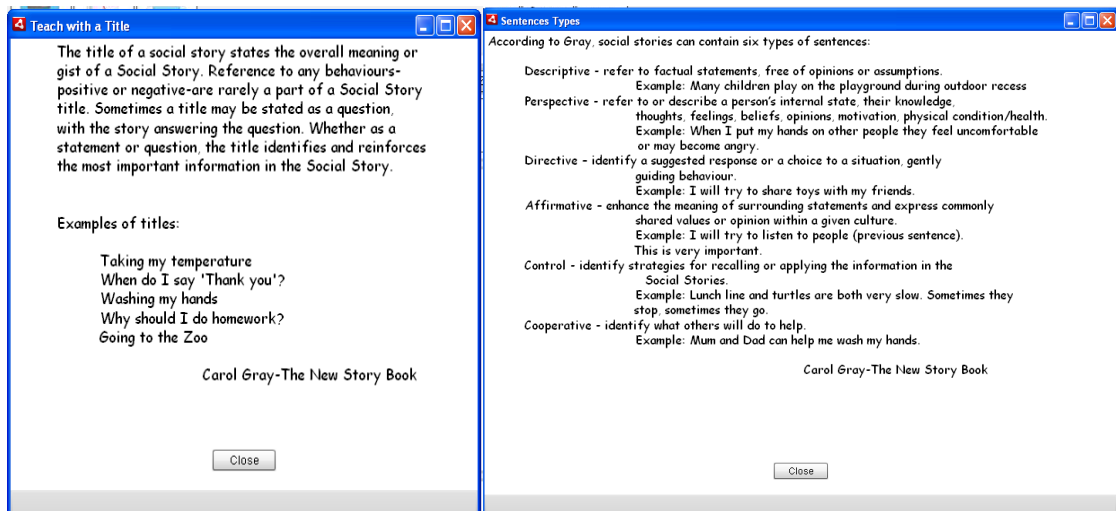


Figure 6.6: Pop-ups windows with information about: [left] social story title; [right] types of sentences

6.1.2.7 Selecting the story goal

Optionally, the goal of the story can be selected from a drop down list on the *Information* area, while the story area displays the title of the story (Figure 6.3, b). This option serves further to filter the shared stories. Thus, if the story is saved in the shared story library, then the user can find it in the corresponding goal category.

6.1.2.8 Annotating the sentences

The sentence type can be optionally annotated using a drop down list which appears on the *Information area*, while the story area displays a sentence on the *story area*. The drop down list displays the six types of sentences, according to Gray's guidelines (see Figure 6.7).

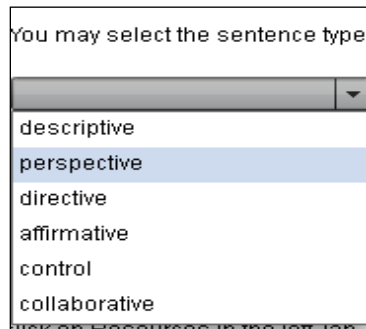


Figure 6.7: Drop down list to annotate a sentence

The user may get feedback about the content of the social story in terms of type of sentences before deciding to save the story. Thus, after clicking the *Save* button, a window appears providing the number of each type of sentence (Figure 6.8). Also, the user gets information about whether or not the story adheres to Gray's recommended ratio (see section 2.2.1).

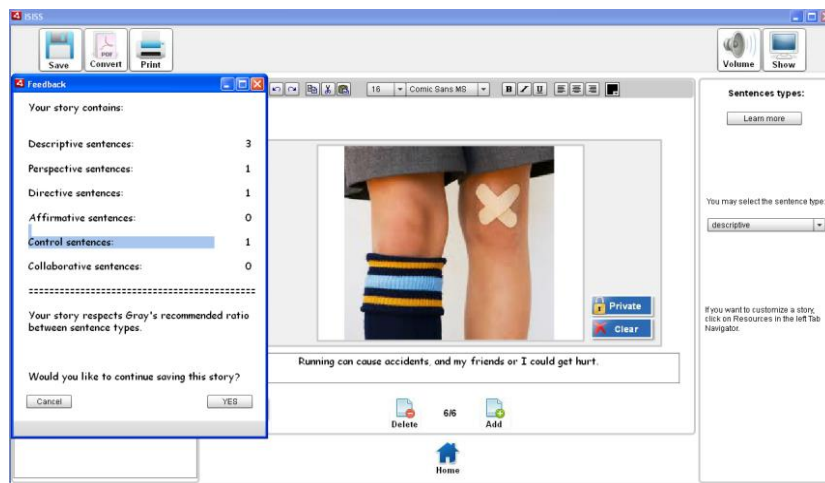


Figure 6.8: Feedback window providing information about story content in terms of sentence types and Gray's recommended ratio

6.1.2.9 Shared Story Library

By clicking the *Libraries* button on the *Homepage* (Figure 6.2), the user is prompted with the *Libraries* screen which contains only two buttons: *Shared Stories* and *My Stories* (Figure 6.9).

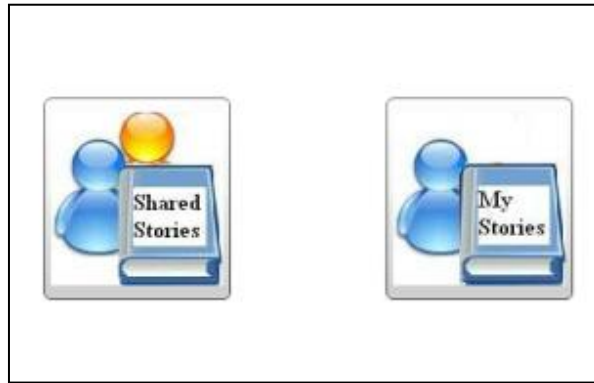


Figure 6.9: Buttons on the *Libraries* screen

Figure 6.10 shows the *Shared Stories* screen. The stories in the shared story library can be filtered by using the goal of the story, or the type of the story in terms of sentence completeness, as it was decided in section 5.4.6. An alphabetical filter of the story title can be also used to select a story.

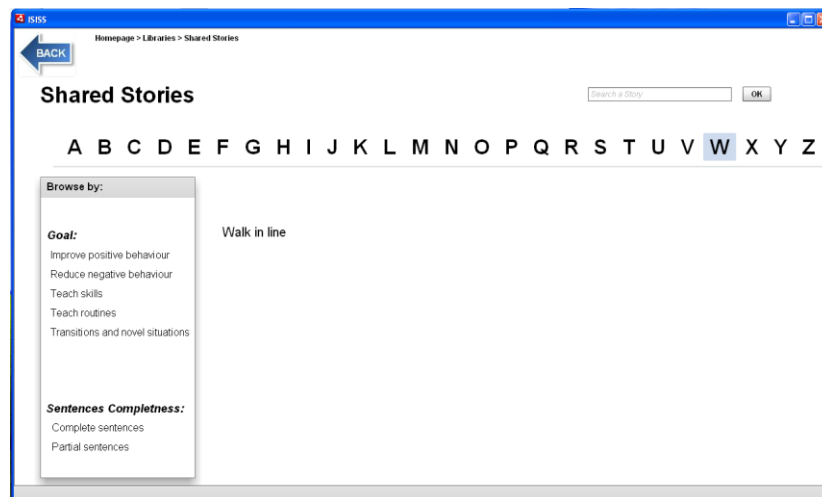


Figure 6.10: *Shared Stories* screen

A search option is also available. The user should introduce either the full title of the story or a word which is contained by the title and then click the *OK* button (see the top right corner of the screen, Figure 6.10).

6.1.2.11 My Stories Library

To select a story written for a particular student (individual story), the user selects the type of story (e.g. with complete sentences or partial sentences), then the name of the student in the left hand side container (see Figure 6.11). A list of stories written for that student is displayed on the right hand side container. A story can be opened by clicking the corresponding story link.

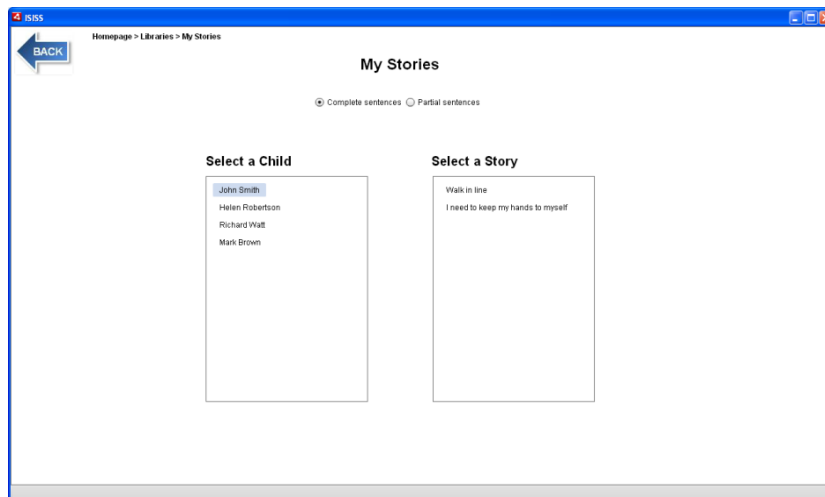


Figure 6.11: My Stories screen

The individual stories can be also opened from the *Student Profile* screen (see 6.1.2.12).

6.1.2.12 Student Profile

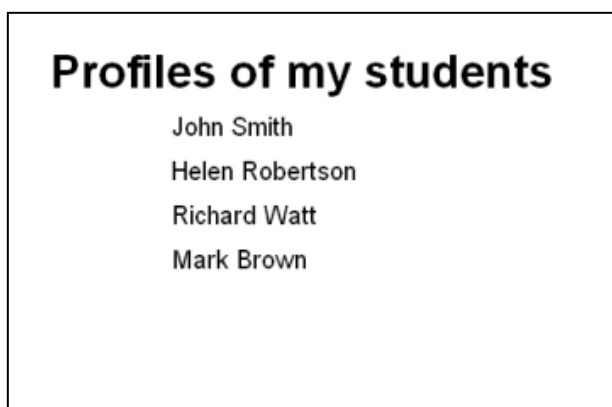


Figure 6.12: Students' list on the Profiles screen

In order to visit a student profile, the user clicks the *Profiles* button on the *Homepage* screen (Figure 6.2) which opens the *Profiles* screen. This screen displays a list of names of the students associated with that user (Figure 6.12). By clicking a certain name the user can

open the *Student Profile* screen. This screen has been further developed by adding options to add a new student and to remove a student from the list.

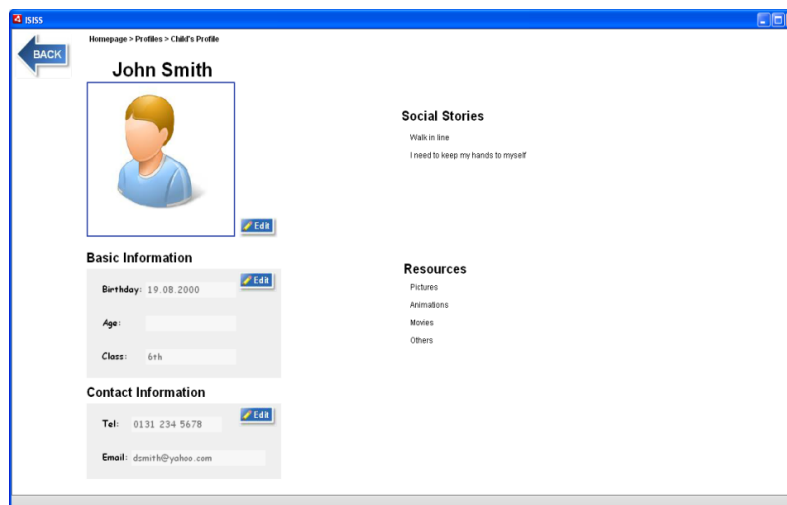


Figure 6.13: *Student Profile* screen

The *Student Profile* screen was only partially developed at this stage (Figure 6.13). According to the results of the previous study it contains basic (name, birthday, age, and classroom) and contact information about the students, as well as a list of social stories written for that student. The information in each section can be edited by using the *Edit* button. Optionally, a photo of the student can be added or changed.

6.1.2.13 *Show Story* Screen

Figure 6.14 presents the *Show Story* screen. The interface allows the student to view and navigate through the story by using *Next* and *Back* buttons. This screen appears

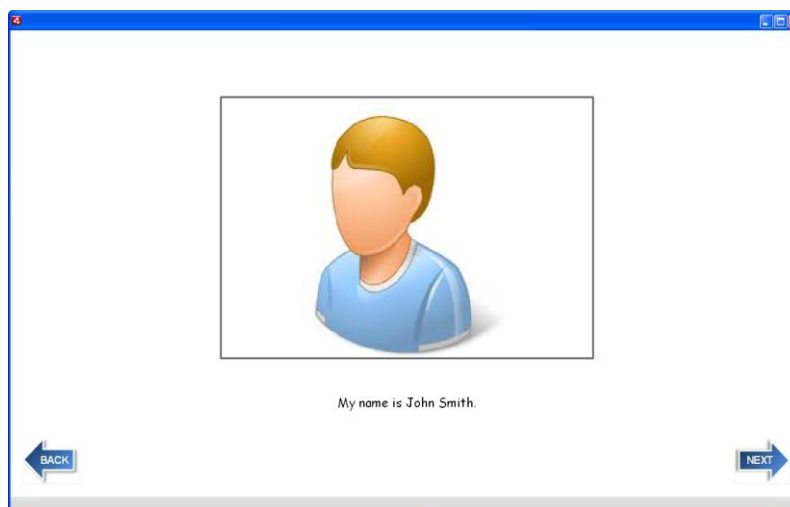


Figure 6.14: *Show Story* screen

on a separate window, so that the student is not allowed to navigate through the entire application and have access to the other features (e.g. edit the story, view other student's profile, etc.).

6.1.3 More Design Decisions

Besides the decisions presented in section 5.4.6, a number of decisions based on the research literature and the regular meetings with the ERT were taken to meet the HCI principles presented in 5.3.2:

- tooltips should be used to indicate the affordable actions (HCI principle: 'predictability');
- the buttons should react by changing the colour background while the pointer is moved on it (HCI principle: 'responsiveness');
- by default, font family for the social story title and sentences should be Comic Sans MS and the font size should be at least 14, as recommended by Walsh and Barry (2008);
- scrolling should be avoided when possible as it involves effort for users and sometimes confusion (HCI principle: 'low physical effort');
- whenever possible, buttons should display both text and images (HCI principles: 'predictability' and 'simple and intuitive in use');
- buttons corresponding to unavailable actions should be disabled (HCI principle: 'predictability');
- windows should be resizable whenever appropriate (HCI principle: 'flexibility in use');
- pop-up windows to prevent possible errors should be used, for example when deleting a page or a story (HCI principle: 'tolerance for errors');
- pop-up windows should be provided to offer feedback for users' action (e.g. when saving a story) (HCI principle: 'responsiveness')
- minimise the design and make optional features which are not frequently used by practitioners (e.g. save a shared story version) (HCI principle: 'flexibility in use').

6.2 Formative Evaluation with Practitioners

The first version of ISIS was used in a formative evaluation conducted with five practitioners with experience in social stories.

6.2.1 Study Aims

The aims of this study were as follows:

- to assess users' ease of use while interacting with ISIS;
- to discover to what extent the designer's mental model coincides with the user's mental model;
- to identify any design problems which causes confusion both in functionality and usability and possible solutions for them;
- to find suggestions to improve the application (in terms of functionality and usability).

6.2.2 Study Design

This study was designed as a task-based exploration and employed cooperative evaluation and semi-structured interview (Dix et al. 2004). Cooperative evaluation is a version of TA, but differs from TA in that the user is encouraged to participate as a collaborator and not as a simple participant. The participant can ask questions (e.g. "why", "what-if") whenever it is necessary to clarify the user's behaviour. At the same time the user can ask the participants to clarify various aspects for any problem they encountered.

Before the formative evaluation took place, a pilot study was conducted with three researchers. The main goals were to discover any problem related to the study design and to check if it fits into the limited time slot with practitioners. However, some technical and usability problems were also discovered in the pilot studies (see 6.2.3). These problems were fixed before the formative evaluation started.

6.2.2.1 Participants

The participants in this study were 5 practitioners (P9, P18-P21, see Appendix F) with experience in developing social stories for children with ASC. They were 3 teachers and 2 nursery nurses working in special schools for children with ASC.

6.2.2.2 Materials

Each participant received an information sheet, a consent form, and a list of the tasks to be performed using the authoring tool ISISS (see Appendix L).

6.2.2.3 Procedure

Each practitioner was invited individually and asked to perform the following tasks:

1. Find a story called “Circle time” in the library of shared stories and open it.
2. Present the story “Circle Time” to a child.
3. Find a story called “I need to keep my hands to myself” which is written for John Smith and show it to the child.
4. Open a story called “Circle time” from the shared library, edit it and adapt it for John Smith as follows. Add a first sentence: “My name is John Smith”, and add corresponding pictures. Delete the last sentence.
5. Annotate the new sentence you have just introduced and check the others. Please, feel free to change the sentences types if you find it necessary.
6. Save the story you have just edited for John Smith.
7. Edit the profile of Mark Brown as follows: i) Birthday: 1.06.2004; ii) Class: 2nd primary; iii) Tel: 0131 245 6789; iv) Email: tb@gmail.com.
8. Find images on Internet using the keyword *dog* and upload them into the application.

During the task the practitioner was encouraged to verbalise her thoughts and to ask questions to clarify some aspects if she encountered problems. At the end of each task the participants were asked what features they liked and/or disliked, and what their suggestions for improving that task were. Additionally, a set of questions were

prepared for each task (Appendix L). These questions were asked in case the answers were not already obtained during the task. Each session lasted for one hour. All the sessions were video recorded.

6.2.3 Results of the Formative Evaluation with Practitioners

6.2.3.1 Ease of Use

The ease of use refers to the ease with which the user discovers how to perform a task and carry it out. Generally, the analysis of the video recordings showed that the practitioners found the application easy to work with. The practitioners performed the tasks without major problems: three practitioners performed six out of the eight tasks without help; one practitioner performed seven tasks without help, whereas the other one performed all the tasks with no help. The problems revealed during this study will be further explained in detail in section 6.2.3.2.

The tool was favourably received by practitioners, who generally regarded it as being intuitive, and meeting their needs. All of the five participants commented that it is simple to work with:

“It’s quite self-explanatory. It was very clear what steps to take to find this” (P9)

“It looks pretty simple. It’s nice and simple, nice colourful pictures” (P19)

Referring to the *Show Story* screen, the practitioners considered them as being easy to use:

“Very straightforward! I think for a child that would be really quite easy.” (P18)

“I like it. You can see the pictures, they are big enough. And you can see even the arrows going back and forth. Yes, that’s fine, the children will know to do that themselves (pointing towards the arrows on the screen)” (P21).

One practitioner remarked that the *Comic Sans* font is appropriate for the children with ASC, especially the younger ones, who struggle with some glyphs:

“The font is good [Comic Sans] because for younger children the font is a problem, especially the letter 'a'. That’s a good one to have” (P20).

6.2.3.2 Designer’s and User’s Mental Models

Various authors in the field of HCI use the terms mental model and conceptual model interchangeably (Staggers and Norcio 1993) to mean the mental representation of a system that guides the user interaction and interpretation of the system’s behaviour (Young 1983, Norman 1983). A clear decision should be made regarding what the model actually represents (e.g. the architecture, the task, etc.). Also, another clarification is necessary when discussing about the owner of the model (e.g. the user or the designer).

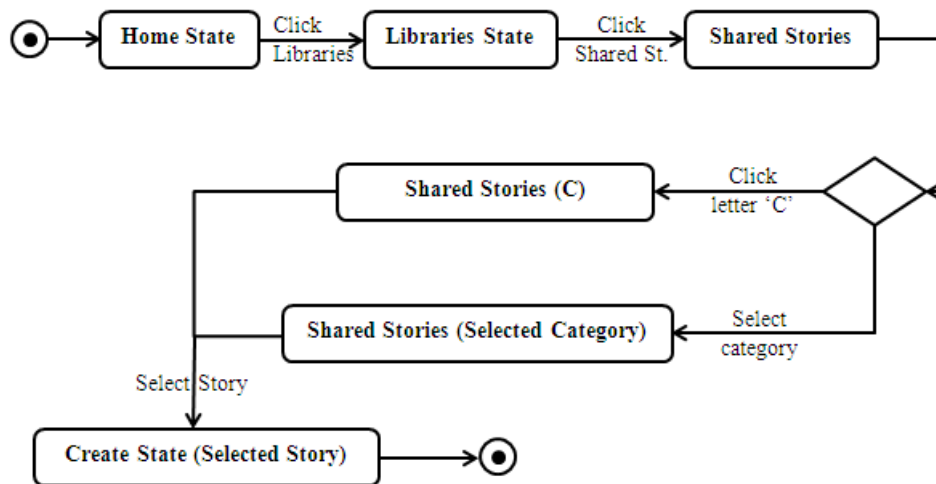


Figure 6.15: States diagram for the first task

The mental model in this study refers to the representation of the tasks described in 6.2.2.3. States diagrams were designed before the study in order to capture the designer’s mental model of the tasks, representing how the system behaves under the expected actions of the user (Figure 6.15). Based on the users’ actions, states diagrams were designed after the study to capture the user’s mental model. For a good design, according to Norman (2002), the user’s mental model should match the designer’s mental model. Therefore, the states diagrams representing the designer’s mental model and user’s mental model were compared to discover the extent to which the two models coincide.

Figure 6.16 shows for each task the number of the users (N) for which the states diagram matched the designer's state diagram. The practitioners performed very well in most tasks, except 2 and 4. These are the tasks where the practitioners encountered the problems discussed in the next section.

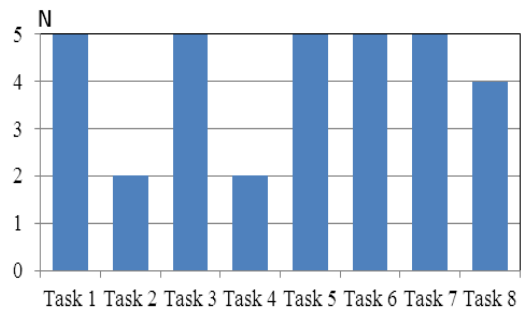


Figure 6.16: Tasks' performance

6.2.3.3 Problems and Solutions

A number of problems were revealed in this study. One of the problems was created by the position of the *Show* button which allows the practitioners to present the story in the student's interface. This button was placed in the right top corner (see Figure 6.3). Three of the practitioners did not notice it without hints from the researcher. A teacher (P9) who managed to find this button with no help also commented: *"It took me a moment to find the 'Show' icon, but that's because it is the first time I'm using it"*. Another problem was related to the *Add and Delete Page* buttons. 3 out of 5 practitioners found it difficult to discover these buttons. Several practitioners remarked that the links to navigate from one screen to another are hardly visible and too 'hidden' among other interface features. Also, two practitioners considered that the font size on some of the buttons labels should be magnified to make the text more visible

The practitioners remarked that the visual materials on the *resources area* were not sufficiently well-organized to make it clear which are general (sharable) and which are individual (referring to a particular child). Most of the practitioners suggested having two tabs called "General Resources" and "Individual Resources" which would enable each to be easily identified.

One of the practitioners was confused by the edit/done button on the *Student Profile* screen. In order to edit the information a button *Edit* had to be pressed and its display

changed to *Done* which was supposed to be pressed to update the information. The user commented that she might forget to press the *Done* button which then results in the data being lost. She suggested that placing the button after the text areas might be a solution.

When saving a story for a particular student, a drop down list with the existing students was provided. For a new child, the practitioners had to fill in a text area (Figure 20, left). During the study it was noticed that, once the name of the student was selected, some practitioners were confused about whether or not the text area for the new child has to be filled in. One practitioner commented that: “*Since I have already chosen the name of the child, I think I don’t need to see this field here. It confuses me*” (P19).

In the pilot study, a participant remarked that when she double-clicked the *Library* button on the *Homepage*, the second click was in fact applied to the button *Shared Stories* on the next screen (*Libraries*) which took her directly to the *Shared Stories Library* without having the chance to choose between *Shared Stories* and *My Stories*. This happened because both the *Library* and *Shared Stories* buttons had almost the same coordinates on their screens.

6.2.3.4 Suggestions

While performing the tasks, the practitioners came up with several suggestions to improve the application. Two of the practitioners suggested that it may be useful if the user had the option to add comments on a social story written for a particular student, including the target behaviour and how the progress of the student is assessed during the story implementation. One practitioner suggested adding the Individual Evaluation Plan (IEP) form on the student profile. The IEP is an individualised document for a student who receives special education to help parents and school staff to work together on improving the student’s educational results. During the tasks, one practitioner commented that the screens ‘have too much white’ which seems intimidating and at the same time not too attractive. Other suggestions were related to: ranking the stories, the option to select a specific page while creating

the story, speech bubbles to be added to the story and others. A table with all the suggestions collected during the formative evaluation with the practitioners can be found in Appendix M.

6.2.4 Changes to the Prototype

The usability problems and the suggestions were analysed together with the ERT. They were prioritised based on the three design principles presented in section 4.3.1 and HCI principles (see 5.3.2). A number of changes were applied to the high-fidelity prototype. All the usability decisions regarding the suggestions and usability problems are summarised in Appendix M. This section will present only the most important changes which were made based on the results in the formative evaluation with practitioners.

Show Button

To make the *Show* button visible, the decision was to move it above the story area (see Figure 6.17, a). This was suggested by 3 of the participants.

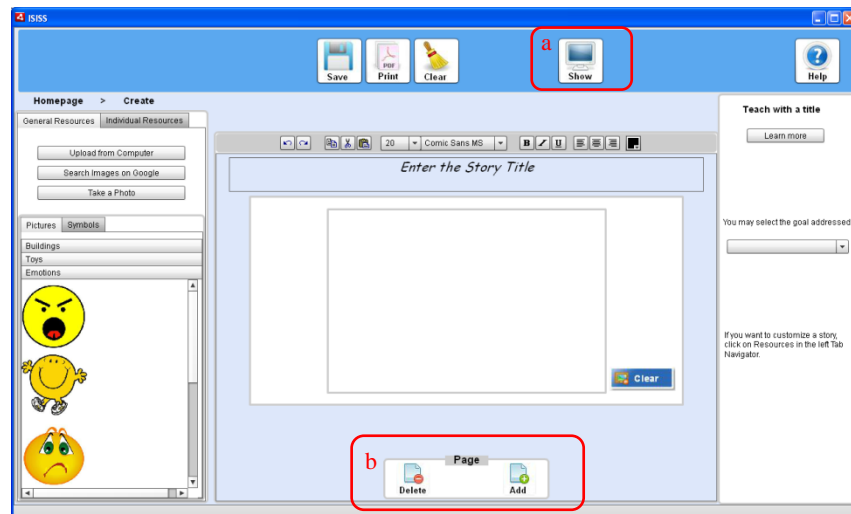


Figure 6.17: Create Story screen in the second version

Add and Delete Page Buttons

The *Add* and *Delete Page* buttons were made visible by placing them on a container with a visible border and attaching a *Page* label (see Figure 6.17, b).

Resources Area

Figure 6.18 shows the *resources* area in the first (on the left side) and in the second prototype version (on the right side). Based on the practitioners' suggestions the resources were grouped into two categories: general resources (which are visible for



Figure 6.18: Resources area: [left] first prototype version; [right] second prototype version

any user) and individual resources (which contains resources for the practitioners' students, and are visible only for the practitioner who created these resources). Moreover, the general resources are grouped in categories which can be created,

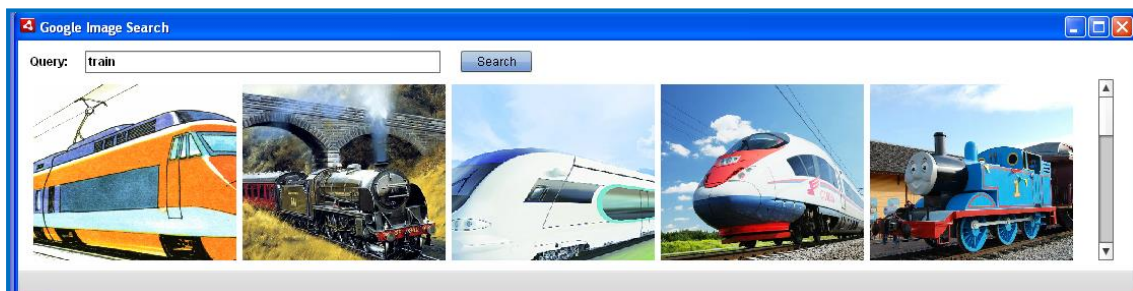


Figure 6.19: Google Image Search window

deleted or renamed by the practitioners using a right click menu.

Another change on the resources area was to replace the text field and the *OK* button for searching images on Internet with a simple button (*Search Image in Google*). When clicking this button a window appears (Figure 6.19). That allows the user to drag a picture directly on the story area or to save it either in general resources or in individual resources.

Save Story Window

Figure 6.20 shows the *Save window* in the first and second version. It can be noticed that in the second version the field for the new child does not appear at the beginning. When the user clicks the *New child* item, a text field appears below the drop down list (similar to the one in the first prototype, see Figure 6.20, left) which permits the name of the new child to be introduced.

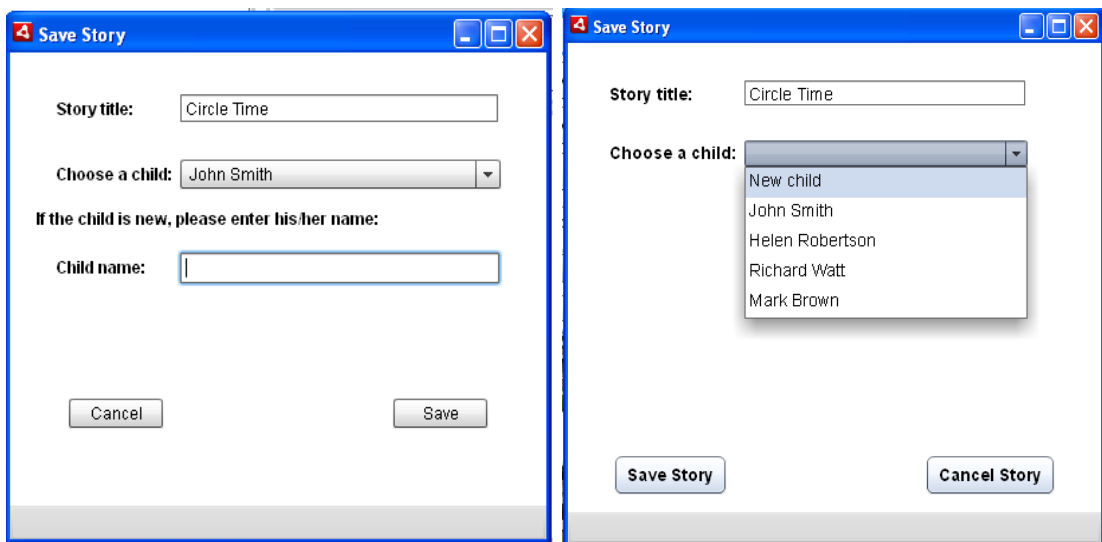


Figure 6.20: Save Story window: [left] first prototype version; [right] second prototype version

Once the *Save Story* button is pressed, the list of students on the *Profiles* screen automatically updates. When clicking on the new added name in this list, a standard *Student Profile* screen appears with a placeholder image for the student's photo (Figure 6.21)



Figure 6.21: *Student Profile* screen for a new student

6.3 Second Version of the Social Story Authoring Tool

As mentioned before, only some of the requirements were implemented in the first version of the prototype. After the changes based on the results of the formative evaluation with practitioners were applied, the remaining requirements were implemented. The main added features are briefly presented in this section.

Settings

Figure 6.22 presents the *Settings* window. This window allows the users to set the font features (such as font family, size and colour), and the background colour for the story. In addition, the users decide whether or not they want to get feedback for the story, to create partial sentence stories or to create shared stories. By default, all these options are selected (see Figure 6.22) and the reason was to make the user aware that these features exist. However, during the process of saving the story, the user can choose to skip creating a partial sentence story version or/and a shared story version. The font family is Comic Sans MS by default, the size is 20 and the font colour is black. For the story background the default colour was chosen to be white.

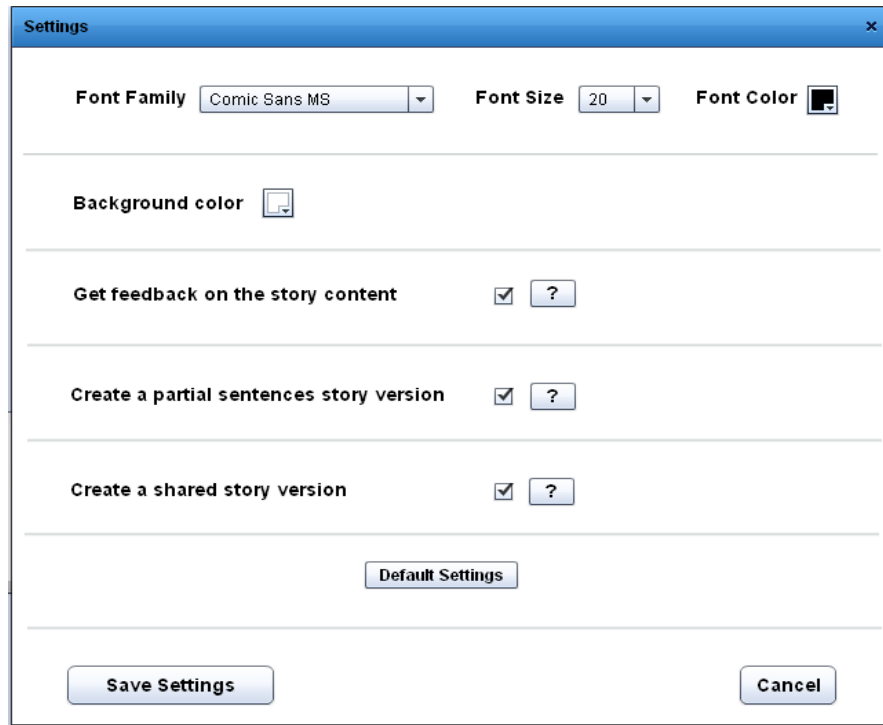


Figure 6.22: Settings window

Take a Photo

Figure 6.23 shows the *Take a Photo* window. The user can take a photo using the web camera. The web camera image appears on the left side. When pressing the Take Photo button a photo is added on the right side of the window. To save this

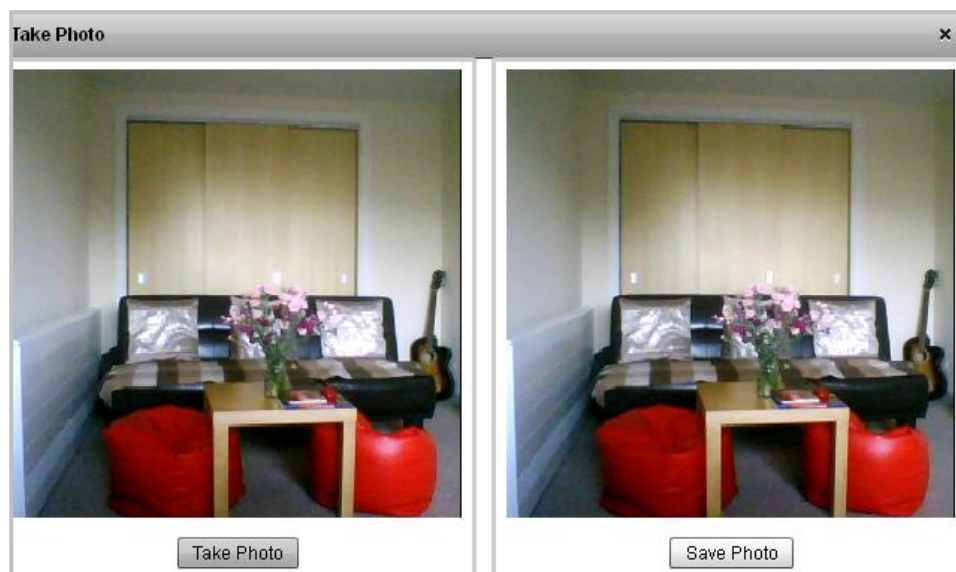


Figure 6.23: Take a Photo window

photo on *resources* area, the user has to click the Save Photo button.

Present a Partial Sentences Story

A partial sentences story contains one or more sentences with words which are missing (hidden words). While navigating through the story, the child is asked to fill in the partial sentences by choosing and clicking the correct word from three choices (Figure 6.24). The child is not allowed to go further until the sentence is completed. If the correct word is clicked, its font becomes green and it moves slowly and fills in the gap in the sentence. If the child clicks the incorrect word, the font of the word becomes red. Once the sentence is completed, the *Next* button is displayed and the child can move further through the story.



Figure 6.24: Presenting a partial sentences story

At the end of the partial sentences story, the child receives a reward which consists of a text and an image which are optionally provided by the practitioner who created the partial story (see Create Partial Sentences Story). If the practitioner did not provide a reward, a default text and image are displayed on the reward page.

Create a Partial Sentences Story

While saving a story, the user can opt for creating a partial sentence story version of the story she is saving. A dialog window appears asking the user to choose whether

or not she wants to create a partial sentences story version (Figure 6.25).

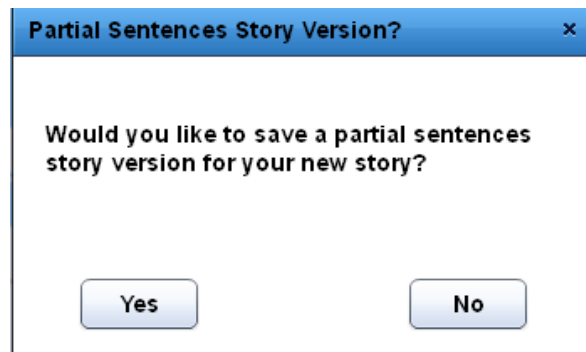


Figure 6.25: *Partial Sentences Story Version Confirmation window*

Once the user selects the *Yes* button, the *Create Partial Sentences Story* window appears (Figure 6.26). The current social story (which is saving) is displayed on the left hand side of the window. On the right hand side the users get instructions about how a social story with partial sentences can be created.

To create a partial sentence, the user is asked to select which word has to be hidden by double clicking that word (e.g. the word 'walk' in Figure 6.26). This word will appear on the right hand side, in the field *Hidden Word*. This word is automatically one of the three choices which will be displayed under the partial sentence when the child will be presented with this story. The other two choices should be provided by the practitioner who introduces them in the two text areas under the label *Choices*

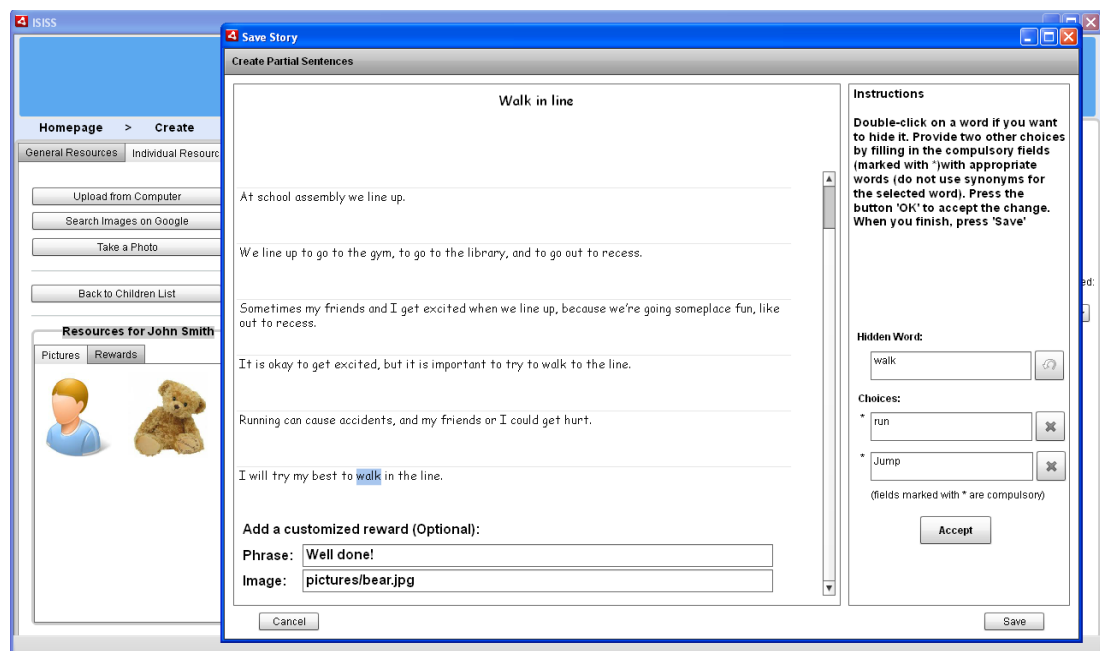


Figure 6.26: *Create Partial Sentences window*

(Figure 6.26).

Once the choices are provided the user has to press the *Accept* button. The word in the sentence is replaced by a line, and the text areas are cleared. The user can move further to select another word to be hidden. In order to save the partial sentences story, the user has to press the *Save* button which is placed at the bottom right corner.

Create a Shared Story

Figure 6.27 presents the *Create Shared Story* window. A dialog window, similar to the one in Figure 6.25 asks the user to confirm if she wants to create a shared story version.

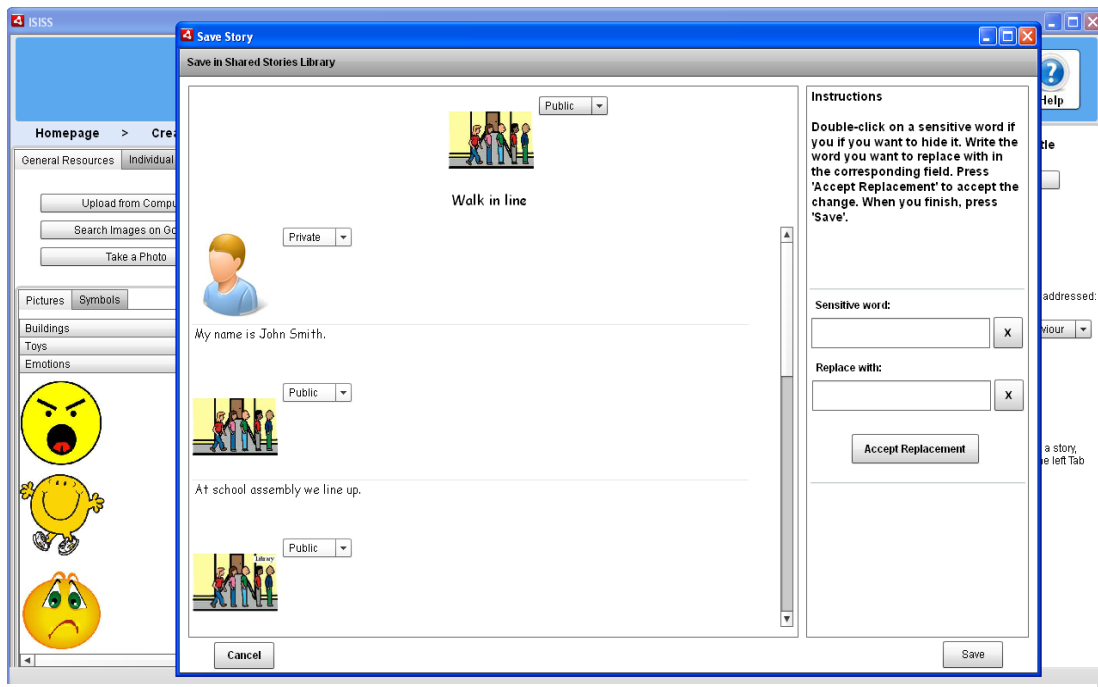


Figure 6.27: Create Shared Story window

Select Story Layout

A story can be created or edited in a book story format as it is illustrated in Figure 6.3. This decision was taken to make the process of writing simple and consistent (in line with HCI principles ‘simple and intuitive in use’ and ‘consistency’- see section 5.3.2). However, when presenting or printing to PDF, the user can either choose to keep the book story format, or to change it to one of the following layouts: *Text*

Only, *Stacked Pictures*, and *Parallel Pictures* (see Figure 6.28). This feature supports the G1_EPW guideline, described in section 4.3.1. The story is displayed on the left hand side of the *Create Shared Story* window, while on the right hand side the user is provided with instruction to create a shared story. Before saving a shared story the user can opt for replacing some ‘sensitive’ words. A ‘sensitive’ word is a word which the story author decides not to share with other users for privacy reasons. When double-clicking a word, this appears in the *Sensitive Word* field on the right hand side, below the instructions. Optionally, the user can suggest a word to replace the ‘sensitive’ word which was selected. If no word is introduced in the *Replace With* field, the selected word is automatically replaced by “_WORD_” when the *Accept Replacement* button is clicked. An image can be also selected to be private using a drop down list which appears next to each image. If *private* item is selected from the down list the image is replaced by a placeholder image when saved in shared stories library. The shared story can be saved by clicking the button *Save* which is placed at the bottom right corner of the *Create Shared Story* window.

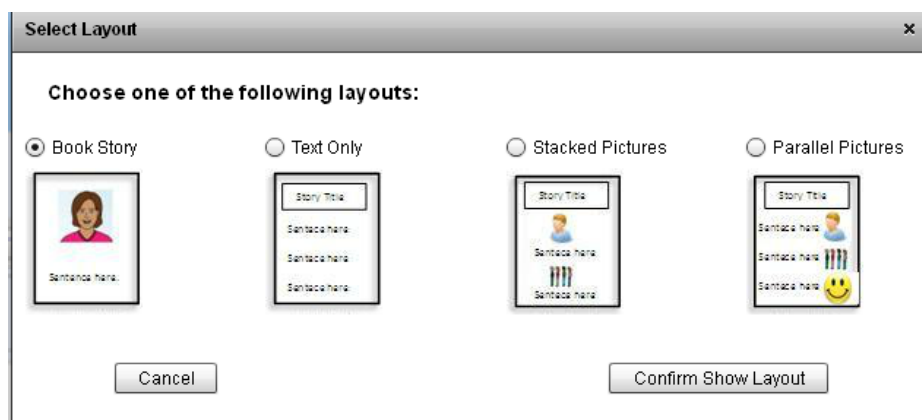


Figure 6.28: Select Layout window

Read the Story Out Loud

The read out loud option is made available to the user based on text to speech technology (TTS). For that the CereProc speech synthesis engine has been incorporated into the tool (<https://www.cereproc.com/>). This is a technology to create realistic synthetic voices which is frequently employed by healthcare and education

authorities to improve individuals’ communication. A Scottish female voice has been used for the option of reading the story out loud.

Student Profile Screen

Figure 6.29 shows the Student Profile screen available in the second version. The stories are grouped into two categories: current stories (which are currently presented to the child) and archived stories (which are stories that are no longer presented to the child). A story can be moved from one category to another by correspondingly clicking the *archive* link or the *current* link.

A story can be open in the children’s interface by clicking on the corresponding title. If the practitioner needs to edit the story, then the corresponding *Edit* link should be clicked and the story is displayed on the *Create* screen so that it is possible to be edited. In order to assess the progress of the child during the story implementation or to view the assessment the practitioner should use the link *assess* which is on the same row with that story.

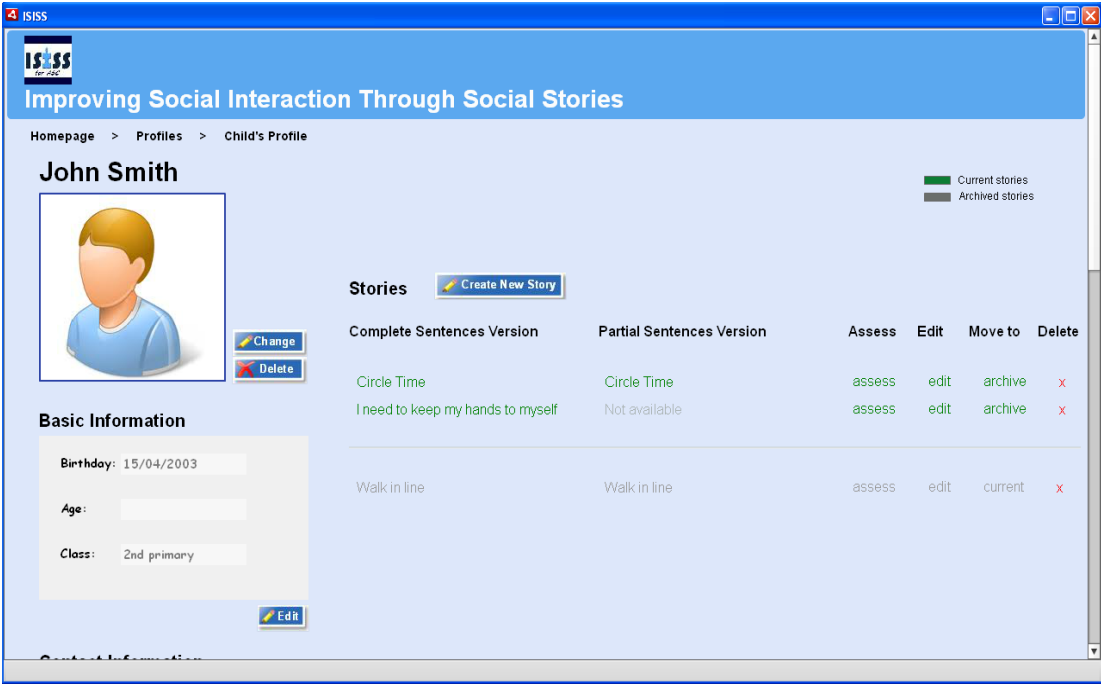


Figure 6.29: Student Profile screen – second prototype

Assess the Story

Once the assess link on the Student Profile screen is clicked, the practitioner is presented with the *Story Assessment* window which allows the user to introduce a comment about the targeted behaviour and about how the story is assessed (Figure 6.30). In a table, the practitioner can introduce the date (the current date appears

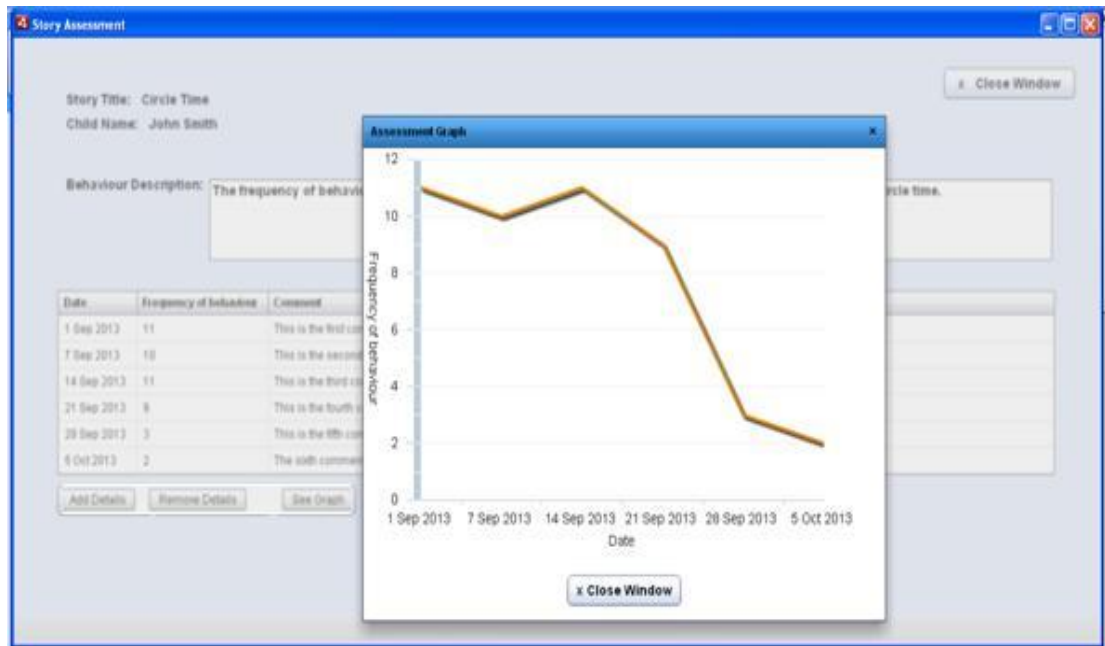


Figure 6.30: *Story Assessment* (backward) and *Assessment Graph* (forward)

automatically when adding a new row, but the user can modify it), the frequency of behaviour and a comment.

A new row can be added by clicking the *Add Details* button which then changes its display into *Save Details*. The *Delete Details* option allows the user to delete a row which was previously selected. The frequency of behaviour-date graph is displayed in a new window when clicking the *Show Graph* button.

6.4 Formative Evaluation with Researchers

After the first prototype version was refined according to the results from the formative evaluation with practitioners and all the other features were implemented, the tool was iteratively evaluated with HCI, Education and ASC researchers and

refined. The remainder of this chapter explains how the formative evaluation with researchers was conducted, and presents its results, as well as the impact of these results on the prototype.

6.4.1 Study Aims

The main aims of this study were to discover usability and functionality problems, provide solutions for problems, and also to gather suggestions for improving the authoring tool.

6.4.2 Study Design

This formative evaluation study with researchers was designed to be similar to the formative evaluation study with practitioners as a task-based exploration. Cooperative evaluation was used during the tasks performance and three questions about the likes, dislikes and suggestions for improvement were asked after each task. A semi-structured interview was set up at the end of the study. The questions in the interview were not specific to the tasks, but were focused on the usability of the entire system (see Appendix L). Similar to the previous studies, this study was also preceded by a pilot study which involved 3 researchers all having knowledge in HCI.

6.4.2.1 Participants

Twelve researchers (E2-E13, see Appendix F) participated in this study. They were experts in HCI, Education and ASC from the University of Edinburgh (School of Informatics and School of Education) and from the University of Dundee (Duncan of Jordanstone College of Art and Design).

6.4.2.2 Materials

Each participant received an information sheet, a consent form, and a list of tasks. A list of the questions for the semi-structured interview was also prepared. All these materials can be seen in Appendix L.

6.4.2.3 Procedure

The practitioners were invited individually and asked to perform 10 tasks. During the tasks the participant was asked to verbalize her thoughts. At the end of each task she was asked what she liked or disliked, and what suggestions for improving the task she had. After the tasks were completed, the researcher was asked a number of questions regarding the usability of the system, in case the answer had not already been obtained during the tasks. This study was conducted in two phases, each phase involving six researchers. After each phase the prototype was refined.

6.4.3 Results in the Evaluation with Researchers

23 usability problems and 14 bugs came to light in the formative evaluation with the researchers. In addition, 23 suggestions to improve the prototype were collected. For brevity, this section will present only the main usability problems and suggestions. A summary of all the usability problems, suggestions and bugs in each of the two phases, as well as the design decisions is presented in Appendix N.

Several researchers found the blank container for the image on the *story area* confusing. They considered that it seemed more like a text area and thought that the users might be puzzled by it, and try to write in it rather than drag and drop an image. The suggestion was to add a placeholder on the container to indicate its affordability.

When adding an image reward, the user had to use drag and drop to add an image from the *resources area* on the *Create Partial Sentences* window. One of the researcher noticed that using drag and drop to add an image reward is awkward. Moreover, in the second prototype version, when the image was dropped the name of the image was appended to a text area. One practitioner suggested that it is more natural to add a miniature of the image, rather than the image name.

One researcher suggested using buttons to navigate between screens rather than links. The reason was that the buttons are more visible than the links.

In the second version, when printing a story to PDF it was automatically saved in a pre-defined folder. Researchers suggested that the users should be provided with the option to choose where to save the file.

One researcher suggested re-organising the content on the *Student Profile* screen in order to avoid using a scroll bar which is difficult for users to use. Another researcher remarked that using colour to distinguish between the current and archived stories is not appropriate for people who have colour vision deficiency. Therefore, it was suggested that labels be used to indicate the two categories of stories.

A number of inconsistencies were noticed by several researchers. For example, one researcher noticed that the way the information is saved on the Student Profile screen (using the *Edit/Done* buttons) is not consistent with the way the sentences are saved on the *Create* screen (where the text is saved when the text area became unfocused).

Several researchers recommended using specific settings for a particular student on the Student Profile screen (e.g. font size or colour).

6.4.4 Changes to the Prototype

The usability problems and the suggestions were analysed together with the expert researcher team. They were prioritised based on the three design principles presented in section 4.3.1 and the HCI principles present in section 5.4.2. A number of modifications were made. Most of them were minor modifications, such as magnifying the font size on some buttons and tooltips, adding visible labels to indicate the affordability of some features (e.g. selecting a story goal or annotating the sentences), magnifying the images in some story layouts, changing the terminology to make it consistent (e.g. *My Stories* has been changed to *Individual Stories*), fixing bugs, etc. All the usability problems, suggestions, bugs and decisions are summarised in Appendix N.

This section presents only the most important changes which were made based on the results of the formative evaluation with researchers.

Picture Container on the *Story Area*

In order to make clear to users where they are expected to drag and drop an image on the *story area*, a placeholder image was added to the corresponding container, as shown in Figure 6.31. The placeholder reappears when an image is cleared (by pressing the *Clear* button on the story area). These decisions are supported by the HCI principles ‘predictability and ‘familiarity’.

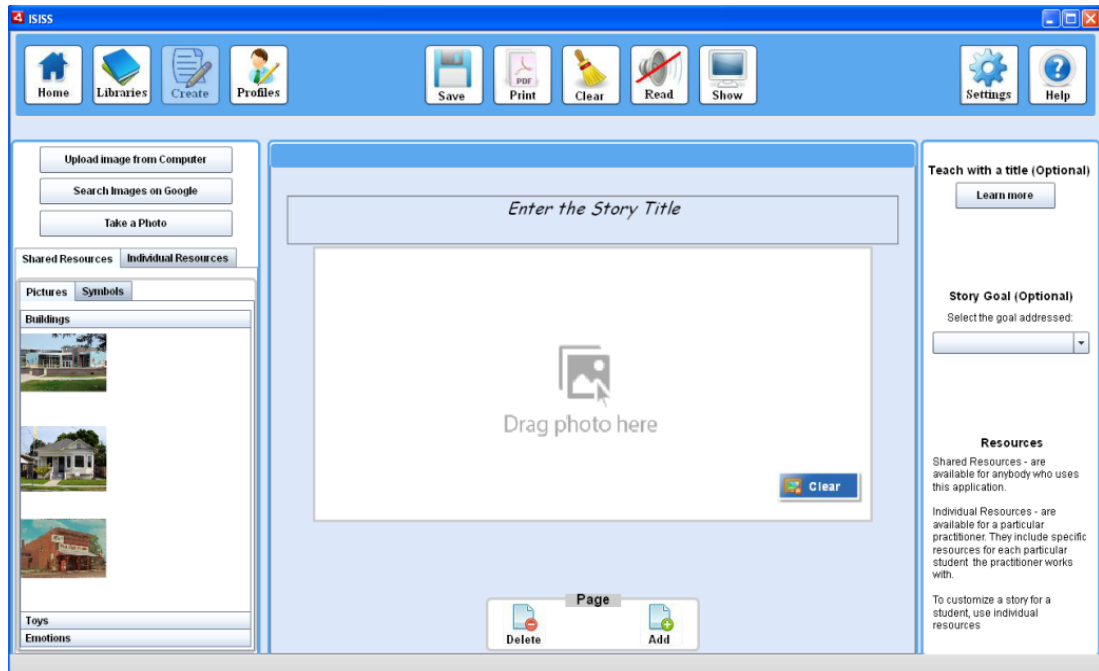


Figure 6.31: The placeholder image on the picture container on the *Create* area

Drag and Drop a Reward Image on the *Create Partial Sentences Story* Window

In order to easier append the image reward for the partial sentences story, the *Create Partial Sentences Story* window was embedded in the *Create Story* screen (Figure 6.32).

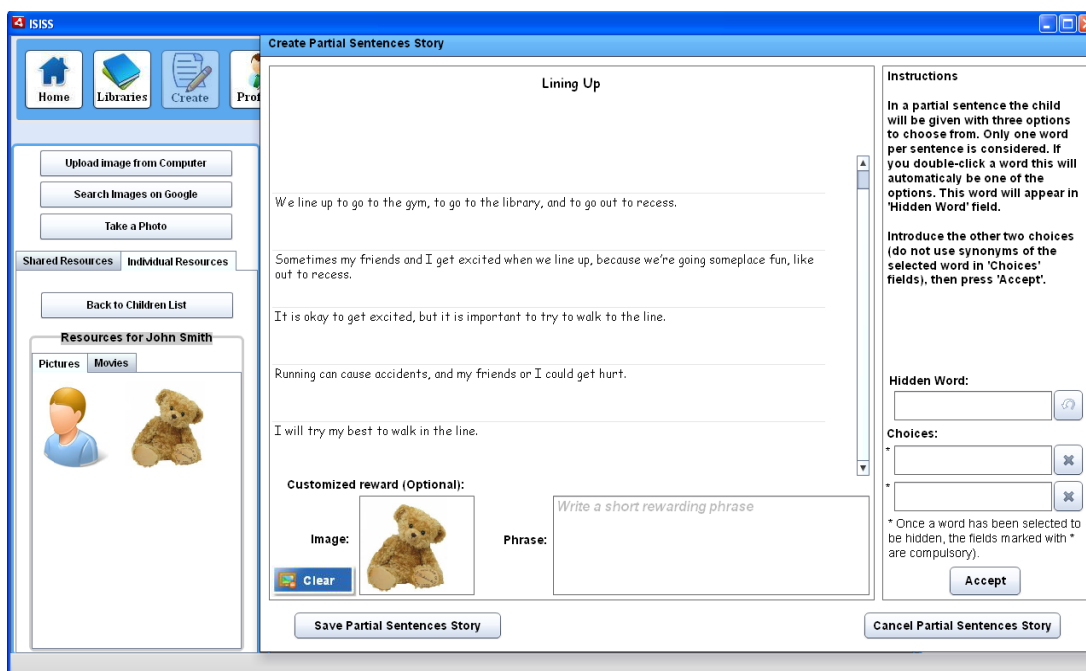


Figure 6.32: *Create Partial Sentences Story* window embedded into the *Create Story* screen

Another modification on the *Create Partial Sentences Story* window was to add a miniature of the image reward rather than the name of the image in a text area, as in the previous prototype version. The container for the image reward has a placeholder image when no image is added (similar to the one on the story area on the *Create Story* screen). These decisions are in line with the HCI principles ‘low physical effort’, ‘predictability and ‘familiarity’.

Navigation between screens

The navigation between various screens was possible in the previous versions through links. Although the links were magnified and positioned in less crowded places, after the formative evaluation with practitioners, researchers still commented that these are not visible enough. The decision was to replace the links with



Figure 6.33: [left] Navigation links; [right] navigation buttons

navigation buttons which are more visible and intuitive, since they have both text and image displayed (Figure 6.33).

Moreover, the buttons allow the user to go to any of the main screens: Homepage, Libraries, Create and Profiles. This decision is supported by the HCI principles ‘predictability’, ‘flexibility in use’ and simple and intuitive to use.

Print in a Specific Folder

Several researchers suggested offering the user the option to choose where to print a social story.

Therefore, after pressing the *Print* button and choosing the desired layout (see Figure 6.28), the user can browse to the computer folders and choose where to save the story or can create a new folder for the story to be saved in (Figure 6.34). This decision is supported also by the HCI principle ‘flexibility in use’.

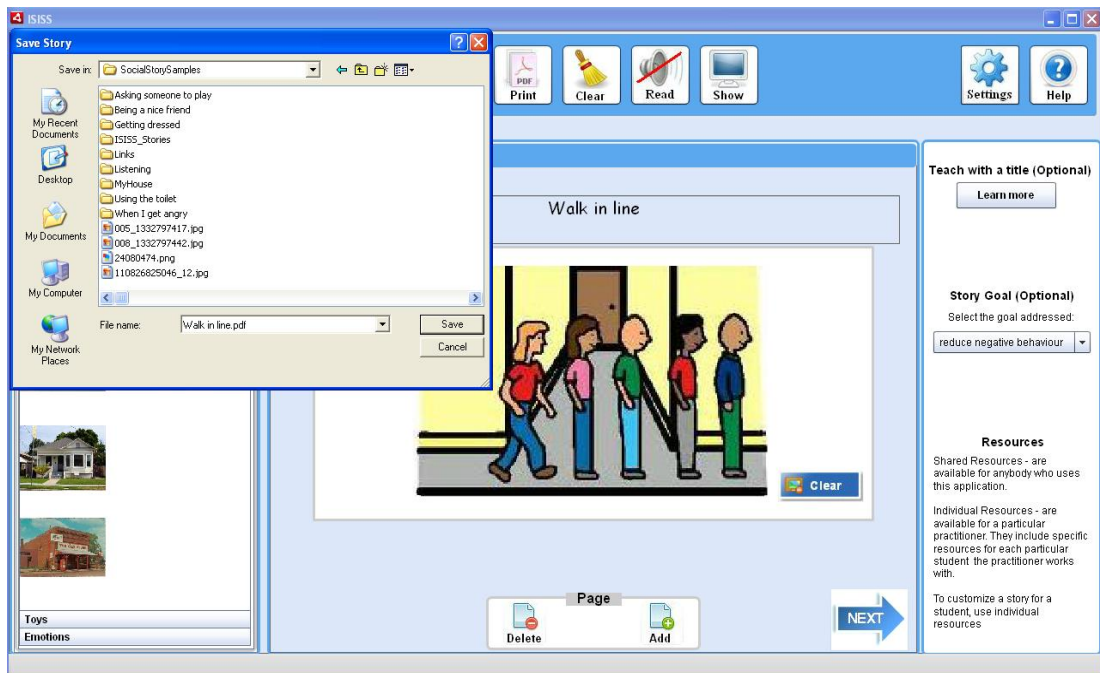


Figure 6.34: Saving PDF story file in a specific location

Student Profile Screen Content

A number of suggestions were collected to re-organise the *Student Profile* screen (Figure 6.34). First of all, the text areas with different information about the student were placed at the top of the window. Then, the two categories of stories were made obvious using corresponding labels: current stories and archived stories, although they are still distinguished by different colours (green for the current stories and grey for the archived stories).

As it can be noticed in Figure 6.35, the *Edit/Done* buttons for the information on the text areas were removed. The information is now saved when the text area is unfocused. This is consistent with the way the sentences are saved in the *Create Story* screen. Moreover, it helped to save space and better organise all the information and stories on the screen.

These decisions are in line with the HCI principles ‘predictability’, and ‘low physical effort’.

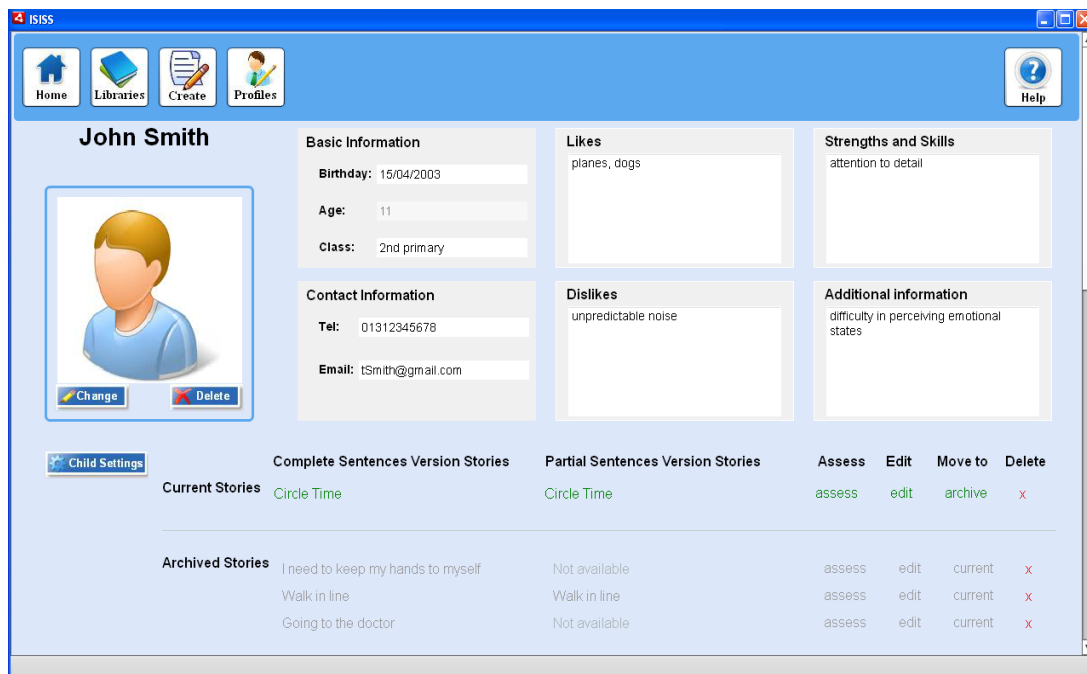


Figure 6.35: *Student Profile* screen – final prototype

Child Specific Settings

Following the researchers' suggestion, specific settings were introduced to be used for a particular child. Thus, when pressing the *Child Settings* button on the *Student Profile* screen, the *Child Settings* window is displayed (Figure 6.36). The practitioner is provided with a range of choices for the font features, and the background to be selected according to the child's preferences. The read out aloud option can be also set to be as on or off.

Whenever an individual story is opened, either to be edited or to be presented, the child settings are applied. This feature meets the 'ease practitioners' workload' and 'design for customisation' guidelines and is also in line with the HCI principles 'customisability'.

Once the changes based on the formative evaluation studies were applied, the final prototype (see Appendix O) was used as a basis for the next stage in this project: the summative evaluation with practitioners.

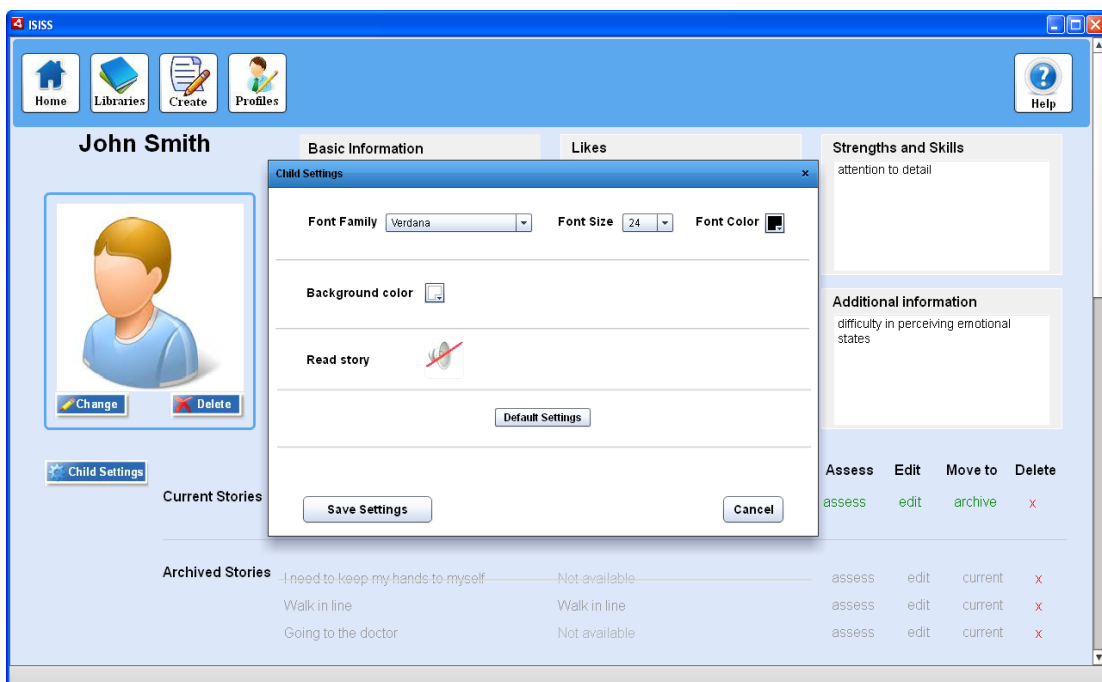


Figure 6.36: *Child Settings* window

6.5 Participants' Roles and Contributions

At this stage of research the practitioners played the role of informant. They performed a number of tasks and evaluated the high-fidelity prototype. They observed and discussed usability problems with the PR and found out solutions to solve these problems. The practitioners contributed to improving the design by suggesting new ideas to be incorporated into the high-fidelity prototype based on their practice. They received positively the features which were introduced based on the theory of social stories (e.g. annotate sentence type, feedback about social story content), and envision new practices that might emerge using them. For example, a practitioner commented:

“It would be great to see it in practice. You might find a pattern. If you did this often enough with children you might find of pattern there. If for every single story you go back to the types of the sentences, you might come up with a pattern that you use for successful stories, you know for example you need the descriptive more than you do the directive, you might be able to frame it more.”(P18).

The researchers who participated to the formative evaluation study played also the role of informant. Based on their expertise they provided feedback to refine the high-fidelity prototype, by finding usability problems and solutions, and providing new suggestions. The researchers who were members of ERT contributed by taking decisions on the design, thus playing the role of design partners. The PR helped practitioners expressed their thoughts and observed the practitioners while using the tool, with the purpose of discovering possible usability problems and understanding what caused these problems. By discussion with the practitioners, during the tasks, the PR supported them to relate theory and practice and to understand the possibilities of the technology.

6.6 Summary

This chapter presented the way the social story authoring tool evolved through an iterative process. An evolutionary prototyping approach was adopted. At the beginning the tool was partially developed including only a sub-set of the

requirements. This first version of the prototype was formatively evaluated in a study including 5 practitioners. Based on the results of this study the prototype was improved. The next step was to incorporate all the requirements, which led to the second version of prototype. A study with 12 researchers with expertise in HCI, Education and ASC was conducted to evaluate this prototype. Based on the results of this study the tool was refined. This chapter also described the roles and contributions of practitioners and researchers during this research stage. The tool that emerged (see Appendix O) was used in the summative evaluation stage which is described in chapter 7.

Chapter 7

Summative Evaluation

The social story authoring tool described in chapter 6 represented the basis of a summative evaluation study conducted with practitioners. This study focused on the third research question:

Q3: Does the computer-based technology enhance the practitioners' activity of writing, presenting and assessing social stories?

This chapter describes the fifth stage of this research, which was focused on the summative evaluation of the ISISS tool based on the social story design guidelines identified in Section 4.3.1 and usability principles. Section 7.1 presents an overview of the study including the evaluation dimensions and the way they were operationalised. This study was conducted in two stages. Section 7.2 reports the first stage, in which the ISISS tool was evaluated against the dimensions of evaluation. Section 7.3 describes the second stage of the evaluation which was centred on comparing the ISISS tool with the tools that practitioners currently use. Several limitations of the evaluation study are presented in Section 7.4. The roles and contributions of the practitioners at this stage of research are discussed in Section 7.5.

7.1 Overview of the Study

The summative evaluation was designed to be conducted in two stages. In the first stage the ISISS tool was evaluated against a set of dimensions which are defined in 7.1.1. This stage also had the role of making the practitioners familiar with the ISISS tool in order to allow for a fair comparison between it and the tools that practitioners currently use. It was designed as a task-based evaluation covering the most important features of ISISS. After each task the practitioners were required to evaluate the difficulty of working with ISISS on that task, and their confidence in using it. At the

end, the practitioners answered a System Usability Scale (SUS) questionnaire (Brooke 1996; Sauro 2011a) and attended a semi-structured interview.

The second stage was designed as a scenario-based evaluation. The practitioners were asked to write two different stories, one using ISISS and the other one using the tool that they currently use. At the end, they answered a questionnaire in which they compared the two tools on the same 10-point scale.

7.1.1 Dimensions of Evaluation

The summative evaluation study was based on seven dimensions which were devised in order to answer research question Q3. Three of them were related to the social story design guidelines discovered in the first exploratory study (see section 4.3.1): practitioners' workload, story customisation, and child's engagement. The other four dimensions were related to usability: effectiveness, efficiency, user satisfaction and ease of use. The definitions of the dimensions are presented in Table 7.1.

Dimension	Definition
Practitioners' Workload	The effort expended (both mental and physical) to achieve the social story intervention goals (e.g. developing a social story, or assessing a social story)
Story Customisation	The flexibility of the tool for tailoring the social story (e.g. pictures, font features, rewards) to the child's needs and skills.
Child's Engagement	The potential of the tool to offer the child opportunities of engaging in the social story presentation
Ease of Use	How easy does the user find using the system's features, finding information to take decisions and navigating through the system?
Effectiveness*	The accuracy and completeness with which practitioners can achieve specific goals in particular environments.
Efficiency*	The resources expended in relation to the accuracy and completeness of goals achieved.
User Satisfaction*	User attitude as a tendency to respond favourably or unfavourably to a computer system.

Table 7.1: Dimensions of evaluation - definitions (*according to ISO 9241-11(1998))

7.1.2 Operationalising the Dimensions of Evaluation

Once the dimensions were defined, the next step was to determine how to assess the tool against them. When establishing how to operationalise the evaluation dimensions, two ‘classical’ concerns appeared. They are related to the validity and reliability of the findings. Validity refers to whether or not an assessment tool measures what it is intended to measure, or how certain the findings are (Maxwell 1992). Reliability is related to repeatability of the results, in other words it refers to the extent to which an assessment tool produces stable and consistent findings (Silverman 2010).

One of the commonly used strategies to check and ensure the validity and reliability of findings is triangulation (Seale 1999, Stenbacka 2001). This strategy allows the researcher to analyse the research questions from different perspectives. Three types of triangulation have been used in this research study: data, methodological, and investigator (Gast and Ledford 2014). Data triangulation implies using more data sources, for example by including more individuals (stakeholders). Methodological triangulation refers to the use of two or more methods to collect data, such as questionnaires, interviews, or observations. Investigator triangulation is achieved through involving more researchers in the process of analysing data.

To ensure data triangulation, twelve practitioners were included in the study, with different professional backgrounds (e.g. teacher, psychologist, nursery nurse, pupil support assistant, speech and language therapist), working with students at various school levels (e.g. nursery, primary school level), and with various types of ASC.

For methodological triangulation the following qualitative data collection methods were used: SUS questionnaire, comparative questionnaires (ISISS versus other tools), verbal behaviour observations during the tasks performance, post-task questionnaires, and interviews. Observations were also used to collect quantitative data, such as: number of tasks completed, number of errors, and time.

A second independent researcher was involved in coding the transcripts of the video recordings at the first phase of the study (unprompted comments during task performance and the interviews) to ensure investigator triangulation.

The practitioners' workload, story customisation, child's engagement, and ease of use were evaluated based on observations on verbal behaviours, the interviews, and the comparative questionnaires. Additionally, for the ease of use the results in the post-tasks questionnaire regarding the perceived difficulty and confidence in performing each task were also employed. Effectiveness was measured through the number of tasks completed and the number of errors. Efficiency was measured in terms of time. User satisfaction was evaluated based on the SUS questionnaire and also verbal behaviour observations during the task performance and comparative questionnaire. Table 7.2 summarises the data collection methods used to support each dimension (research sub-question).

Method Dimension	SUS quest	VBO	No of Task Compl.	No of Errors	Post-task questions	Interv.	Time	Comp. Quest.
Perceived Practitioners' workload		✓				✓		✓
Perceived Story Customisation		✓				✓		✓
Perceived Child's engagement		✓				✓		✓
Perceived Ease of use		✓			✓	✓		✓
Effectiveness			✓	✓				
Efficiency		✓					✓	
Perceived User satisfaction	✓	✓						✓

Table 7.2: Methods used to collect data for each dimension (SUS quest. = SUS questionnaire; VBO = Verbal Behaviour Observations; No of Task Compl. = Number of tasks successfully completed; No of Errors = Number of Errors; Interv. = Interviews; Comp. quest. = comparative questionnaire)

7.2 Summative Evaluation - Stage I

At this stage the ISISS tool was evaluated against the following dimensions: perceived practitioners' workload, perceived story customisation, perceived child's engagement, and perceived ease of use, effectiveness, efficiency and user satisfaction.

7.2.1 Study Aims

The aims of this study were to answer the following questions:

- 1. How do practitioners perceive the ISISS tool in terms of reducing practitioners' workload?*
- 2. How do practitioners perceive the ISISS tool in terms of supporting social story customisation?*
- 3. How do practitioners perceive the ISISS tool in terms of engaging the child with the social story?*
- 4. How do practitioners perceive the ISISS tool in terms of ease of use?*
- 5. Is the ISISS tool effective?*
- 6. How do practitioners perceive the ISISS tool in terms of efficiency?*
- 7. How do practitioners perceive the ISISS tool in terms of user satisfaction?*

7.2.2 Study Design

This stage of the evaluation was intended to make practitioners familiar with ISISS, but also to get their perception on the practitioners' workload, customisation, child's engagement, ease of use, efficiency and user satisfaction. After each task, practitioners were asked to report their perception about the difficulty and confidence in performing the task with ISISS on a four-point Likert scale. The System Usability Scale (SUS) questionnaire (Brooke 1996; Sauro 2011a) was used to determine perceived user satisfaction. At the end of the study, each practitioner attended a semi-structured interview focused on practitioners' workload, customisation, child's engagement and ease of use.

7.2.2.1 Participants

Twelve practitioners participated in this study: six teachers, one nursery nurse, three speech and language therapists, one psychologist, and one pupil learning support assistant (P9, P13-P15 and P22-P29, see Appendix F). All the practitioners work in special schools and have experience in working with children with ASC (between 3 and 15 years) and also in developing social stories (between 1 and 15 years). Seven of the practitioners are permanently employed in special schools for pupils with complex, long term additional support needs. Five of the teachers work for VTSS (2014). One participant (P30) took part in a pilot study. She is a care dental researcher with 2 years experience in working with children with autism. She has six months experience in working with social stories for children with autism as part of a research project.

7.2.2.2 Materials

All participants received an information sheet and a consent form, a list of tasks to be performed and a SUS questionnaire. A list of questions for the semi-structured interview was also prepared to be used by the PR. All these documents can be seen in Appendix P. The participants used the ISISS authoring tool (installed on a DELL Latitude E4300 laptop) to perform the tasks. In all the sessions the activity was video recorded with the participants' agreement provided in the consent form.

7.2.2.3 Procedure

The average duration of this stage was about one and a half hours. The practitioners were invited independently. After the participant read the information sheet and signed the consent form, she started performing the tasks. At the end of each task the practitioner reported her perceived difficulty and her confidence in using ISISS to perform that task.

Then the practitioner filled in the SUS questionnaire, after which she was invited to join a semi-structured interview focused on practitioners' workload, story customisation, child's engagement and ease of use. The practitioner's satisfaction

with the tool was not brought up in the interview in order to avoid biased answers determined by the novelty effect. As explained by Bhattacharjee (2001), this is an aspect which should be considered in the evaluation of user satisfaction.

7.2.3 Data Collection and Analysis

The data were collected from the following sources:

1. Observations on verbal behaviours during the tasks (based on the transcripts of the video recordings)
2. Interviews
3. Post-task questionnaire
4. SUS questionnaire

7.2.3.1 Observations

Observations on users' behaviour while interacting with a system, are often used in evaluating a system (Albert and Tullis 2013). These observations can be verbal (regarding what participants say) and non-verbal (related to what they do). Verbal behaviours help the researcher to understand the participants' emotional and mental state while interacting with the system (Sauro 2011b). The participants make positive comments (e.g. "This is a lovely feature. I like it") or negative comments (e.g. "I don't think I would use this feature too often"). Some comments may be hard to interpret, so they can be considered neutral (e.g. "This is interesting"). The nonverbal behaviours include facial expressions (e.g. laughing, smiling, frowning, etc.) or body language (e.g. fidgeting, clapping, rubbing head, etc.) (Sauro 2011b).

7.2.3.2 Interviews

Post-tasks interviews are also used to get information about the "user preferences, impressions and attitudes" (Dix et al. 2004, p. 348). The interviews were conducted in a top-down approach, asking first a general question related to one of the evaluation dimensions and moving then to more leading questions (e.g. "How do you find annotating the types of sentences?").

In order to analyse the verbal behaviours of the participants during the task performance and also the answers in the post-task interviews, a method inspired by thematic analysis was used. “Thematic analysis is a method for identifying, analysing, and reporting patterns (themes) within data.” (Braun and Strauss 2006, p. 82). In the deductive, top-down approach the thematic analysis starts with pre-established themes (Fielding 2001). New themes and subthemes which are drawn from data can be added later.

In this study, the video recordings were transcribed and the transcription for each participant was coded separately. The positive and negative comments related to each of the evaluation dimensions (except effectiveness which was evaluated based on the tasks completed and number of errors during the tasks) were extracted from the text. These dimensions were regarded as themes in thematic analysis. For each participant a table was created and the comments were added in a column corresponding to a certain theme. After finding the passages that match to each dimension, the next step was to look inside each dimension and to group the passages on subthemes related to that dimension (theme). A coding schema was created with all the themes and subthemes (see Appendix Q). A second researcher was asked to code the data based on this coding schema. The results are described in the section 7.2.4.

7.2.3.3 Post-task Questionnaire

Post-task ratings are one of the most common self-reported metrics (Albert and Tullis 2013). Typically, they request the participants rate the task (immediately after performing it) on a Likert scale or on a differential semantic scale. Post-task ratings on difficulty and confidence were employed in this study. The participants were asked to select their answer on a 4-point Likert.

7.2.3.4 SUS Questionnaire

The perceived user satisfaction was evaluated based on the System Usability Scale (SUS). The SUS questionnaire was originally developed by John Brooke in 1996 while he was working at Digital Equipment Corporation (Brooke, 1996). SUS is

a valid and reliable questionnaire which contains ten statements, half positively formulated and half negatively formulated (Appendix P). Each statement has five-point Likert scale options (Sauro 2011a). The overall score is obtained by combining the ten scores for each question and it ranges from 0 to 100 (see Appendix P).

Bangor et al. (2009) proposed a set of acceptability ranges and added an adjective rating scale to SUS to help in the interpretation of the SUS scores. The authors also

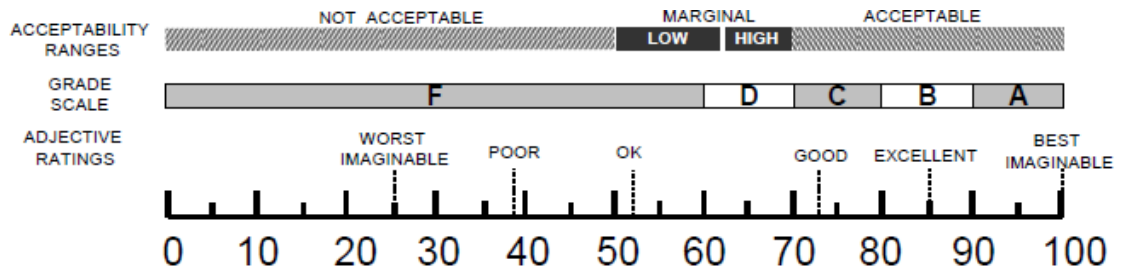


Figure 7.1: Comparative illustration of adjective ratings, acceptability scores, school grading scores and the overall SUS scores (after Bangor et al. 2009)

proposed mapping the SUS score to the traditional grading scale (e.g. A=90-100, B=80-89, etc.). Figure 7.1 shows the mapping of the adjective ratings, acceptability scores, school grading scores and the overall SUS score. Although SUS scores range from 0 to 100, they are not a percentage. A score of 68 is in fact an average score. In order to be excellent, a product should score over 85.5. The recommendation is that the overall score and not the individual ones should be considered.

7.2.4 Results

7.2.4.1 Practitioners' Workload

When evaluating the practitioners' workload the following subthemes were considered: *general comments*, *shared story library*, *Internet image search*, *shared resources*, *create a new story*, *annotate sentences*, *monitor the child's progress*, *view the child's progress*, and *other remarks* related to workload.

Both while completing tasks and during the interviews, all the participants (100% agreement with the second independent coder) commented that in terms of workload

the ISISS tool is better compared to the tools that they currently use. Practitioner P22 remarked during the interview:

“I think it is so much easier and quicker just being able to add pictures from existing resources, to be able to set text size, to be able to save individual settings [...]. If it is just there and is done then it is a lot easier. No only reduce work but also reduce mental effort. I could see from both creating the social story and evaluation how useful it’s been.”

During the task completion practitioner P29 also commented:

“It is more efficient for the whole process for editing; sharing the stories...and all the options are already there in one tool.”

All the practitioners commented positively (100% agreement with the second independent coder) about the shared story library and re-using the stories:

“Shared stories...you need to write some stories over and over again, for example ‘Hand washing’. If you have an example that’s very helpful, you save a lot of work.”(P22, during the interview)

All the practitioners (100% agreement with the second independent coder) considered that the Internet image search feature, which allows them to directly add the images to a story and also to save them as resources for future use is very useful for reducing their workload:

“The big thing is being able to drag and drop images from Google. That’s lovely ... that’s really, really helpful. You can drag and drop and save like a shared resource. This is a brilliant feature.” (P22, during the interview)

“Nice. Ohh, goodness me! Google search is very helpful!”(P24, while performing a task)

Using shared resources was considered by most of the practitioners (10 out of 12, 90% agreement with the second independent coder) a good feature to reduce their workload, but also to make the stories more consistent with regards to images:

“Somebody may have the same problems in the next class. It would be useful to have photographs specific to the school, pictures of the teachers, pictures of the staff... If three children in the school will be going to have stories about snacks it will be useful to have photos of the

kind of things we have for snacks. At least if you have shared resources you can be consistent with these images.” (P13, during the interview)

All the practitioners found it easy to create a new social story (100% agreement with the second independent coder):

It is simple and straightforward as everything is there. That’s brilliant! (P25, while performing task 15 - create a new story).

After completing a task which required them to create a new story from scratch, a teacher stated:

“Many people are not confident with computer applications whereas with this [ISISS] I think anybody can manage to create a story. This is fantastic!” (P26, during the interview)

Most of the practitioners (10 out of 12, 90% agreement with the second independent coder) considered that the annotation feature and the feedback on the social story including the types of sentences and the story compliance with the Gray’s recommendations (see 2.2.1) are important, especially to reflect on later when analysing the impact that the social story has had on the child’s behaviour:

I think it is a really great part or it [ISISS]. I like that bit [annotation]. You can have a look later and reflect whether or not a specific ratio between sentences is effective. (P28, during the interview)

However, one teacher commented that she is not confident that she will use this feature:

“I am not sure how much it will be used but it is a good feature to have” (P9, during the interview).

Another teacher was confused when she had to perform task 5 requiring the annotation of a sentence:

“No sure what is it about” (P13).

In the post-tasks interview she admitted that she had forgotten about the types of sentences and the Gray’s recommendation about the ratio between different types of

sentences. She remarked that having information about Gray's recommendation on sentences types ("Learn More" feature) is useful to refresh the user's knowledge:

"Ahh...I guess it is if you need a refresher. That's cool" (P13, during a task).

Most of the practitioners (11 out of 12, 91% agreement with the second independent coder) admitted that monitoring the child progress during the social story intervention is important, but that is hard to do with their current methods. They therefore avoid doing it or they do it but not in a rigorous way:

"Monitoring the story makes things more scientific. It is more evidence based." (P15, during the interview)

"It is good for people working with children with autism to monitor the behaviour. I think it is a really great part of it [ISISS]." (P28, during the interview)

"Now we don't have a profile, we don't have an archive. You have just a physical folder. No way to monitor the child's behaviour." (P25, during the interview)

Most of the practitioners (11 out of 12%, 91% agreement with the second independent coder) commented positively on the assessment graph, considering it useful in decreasing the workload:

"From the social story perspective seeing a graph is quite clear. And I like that. It is a good way of very objectively assessing how effective it's been. And it makes my work easier" (P22, during the interview)

A practitioner remarked that the graph for the child's progress can be shared with other members of staff: *"Amazing! It is very good for school staff!"* (P29, during a task). She added that it helps to assess the impact of the story on the child's behaviour and to take further decisions for a comprehensive plan to change the behaviour, together with other members of staff.

While writing a social story, one of the practitioners observed that the ISISS tool helps her to standardise the stories and encourages her to write short sentences:

“It encourages me to write very simple short sentences. It gives the feedback about the ratio; it keeps us within the framework.” (P14, during the interview)

7.2.4.2 Story Customisation

The evaluation of the ISISS tool in terms of the story customisation, took into account the following subthemes: *general comments, individual resources, child profile, settings for child’s preferences, automatic convert to various layouts, and read out aloud.*

All the practitioners (91% agreement with the second independent coder) remarked that the ISISS tool is helpful in customisation:

“It is very simple to use for customisation [...]. For customisation I found your system much, much better.” (P9, during the interview).

“Customisation is easier on this programme” (P28, during the interview)

“You can make the story much more personal to the child, much easier” (P23, during a task).

All the participants commented that “individual resources” (100% agreement with the second independent coder) is very helpful feature in supporting the story customisation. One practitioner noted:

“If you are working in a school you might know each of them individually well, but you know, if you don’t remember that they like Superman and you put Batman, because you were tired, then that story does not work as you made a tiny mistake. The individual resources are really, really strong feature” (P22, during the interview)

While performing the tasks, but also during the interviews, all the participants (91% agreement with the second independent coder) noted that having a profile for each child is a feature which makes story customisation much easier compared to their current approaches. A teacher commented about the child’s profile:

“You have a profile for each child, and you can do it [customisation] easily. With my tool it is possible but not practical.” (P13, during the interview)

Then, the same teacher added:

“When we spoke about that [referring to the exploratory study with low-fidelity prototypes in which she participated] I thought it is too much in detail and as I would use my folder, but seeing it working I can see from the point of view of transition that it is very useful.” (P13, during the interview)

All the practitioners (100% agreement with the second independent coder) had positive comments about the “child’s preferences settings” feature. Some commented that, even if they know the children, it is time consuming to always adapt the story to the child’s preference and that this also implies physical and mental effort. By using the feature provided by ISSS, the user does not need to remember each child’s preferences, and input them repeatedly for each child:

“You can have different font sizes that are automatically saved for different children. And she likes blue colour [referring to the task she is doing]. Just having a feature to customise for the child it does make a difference. It’s much easier” (P15, during the interview)

All the practitioners (92% agreement with the second independent coder) commented positively about the option to convert the story to different layouts without necessarily working on it:

“I usually used book stories I think it is probably the common layout ... but it is a handy technique if you had a story with pictures rather than rework to modify that story ... you just click and that’s it” (P22, during the interview)

A teacher noted that it might be useful to use different layouts for the same story and the same child depending on the context in which the story is presented:

“In terms of layouts – I really like that. I would imagine here using that for a situation, for instance when let’s say you have a child growling and you create a social story in book format. But when the child has problems on the playground you can print in other format.” (P13, during the interview)

All the practitioners (100% agreement with the second independent coder) noted that using the feature of having the story read out aloud is a good option for customising

the story presentation to the child's preferences. Some practitioners remarked that this feature gives the child more autonomy:

“The child doesn't have to rely on the adult to read the story. They can use themselves and have more ownership on that. The child can have more autonomy.” (P15, during the interview)

7.2.4.3 Child's Engagement

While performing tasks, the participants expressed their opinion regarding the opportunities that the ISISS tool would offer to the children to engage with the social stories. Moreover, after finishing the tasks they were also asked to discuss several features which might increase the child's engagement with the social stories, such as: partial sentence social stories, adding rewards at the end of social stories and using individual resources to customise the story with images which are of interest or familiar to the child (e.g. images of familiar people). The subthemes for coding the practitioners' comments while performing tasks and their answers in the interviews were built around these features. Besides these, *general comments* and *other remarks* subthemes were added.

Most of the practitioners (11 out of 12, 91% agreement with the second independent coder) had positive general comments about the ISISS tool's potential of engaging the child with the social story:

“It allows the child to engage in the process. It is more instantaneous” (P29, during the interview).

“You can better engage the child with this tool [ISISS]” (P23, during the interview)

One of the practitioners was firm in her preference for using a hard copy format of the social story rather than a computer-based social story: *“I will be more confident using a hard copy”*(P9). Although she did not have negative comments about the potential of the ISISS tool to engage the child, she was reluctant about it.

Most of the practitioners (10 out of 12, 90% agreement with the second independent coder) considered that the partial sentence social stories feature is very helpful for increasing the child's engagement with the social story:

"You can work with the child to write the story. It is so easy to personalize for them. When you create partial sentence stories to have the child with you is exciting. If they participate in feeding in it they get ownership. It is great!" (P24, during the interview)

"I like the partial sentences and I like it is quite flexible, to change them, you can use the same social story and you can choose the words you take out. I quite like that. That's a really good way to... if you use a social story be able to change what words are missing to help engagement. I think it is very useful and easy to do and I think it really helps the engagement." (P22, during the interview)

Two of the practitioners declared that they are unaware of the concept of partial sentence social stories:

"It seems fine. I was quite confused of partial sentences as I was not sure what they are." (P15, during the interview)

"Not sure about the partial sentences as it is a new concept for me" (P9, during the interview).

Adding rewards at the end of the social story is a feature which does not appear in the practitioners' current social story approaches. This feature was perceived by most of the practitioners (9 out of 12, 88% agreement with the second independent coder) as being useful for engaging the child with the story:

"The rewards are great actually. I really like adding a reward at the end. I think this is really fantastic addition. I think it is really useful for engagement." (P22, during the interview)

The other three practitioners did not have negative comments, but they were not sure if the reward adds anything in terms of child's engagement.

Most of the practitioners (11 out of 12, 91% agreement with the second independent coder) also considered that the individual resources help to make the child more engaged with the social story. One teacher remarked that children may be more

engaged if they are allowed to choose the pictures themselves from the individual resources:

“Having the children to choose the pictures from their own library it would be very nice. It gives them ownership.” (P26, during the interview)

One of the practitioners remarked that having a graph which represents the progress of the child during the intervention can be motivating for the child. She commented:

“I also want to see how children react-when working with children. Even the child can be motivated. Children might be encouraged if they look at the target. You might use that for children to engage” (P14)

7.2.4.4 Ease of Use

The comments during the task completion and the interview answers indicated that all the practitioners perceived the ISISS tool as very easy to work with in terms of *navigation, screen layouts and information to take decision* (100 % agreement with the second independent coder for all these subthemes). As for the previous dimensions (themes) a subtheme *general comments* related to ease of use was added to the coding scheme.

All the practitioners had positive general comments (100% agreement with the second independent coder) about the ISISS tool’s ease of use:

“I find it very easy. Everything is there; it is linked very logical with different features. It is nice to have everything available in one place.” (P14, during the interview)

Five participants also noted that ISISS is much easier to use than Boardmarker (a tool which they use sometimes for social stories), the difficulty of which even impedes some of them from using it:

“It wasn’t difficult to use it at all. Definitely, it is very easy to use. Boardmaker is so hard to use, many people are afraid to use it.” (P23, during the interview)

“As I said a lot of the staff at the moment is very reluctant to use Boardmaker. They’ve become reliant on ore two members of the team who are competent at it. So each time a social story needed done it was

usually passed on to that member of staff, whereas, I think, with something like this it's so user friendly that anyone could use it.” (P26, during the interview)

Discussing the navigation from one screen to another, a practitioner who participated in the exploratory study with the low-fidelity prototypes noted:

“I am surprised by how easy it is. I thought it is very hard to navigate. I couldn't imagine how you will put all together. But it is good, very simple [...] It is a friendly programme.” (P14, during the interview)

Another practitioner commented on how she perceived the interfaces and the information to take decisions:

“In terms of layouts everything is how you want it to be and where you want it to be. No unexpected searching. I like it. It is good.” (P22, during the interview)

Based on the post-task questions, Figure 7.2 shows that all the practitioners perceived all the tasks as being easy and very easy, except the tasks 4 and 7 (Appendix P). One practitioner found that task 4 was difficult and three practitioners reported that task 7 was difficult.

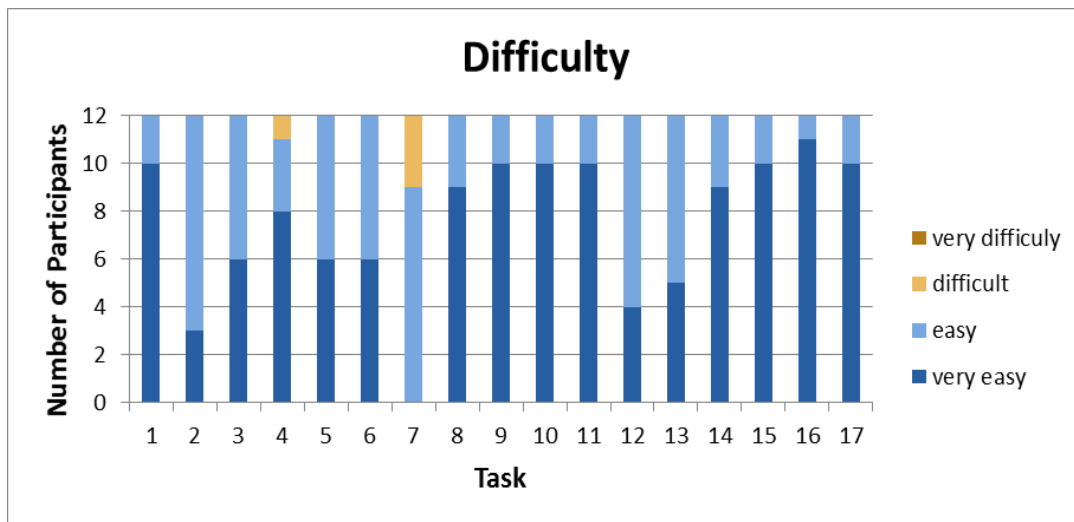


Figure 7.2: Results for difficulty in the post task questionnaire

Figure 7.3 illustrates the answers in the post-task questionnaire regarding how confident practitioners felt in doing the tasks with the ISISS tool. Again in task 7, 2 of the 3 practitioners who found this task difficult reported they felt unconfident and one reported feeling very unconfident. Another practitioner who perceived task 7 as being easy reported that she felt unconfident in doing it. One practitioner reported that she felt unconfident in completing tasks 2 and 3. Another practitioner felt also unconfident in completing task 12.

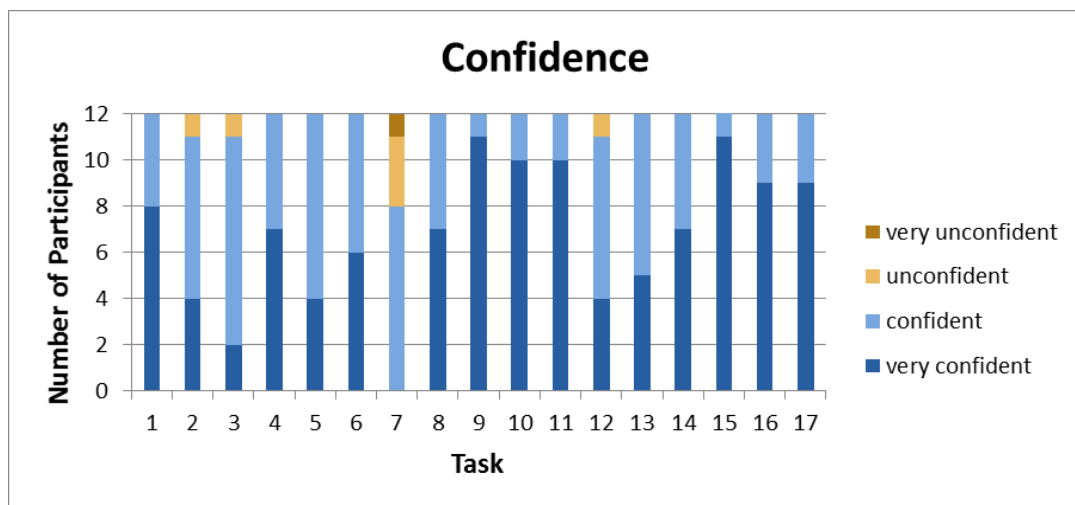


Figure 7.3: Results for confidence in post task questionnaire

7.2.4.5 Effectiveness

Effectiveness was measured in terms of number of tasks completed and number of errors during the tasks. All participants completed the 17 tasks as can be seen in Figure 7.4. However, in 14 of the tasks some the practitioners received assistance. The situations in which the practitioners required assistance were classified into three categories:

1. the researcher restated the task;
2. the researcher took the practitioner back to the prior state/screen;
3. the researcher provided information that helped the participant complete the task.

From all the 30 situations in which practitioners received assistance, 24 situations fell in the first category, 1 in the second category and 5 situations in the third category.

Errors consisted of pressing the wrong button which resulted in the participant going to a wrong screen, trying to use drag and drop instead of left-click when filling in a partial sentence, and changing the tab to *resources area* before cutting the image which the task requested to be moved.

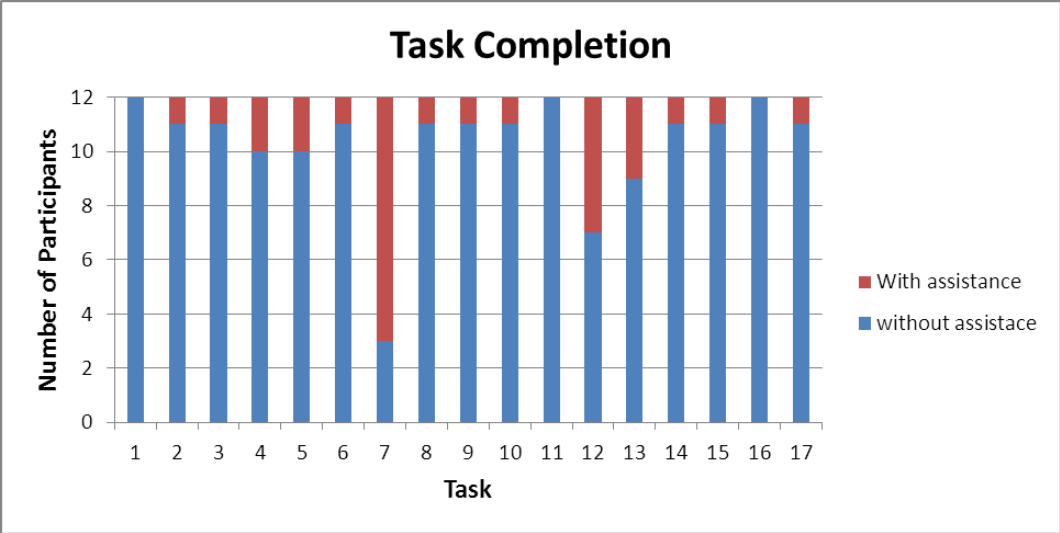


Figure 7.4: The number of tasks completed

7.2.4.6. Efficiency

At this stage, efficiency was analysed based on the *general comments* that participants made regarding ease of use while performing tasks. Most of the practitioners (8 out of 12, 100% agreement with the second independent coder) commented that using the ISSS tool helps them develop social stories and assess them in less time than the tools that they currently use *“It will save me a lot of time.”* (P14, while performing a task).

Practitioner P28 commented while using the individual resources for a particular child:

“It is good. I like it. You can go very quickly. You save time. I think it’s gonna be much simpler [using ISSS].”

Once having finished performing the tasks one of the teachers stated:

“It's going to be such a pain writing social stories in my normal way knowing there is a tool [ISISS] in development that makes it so much quicker and effective!” (P15)

7.2.4.7 User Satisfaction

As can be noted from Figure 7.5, the overall scores for the participants ranged between 85 and 100 which on the adjective rating scale fall in excellent and best imaginable categories. The average score for all the participants was 93.75.

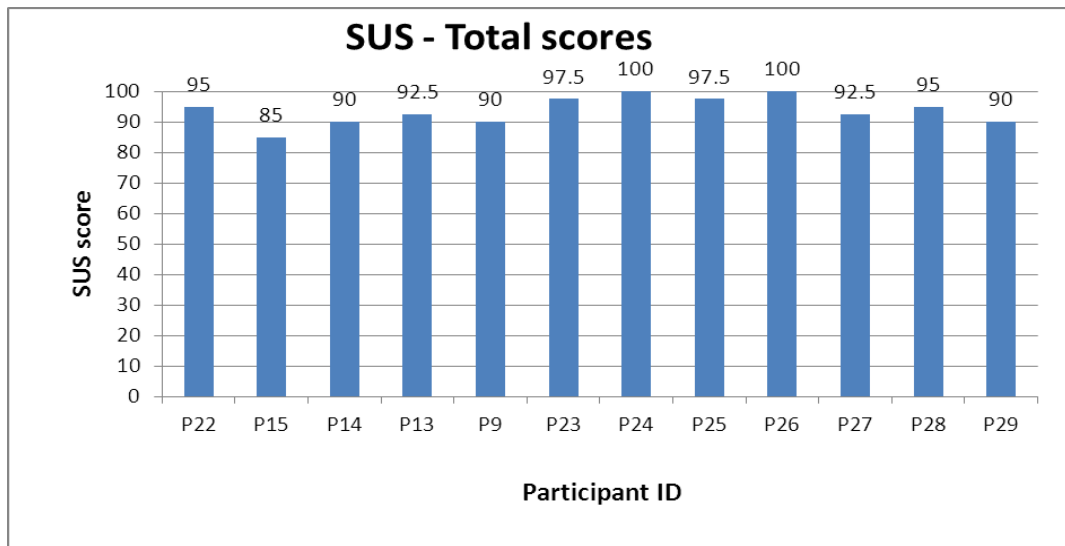


Figure 7.5: Results in SUS questionnaire

These results were also reflected in the practitioners' unprompted comments during task performance. During most of the tasks, all of the practitioners (92% agreement with the second independent coder) had positive verbal comments such as:

“That was really good. Very smooth, very quick! [laughing]” (P13);
“That's a lovely feature” (P14);
“Cool! That's fine!” (P22);
“It's good! [laughing]” (P15);
“That's brilliant!” (P24); “Awesome” (P25);
“It is nice I like that. Excellent, excellent!” (P25).

There were no negative comments related to user satisfaction.

7.2.5 Discussion

The first question in this study was: *“How do practitioners perceive the ISISS tool in terms of reducing practitioners’ workload?”* To answer this question the results from the analysis of the practitioners’ verbal behaviour during the tasks and from their answers in the interviews (presented in Section 7.2.4.1) have been considered. These results show that all the practitioners considered that the ISISS tool does reduce their workload in social story interventions. Most of the practitioners had positive comments on the ISISS tool’s features, such as the shared story library, creating and re-using a social story, shared resources, annotating the sentences, monitoring the progress of the child during the intervention, are helpful for decreasing their workload. They considered that these features make a positive difference in terms of workload between the ISISS tool and their current approaches.

The second question in this study was: *“How do practitioners perceive the ISISS tool in terms of supporting social story customisation?”* The results presented in Section 7.2.4.2 (which were obtained by analysing the practitioners verbal behaviour while performing the tasks and their answers in the interviews) show that practitioners perceived the ISISS tool as being helpful for the customisation of social stories to the child’s needs and preferences. Individual resources, child profile, child’s preferences settings, automatically converting to various layouts, and reading a story aloud were perceived to be very useful for supporting practitioners to easily customise social stories. All the practitioners considered that the ISISS tool better in customising social stories compared to their current approaches.

The answer to the third question (*“How do practitioners perceive the ISISS tool in terms of engaging the child with the social story?”*) was based on practitioners’ opinions about the ISISS tool’s potential to offer the children opportunities to engage with the social stories (expressed during the tasks performance and interviews). The results in Section 7.2.4.3 show that partial sentences, the rewards and the individual resources are perceived by practitioners as being useful features for increasing the child’s engagement with the social story. Most of the practitioners considered that

the ISISS tool is better than their current tools in engaging the child with the social stories.

The fourth question in this study was: “*How do practitioners perceive the ISISS tool in terms of ease of use?*” Practitioners’ perception about the ease of use when interacting with the ISISS tool was analysed based on practitioners’ verbal behaviour during the tasks, their answer in the post-task interviews, but also on their answers to the post-task questionnaire regarding the difficulty and confidence in performing a certain task using the ISISS tool. The results converge to the conclusion that all the practitioners perceived that the ISISS tool is easier to use than their current tools in terms of navigation, interface layouts and information to take decision.

The post-task questionnaires showed that most of the tasks were considered as easy or very easy, and the practitioners reported as being confident or very confident in performing the tasks. Only one practitioner considered that task 4 (see Appendix P) was difficult. This practitioner was confused about adding a new page at the end of the story. She received assistance which consisted of restating the task. Although for task 7 practitioners received a hint, only three of them reported this task as being difficult. Since task 7 consisted of creating a partial sentence social story which is a new task for practitioners (and some of them were not aware of the concept of partial stories), it was somehow expected that practitioners would encounter some difficulties. Moreover, some practitioners admitted that, when rating the difficulty, they thought more about the task difficulty rather than the way that the tool helped them to perform that task.

In the post-task questionnaire regarding confidence, most of the practitioners reported being confident or very confident with the tasks. Only 3 practitioners reported that they were unconfident, and one reported that she was very unconfident when performing task 7. The practitioner who was very unconfident with task 7 also reported being unconfident with tasks 3 and 4. She stated later that she considered her level of confidence based only on the task complexity and the fact that the tasks were unusual for her: “*I just thought of the task. I didn’t think of the way you explained to me at the beginning. If I think now I would probably change it*” (P9).

One practitioner also felt unconfident in completing task 12. This task required right clicking to select various options (e.g. copy, delete, cut or paste an image). Although when keeping the cursor over the *resources area* a tooltip appeared several times to inform the practitioner about what action is possible, she ignored it and finally she got assistance to complete the task, in the form of advice about reading the tooltip.

The effectiveness of the ISISS tool (which was included in the fifth question of this study: “*Is the ISISS tool effective?*”), was measured based on the number of the tasks completed and the number of errors that practitioners did during the tasks. All the practitioners completed all the 17 tasks. Although a few practitioners (between 1 and 5) received hints during 13 of the tasks, and 9 practitioners received hints for task 7, most of these hints (24 out of 30) reformulated the task. In one case the hint consisted of suggesting that the participant return to the previous state, and only in 5 cases did the researcher provide additional information. The participants only made 6 minor errors during the tasks, which did not prevent them from completing the tasks. These results support the statement that the ISISS tool is effective.

The sixth question in this study, “*How do practitioners perceive the ISISS tool in terms of efficiency?*” was answered based on the practitioners’ verbal behaviour while performing the tasks. The data analysis of the practitioners’ unprompted comments showed that most of them remarked that the ISISS tool helped them complete the tasks faster than currently, with the use of their current tools. This leads to the conclusion that the ISISS tool is more efficient than the tools that practitioners currently use.

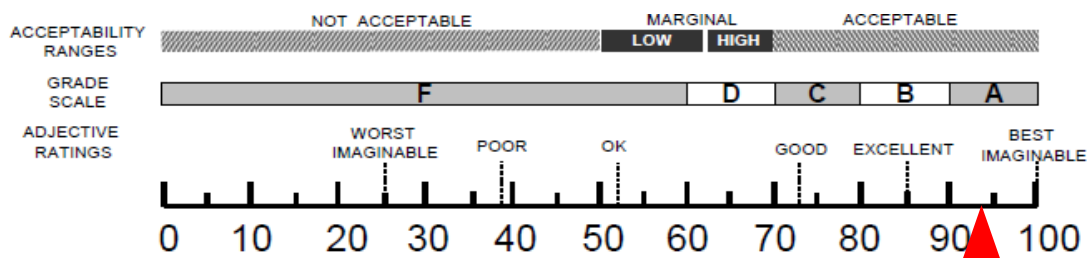


Figure 7.6: The average score on the SUS questionnaire (93.75) on the adjective ratings, acceptability scores, and school grading scales (adapted after Bangor et al. 2009)

To measure user satisfaction, and implicitly to answer the seventh question (“*How do practitioners perceive the ISISS tool in terms of user satisfaction?*”), a SUS questionnaire was used after all the tasks were performed. In addition, the unprompted comments of the practitioners during the performance of the tasks were also analysed to find positive or negative comments regarding user satisfaction. According to the adjective scale (see Figure 7.6) the overall scores obtained in the SUS questionnaire fall in excellent and best imaginable categories. Only one score got B in terms of traditional school grading, whereas the other eleven were graded A.

7.3 Summative Evaluation - Stage II

At this stage the ISISS tool was evaluated against the following dimensions: *perceived practitioners’ workload, perceived story customisation, perceived child’s engagement, and perceived ease of use, efficiency and user satisfaction.*

7.3.1 Study Aims

The aims of this study were to answer the following questions:

- 1) *Does ISISS tool reduce practitioners’ workload?*
- 2) *Does ISISS improve social story customization?*
- 3) *Does ISISS provide more opportunities to engage the child with the social story?*
- 4) *Is ISISS better than the tools practitioners currently use in terms of use?*
- 5) *Is the authoring tool more efficient than the tools practitioners currently use?*
- 6) *Is the authoring tool better than the tools practitioners use in terms of user satisfaction?*

7.3.2 Study Design

A scenario-based evaluation was used for the second stage. The same practitioners who participated in the first stage were individually invited and asked to write a social story using ISISS and another social story using the tool that they currently use. MS Word was the current tool for ten of the practitioners, whereas the other two

used MS PowerPoint (P22) and Communicate: In Print (P15). It has to be emphasised that all the participants had tried various other tools for developing social stories (such as Boardmaker, Comic Life or StoryMaker), but they did not find them satisfactory. The reasons they mentioned were mainly related to the ease of use, customisation and the effectiveness of these tools. In many cases, the practitioners had to rely on their colleagues with better IT skills to write social stories using some of these tools. Also, these tools do not support the users to customise the stories for particular children. The practitioners said that they did not find the tools they tried effective enough, in the sense of covering their needs (which is in line with the results of the analysis in section 4.4). For instance, one of the practitioners (P22) mentioned that she did not like the fact that the tools she used did not allow her to create the social stories in different layouts (e.g. text only, or parallel pictures). This practitioner also added that the social story tools she tried were ‘too Americanised’ (she referred to the example stories and the voices used to read the stories).

The stories were based on background information about the child with whom the story was to be used and concerned the target behaviour. At the end, the participants received a questionnaire with 10-point semantic differential scale questions to rank both the ISSS tool and the tool that they currently use regarding practitioners’ workload, customisation, child’s engagement, ease of use, and user satisfaction.

7.3.2.1 Participants

The same 12 practitioners who participated in the first stage were invited at this stage (see Section 7.2.2.1).

7.3.2.2 Materials

All participants received an information sheet and a consent form, a sheet describing the background information for the stories to be written and a questionnaire (see Appendix P). They used the ISSS authoring tool (installed on a DELL Latitude E4300 laptop) to write the stories. All the sessions were video recorded.

7.3.2.3 Procedure

The overall duration of this stage was on average about one hour. The practitioners first read the information sheet and signed the consent form. They then wrote the two stories: one with ISISS and the other with the tool that they currently use.

The practitioners were encouraged to carefully read the background information that they received for each story. This information included:

1. child's name;
2. child's age;
3. child's diagnosis (e.g. high functioning autism, PDDNOSS, etc.);
4. story setting (e.g. home, school, etc.);
5. story goal (e.g. promoting positive behaviour, reducing negative behaviour);
6. what the child needs to understand to achieve this goal (e.g. potential repercussions);
7. child's personal interests;
8. previous exposure to social stories and its impact (e.g. if the child has used social stories before were the interventions successful?);
9. child's communication level (e.g. using short phrases);
10. motivation for the child to follow the social story;
11. expectation at the end of the story (e.g. to learn washing hands routine);
12. additional problems (e.g. hypersensory issues that need support regarding the intervention).

To avoid learning effects, a between-group design strategy was used. Thus, the order of using the tools (e.g. ISISS first, the other tool second) and the allocation of the story to the tool (e.g. story A with ISISS, story B with the other tool) were balanced among the participants. Since there were 2 x 2 conditions (two for the order of the tool and two for the allocation of the story with the tool) and twelve practitioners, three practitioners fell into each condition. After writing the story, the practitioners were invited to score the two tools (ISISS and the tool that they use) on a scale from 1 to 10. Although they did not use the ISISS tool with a child, they were asked to appreciate the potential of it to offer the children opportunities of engaging in the

social story presentation (child’s engagement) taking into account the tools’ functionalities.

7.3.3 Data Collection and Analysis

The following data were collected:

- 1. the answers in the comparative questionnaires for ISISS versus other tools;
- 2. outcomes of the ISISS tool (a set of 24 social stories were collected, 12 stories written with the ISISS tool and 12 stories written with other tools).

The data in the comparative questionnaire were graphically represented and the number of participants who scored the ISISS tool higher or lower than the other tools was counted for each dimension.

7.3.4 Results

The results of this stage are based on the practitioners’ answers in the comparative questionnaire for ISISS versus other tools (for perceived practitioners’ workload, perceived story customisation, perceived child’s engagement, perceived ease of use, and perceived user satisfaction) and on the measures of the time spent to write a social story with the ISISS tool and with the tool that practitioners currently use (for efficiency).

7.3.4.1 Practitioners’ Workload

Figure 7.7 shows the results with respect to the practitioners’ workload. As can be

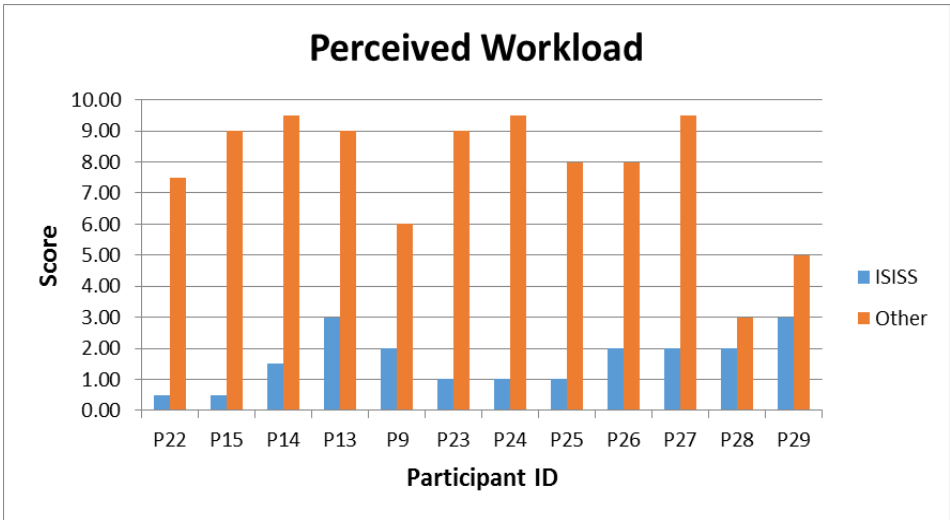


Figure 7.7: Comparative scores for practitioners’ workload (lower score are better)

seen, all the practitioners with no exception perceived the workload when using the ISISS tool as much lower compared with the workload when using their current tools.

7.3.4.2 Story Customisation

From Figure 7.8 it is clear that, except for one practitioner (from whom both the ISISS tool and MS Word are equally useful for customising social stories), the practitioners scored the ISISS tool better than their current tools regarding its potential for customising a social story.

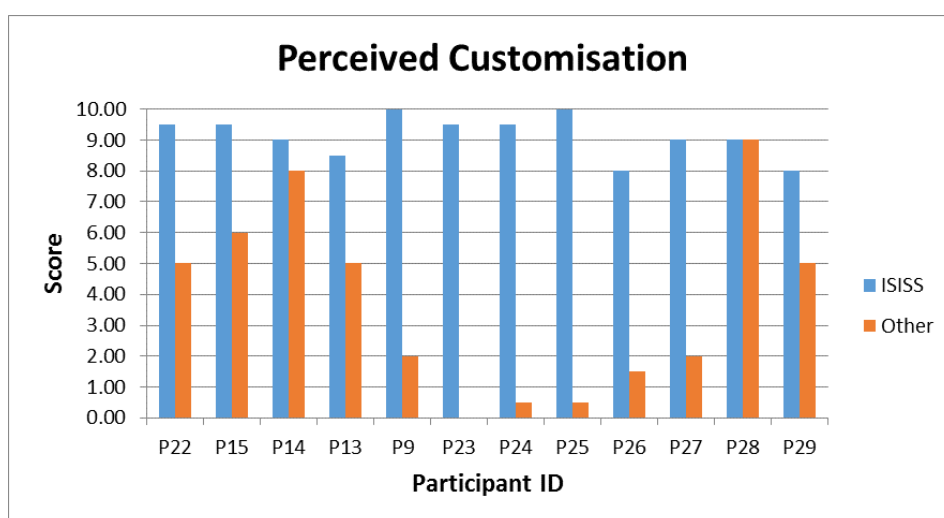


Figure 7.8: Comparative scores for story customisation (higher scores are better)

7.3.4.3 Child's Engagement

Figure 7.9 illustrates the results with respect to child's engagement. For the child's

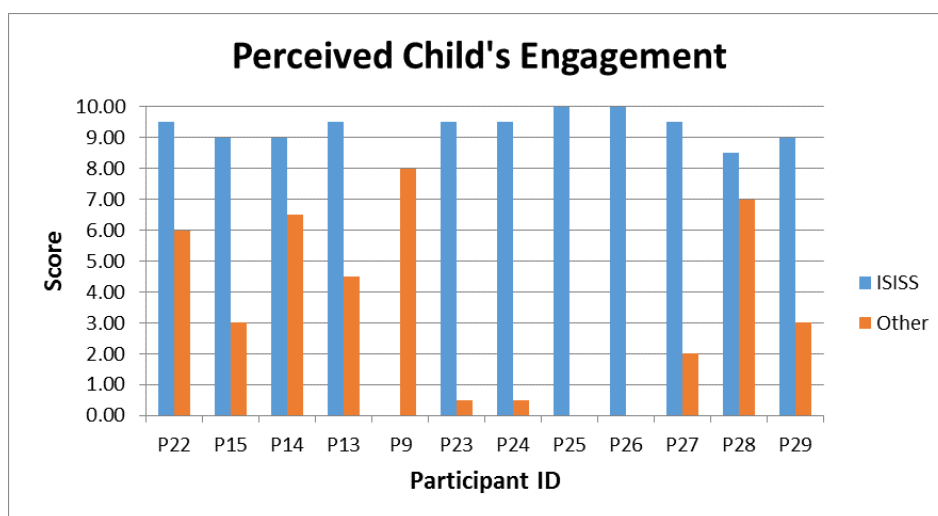


Figure 7.9: Comparative scores for child's engagement (higher scores are better)

engagement with the story, most of the practitioners (11 out of 12) scored the ISISS tool as better than the tool that they currently use (see Figure 7.9). One practitioner considered that the ISISS tool is less appropriate for child engagement compared to her current approach.

7.3.4.4 Ease of use

Figure 7.10 shows that, with respect to ease of use, all the practitioners scored the ISISS tool as better than the tools that they currently use.

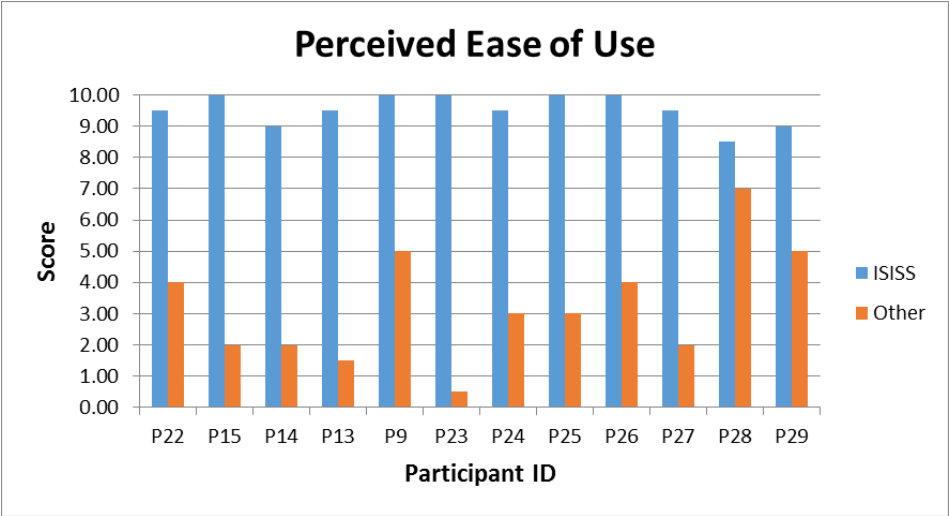


Figure 7.10: Comparative scores for ease of use (higher scores are better)

The scores for the ISISS tool ranged between 8.5 and 10, with five of the practitioners scoring the ISISS tool with the maximum score 10. The scores for the other tools ranged between 0.5 and 7.

7.3.4.5 Efficiency

Efficiency can be measured by the time spent on a task (Dix et al. 2004). In the present project, efficiency was determined by measuring the time that practitioners spent to write a social story. Figure 7.11 shows the comparison of the time intervals spent by each practitioner in writing a story with the ISISS tool and with the tool that they currently use. All the practitioners spent more time in writing social stories with the tools that they currently use than with the ISISS tool.

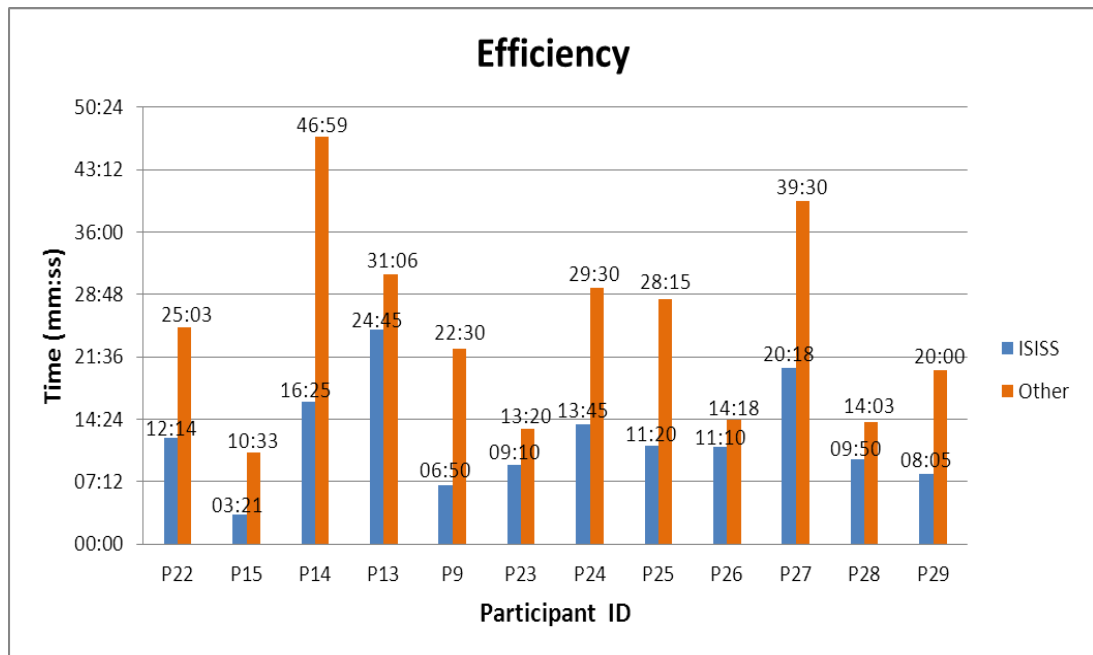


Figure 7.11: Efficiency - measured as the time expended to develop a social story

Figure 7.11 also shows that that seven practitioners spent more than double the time writing the story with their usual tool than with the ISISS tool. The average time spent in writing the stories with ISISS was 12 minutes 16 seconds, while the time spent to write the stories with other tools was 24 minutes 36 seconds.

These results are not surprising, since most of the practitioners commented positively about the efficiency of ISSIS, and stated that it is more efficient than the other tools that they use.

7.3.4.6 User Satisfaction

The ISISS tool received better scores for user satisfaction compared to the other tools from 11 practitioners (Figure 7.12). The remaining practitioner, practitioner P9, scored both the ISISS tool and the tool that she currently uses (MS Word) with the same score. On the SUS questionnaire, this practitioner scored ISISS with 90, which means excellent on the adjective scale (see Figure 7.4).

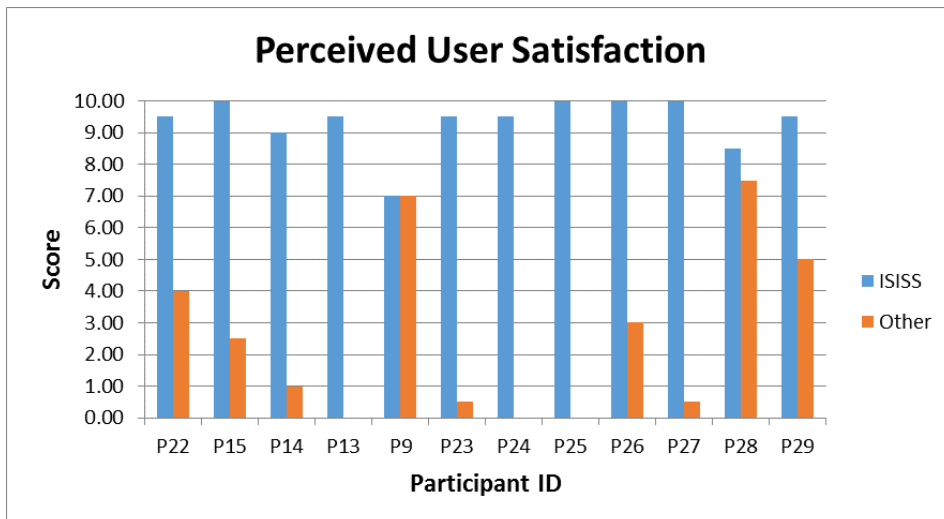


Figure 7.12: Comparative scores for user satisfaction (higher scores are better)

7.3.5 Discussion

The results in 7.3.4 show that all practitioners perceived the ISISS tool to be better than their currently used tool regarding their workload and ease of use. With only one exception in each case, the practitioners scored the ISISS tool better than the tool they currently use in story customisation, child’s engagement and user satisfaction. While for customisation and user satisfaction both ISISS and the other tool each got equal score from one practitioner, for the child’s engagement one practitioner scored the ISISS tool lower than the tool she currently uses. She explained later that she prefers to have the social story printed out and to present it to the child on paper, as she considered this way of working as more engaging than computer-based social stories. However, the ISISS tool does allow practitioners to print out their stories. Its additional feature of an interface to present the stories gives more flexibility to practitioners, and implicitly to children in social story presentation.

An analysis of the requirements that are covered by the other social story tools (see section 4.4) and by the tools that practitioners currently use also showed that these are only partially covered. For example, creating partial sentences, monitoring the impact of social stories on children behaviour, annotating the sentences and other requirements are not implemented in other tools. Therefore, it can be argued that the

ISISS tool is more effective than the tools that practitioners currently use w the other social story tools, in that it provides greater functionality.

Based on the results of the second stage of the summative evaluation, it can be argued that the ISISS tool is evaluated as better than the tools that practitioners currently use in easing their workload, supporting social story customisation and child's engagement with the social stories, as well as in the following usability dimensions: ease of use, effectiveness, efficiency and user satisfaction. These conclusions are in agreement with the findings reported in section 7.2.5.

This study was conducted to answer the following general question: *“Does the computer-based technology enhance the practitioners’ activity of writing, presenting and assessing social stories?”*

Based on the results of both stages of the summative evaluation, it can be argued that the ISISS tool did enhance the practitioners’ activity in social story interventions compared with the current approaches. A detailed answer to this question will be provided in Section 8.1.

7.4 Limitations of the Study

This study has a number of limitations which are further discussed.

7.4.1 Post-task Questions

The post-task questions for difficulty and confidence were devised to have a 4-point rating scale, with the neutral option being removed. This type of scale, called forced choice, is often used to force the respondent to make a judgement instead of choosing the neutral choice as an easy option (Allen and Seaman 2007).

When rating the difficulty in a few tasks one participant commented that she would have liked to choose the neutral point. Although it may be frustrating for some participants to be forced in choosing a positive or negative answer, it is clear that the lack of the mid-point did not affect this study results. The results from the other methods (verbal behaviour, interviews and comparative questionnaires) regarding the

ease of use are in line with the results based on the post-task questionnaires. Also, there is evidence that the mid-point in Likert scale does not affect the results (Si and Cullen, 1998).

7.4.2 Nonverbal Behaviour Observation

The nonverbal behaviour observations during the tasks were initially considered as potential data collection methods for the study. They would have implied either using two or three observers during tasks performance or having a second video camera focused on the participant. Since the presence of observers as well that of a camera focused on the participant are very disturbing, it was decided to only use verbal behaviour observations. The use of nonverbal observations most likely would not have changed the conclusions of the study, but they might have strengthened the evidence to support these conclusions.

7.4.3 Child's Engagement

The evaluation of the potential of the tool to offer the child the opportunity to engage with the social story was based on practitioners' opinions. It would be interesting to carry out, as future work, a longitudinal study with children with ASC to compare the child's engagement with the ISISS tool and with the tools that practitioners currently use.

7.4.4 Comparative Analysis of the Social Stories

The evaluation of a software system may include a comparison of the outcomes produced with it, and with other systems (Boujarwah et al. 2012). This was proposed as future work (see Section 8.4.1). However, a pilot study with seven practitioners was conducted to compare the quality of the social stories written with the ISISS tool and the practitioners' current tools. The initial results are discussed in Section 8.4.1.

7.4.5 The ISISS Tool Impact on Practitioners' Activity

The main aim of this research was to determine what form a social story authoring might take and to develop an initial proof of concept prototype. Future work is

necessary to evaluate the ISS tool in a longitudinal study in real environments (e.g. schools) involving practitioners and children with ASC (see Section 8.4.4).

7.5 Participants' Roles and Contributions

At this stage the practitioners played the role of evaluator. This role is not only to test the tool, by performing some tasks while observed by researchers, but also to reflect on changes introduced by the new tool and relate theory and practice. The practitioners contributed by evaluating the ISS tool against a set of dimensions, comparing them with their current approaches and envisioning new practices supported by the new tool.

The PR's role was also one of evaluator. She contributed by facilitating the use of the new tool for practitioners, supporting them verbalise their thoughts, gathering information to set up further directions for improving the design of the tool. The PR also observed the practitioners using the tool with the aim of evaluating it.

7.6 Summary

This chapter presented the summative evaluation of the social story authoring tool. Seven dimensions of evaluation were introduced and defined. They were related to the design guidelines which were devised in section 4.3.1 (ease practitioners' workload, design for customisation and design for child's engagement), and to the usability specification (ease of use, effectiveness, efficiency and user satisfaction). The evaluation was conducted in two stages. The first stage was a task-based evaluation. The methods used were: verbal behaviour observations, post-task questionnaire, SUS questionnaire, and interviews. At this stage the social story tool was evaluated against all the dimensions of evaluation.

The second stage was a scenario-based evaluation which employed observations and questionnaires. The aim was to investigate if the ISS tool brings an improvement over the practitioners' current approaches. Although all the participants had used different social story authoring tools or other tools for visual educational materials, they did not use them anymore, but preferred to write stories using MS Word (10 out

of 12), MS PowerPoint (1 out of 12) and Communicate: in Print (1 out of 12). The main reasons were that they did not find these tools easy to use, flexible (in the sense of customising the stories for particular children) and effective (in the sense of covering their needs). Therefore it was decided to compare the ISISS tool with the tools that the participants currently used.

The analysis of the data at both stages of evaluation showed that the ISISS tool was evaluated by practitioners as better than the other tools on all the dimensions of evaluation.

Some limitations of the study were finally revealed that might be addressed in future work. A detailed discussion will be presented in section 8.2.

Chapter 8

Discussion

The claim of this thesis is that it is possible to design and implement a computer-based authoring tool that supports practitioners in social story interventions, and which is evaluated by experts to be an improvement when compared to current approaches. In order to support this claim three research questions were devised. In the first section of this final chapter these questions are answered based on the results of the studies conducted in this research. Section 8.2 discusses what roles and contributions practitioners and researchers had during the design, development and evaluation processes. A set of guidelines for involving practitioners and researchers in the design, development and evaluation of computer-based educational tools are presented

The second section identifies the directions for future work. This chapter concludes with the main contributions of this research.

8.1 Thesis Questions

Q1. How do practitioners develop, present and assess social stories?

To address this question, two studies were conducted involving 17 practitioners with experience in social stories. These studies and their results are presented in chapter 4. The main aim was to understand the current practices in social story interventions, but also to envision possible future practices. A focus group study involving 12 practitioners was initially conducted. This provided an initial insight into the practitioners' current practices and procedures and identified the need for a technology to support practitioners to develop social story interventions. An exploratory study was conducted to create a thorough framework of social story interventions with the purpose of informing the design of an authoring tool to support

practitioners in these interventions. This framework was based on the empirical data collected from the exploratory study and also on the research literature (Figure 4.9).

The results of this study revealed four core categories which describe the development of a social story intervention: *Steps*, *Challenges*, *Structure*, and *Goals* which group 21 corresponding concepts (or subcategories). Ten steps were identified as being followed by practitioners during the social interventions: *identifying the problem*, *finding the cause*, *“getting to know the child”*, *finding motivators*, *writing the story*, *sharing the story with others*, *presenting the story*, *checking comprehension*, *monitoring the story*, and *assessing the impact* of the story on the child’s behaviour. Three main challenges, expressing the practitioners’ concerns while working with social stories were discovered in this study: *workload* (practitioners’ effort expended in social story interventions), *customisation* (tailoring the social story to the child’s needs, skills, and interests), and *engagement* (creating social stories which are motivational for children and which engage the child). Three concepts were grouped under the *Structure* category and these are: *format* (referring to how the text and the pictures are presented on the page), *content* (referring to the types of sentences and the vocabulary used in the story), and *length* (representing the number of the sentences contained by a social story). The fourth core category, *Goals* (the goals of the social story interventions), included the following subcategories: *improving appropriate behaviour*, *reducing inappropriate behaviour*, *teaching routines*, *teaching skills*, *supporting transition and novel situation*.

Q2. Can we develop computer-based technology that enables the development, presentation and assessment of social stories? If so, in what way?

The framework for the social story interventions has been translated into three guidelines and an initial set of high-level requirements for social story authoring tools (presented in section 4.3). The design of the social story authoring tool was guided by the three social story authoring tools guidelines, but also by a set of HCI principles (see section 5.4). Both the design and implementation stages followed an iterative approach, involving practitioners with experience in social stories and researchers with expertise in HCI, Education and ASC. The participants had different

roles at each research stage. These roles were previously discussed and they will be summarized later in this section (see research question Q4).

Based on the requirements for social story interventions, two versions of low-fidelity prototypes were developed to meet these requirements, as well as the social story authoring tools guidelines and HCI principles. The low-fidelity prototypes were explored then with 10 practitioners and the design specification were refined. This study and the impact of its results on the design of the social story authoring tool are presented in chapter 5.

During the implementation of the high-fidelity prototype, two formative evaluation studies were conducted in three stages, involving 17 practitioners and researchers. Based on the results obtained at each of the 3 stages, the prototype has been refined. These studies and the modifications of the high-fidelity prototype according to the results obtained at each stage are reported in chapter 6.

The ISISS tool demonstrates that computer-based technology can be developed to support practitioners in social story interventions. This tool meets the social story guidelines and the requirements which were devised based on the first exploratory study with practitioners and the research literature, as well as HCI principles.

Q3. Does the computer-based technology enhance the practitioners' activity of developing, presenting and assessing social stories?

A summative evaluation study with 12 practitioners was conducted in order to answer this question. This study and its results are reported in chapter 7. The evaluation study was designed based on seven dimensions: practitioners' workload, story customisation, child's engagement, effectiveness, efficiency, user satisfaction and ease of use. The study was conducted in two stages. The first stage was a task-based evaluation, involving the most important tasks that practitioners are expected to use while developing, presenting and assessing social stories. The second stage was a scenario-based evaluation, where each practitioner was required to develop two social stories with the ISISS tool and with the tool she currently uses.

The results from both stages of the summative evaluation converged towards the same conclusion: practitioners perceived the ISISS tool better than the tools they currently use for workload, customisation, engagement, ease of use, and user satisfaction. The ISISS tool was also evaluated better than the other tools in terms of effectiveness (based on the number of the requirements covered and number of errors made) and in terms of efficiency (measured through the time expended to develop a social story).

Thus, based on the summative evaluation results, it can be argued that the ISISS tool enhances practitioners' activity of developing, presenting and assessing social stories.

Further work is necessary to determine if the social stories produced with the ISISS tool are better ranked than the social stories produced with other tools that practitioners currently use in terms of quality. A pilot study was conducted to evaluate and compare the quality of the 12 social stories produced with the ISISS tool and the 12 social stories produced with the other tools during the second stage of the summative evaluation. This study involved 8 practitioners, different from the ones who participated to the summative evaluation. The results show that the ISISS tool might help practitioners to produce better quality social stories compared with the other tools. A more detailed description of the pilot study is presented in 8.2.1.

8.2. Participants' Contributions and Roles in the Development

Process

Practitioners and researchers brought valuable contributions to the design, development and evaluation processes of the social story tool. These contributions were grouped into five categories which are discussed below.

Revise current practices

Practitioners reflected on their current practices. That helped them revise the educational goals, identify challenges in their work, patterns, exceptions and interesting cases they met in their activity with children with ASC. The PR supported

practitioners express their thoughts and discussed around the challenges, patterns, exceptions and interesting cases identified by practitioners.

Relate practice and research

Practitioners and researchers discovered the gaps between practice and theory. Practitioners informed researchers about the best practices. At the same time researchers contributed by informing practitioners about the research results related to social story interventions and helped them and technologists understand the theory behind these interventions. Both practitioners and researchers reflected on how research can be integrated into the emerging tool.

Contribute to the revision of the existing tools

Practitioners contributed to the revision of the existing tools for social stories, expressing their likes, and dislikes. Researchers and practitioners also identified the problems and the lacks in the existing tools by observing the tools in use. They collaborated to find out solutions for the problems and generated ideas to improve these tools.

Collaborate on the design of the new tool

Practitioners collaborated on the design of the new tool by generating ideas, validating the requirements, participating in the design and refinement of the low-fidelity prototypes, identifying problems with the high-fidelity prototype and finding solutions for these problems. On the other hand, the researchers, contributed by devising the design guidelines and the requirements, designing and refining prototypes, facilitating the use of prototypes and helping practitioners understand the technology possibilities.

Evaluate the new tool

When evaluating the new tool, practitioners assessed it against a set of criteria, and performing a number of tasks both on the new tool and the tools they currently use

and compared them. Both researchers and practitioners reflected on changes introduced by the new tool and envisioned new practices.

The PR facilitated the use of the new tool, helped practitioners express their thoughts and observed practitioners using the tool with the aim of evaluating it and finding further directions for improving the tool and new research directions.

These contributions are summarised in Table 8.1.

Category	Contributions	Participants
Revise current practices	Reflect on current practices Identify challenges in current practices Revise educational goals Identify pattern, exceptions and interesting cases	practitioners practitioners practitioners practitioners, researchers
Relate practice and research	Identify gaps between practice and theory Inform researchers about best practices Inform practitioners about research	practitioners, researchers practitioners researchers
Contribute to the revision of the existing tools	Observe tools in use Express likes and dislikes Identify problems with existing tools Identify lacks in existing tools Collaborate to find out solutions for problems Generate ideas to improve the existing tools	researchers practitioners, researchers practitioners, researchers practitioners, researchers practitioners, researchers practitioners, researchers
Collaborate on the design of the new tool	Devise design guidelines Generate ideas for the new tool Devise requirements Validate requirements for the new tool Prototyping Facilitate the use of prototypes Identify problems with the new tool and find solutions for these problems Contribute to the refinement of the new tool Support understanding of technology potential	researchers practitioners, researchers researchers practitioners, researchers practitioners, researchers practitioners, researchers practitioners, researchers practitioners, researchers researchers
Evaluate the new tool	Assess the new tool against a set of measures Compare the new tool with the existing tools Envision new practices and changes introduced by the new tool Collect information for devising further research	practitioners practitioners practitioners researchers

Table 8.1: Participants' contribution to the development process

Practitioners and researchers played different roles across different stages of the development of the ISS tool: informant, design partner and evaluator.

The roles and contributions of the participants' groups differed and complemented each other's. Thus, the practitioners came with their experience in social story interventions and with design ideas from the perspective of their practices and

procedures. The PR supported them to understand the technology affordability and to relate the practice and theory. The researchers added information based on their expertise in HCI, Education and ASC.

8.3 Guidelines for Designing Computer-based Educational Tools for ASC

Based on the 50 participatory sessions with 44 participants during this project, a set of guidelines on how to best design computer-based educational tools for ASC and involve practitioners and researchers within the design, implementation and evaluation have been devised. This is not a compulsory list and it is not meant to be an exhaustive one.

8.3.1 Guidelines for Establishing Relationships with Practitioners and Motivate their Participation

One of the most important concerns in the participatory approaches is to create relationships with participants. These relationships require time and imply deep understanding of the specific work culture and practical constraints. When the participants are practitioners who work with children with ASC, it is necessary to put more effort in building relationships with them, due to the complexity of the work environment. Therefore, although some of the conclusions which are presented below may apply when building computer-based educational tools in general, they are extremely important when these tools are addressed to children with ASC and the practitioners who work with them.

Demonstrate empathy and trust. Using empathetic listening helps create good relationships with practitioners. That can be achieved by showing genuine interest in practitioners' work. Preparing educational materials is time consuming and this work is often underestimated. Therefore, showing understanding toward the challenges that practitioners encounter in their activity and appreciation of their work can create an atmosphere of trust which support practitioners in sharing their experience. Mutual trust is very important especially in the first sessions when no promise can be made in advance for a concrete outcome.

Emphasise that practitioners' experience and participation is valuable.

Practitioners are clearly experts in their field. However, when discussing in the workshops with other colleagues and researchers they seemed to be concerned about their own limitations. For example, one of the practitioners said in the first study:

"I don't know what's recommended there, that's just how I approach it. I'm not sure if it's right or wrong, but that's how I'll do it" (P9, when discussing about reading a social story).

Demonstrating genuine interest and emphasising that their experience is valuable can reassure practitioners that their own practices are those which matter. One of the practitioners declared, after the PR said that she learned a lot from that session and collected original ideas for the new tool:

"I would be very pleased to help in any way I can with your research. I am happy to discuss more about how I work with social stories if that is of use to you."(P1)

Practitioners' IT skills are in a large range. Although all the participants in this project were familiar with computers, some of them had only basic IT skills which sometimes made them worried that it is their fault if they do not achieve a task without support:

"This is only me and my weak IT skills" (P18, during the formative evaluation)

The researcher(s) who lead the sessions should keep reminding practitioners that their participation is important regardless their IT skills and that, since the tool is not going to be built only for people with high IT skills their participation is helpful.

Create and highlight the benefits that practitioners could have through their participation.

It is important to illustrate the benefits practitioners and their students can have from their participation in the project. Practitioners can learn from each other, by sharing knowledge and experience and reflecting on their practices. Sharing ideas with researchers can be an opportunity for practitioners to broaden their knowledge, to link their expertise with the new technologies, and to envision new efficient practices. Specific benefits related to a particular project should be

underlined. In the current project these benefits were related to the main challenges identified in the first exploratory study and translated into the design guidelines: ease the practitioners' workload, design for customisability and design for engagement.

Reward practitioners. A reward can not only prove that practitioners' work is valued, but it could be used as an evidence for extra-curricular activities. Although practitioners who participated in this project did not necessarily expect to be rewarded, they were happy to receive certificates which proved their participation to the research studies. This appeared to be appreciated by practitioners, as they need to document their participation in activities related to Continuing Professional Development.

8.3.2 Guidelines for Organising Design Workshops and Interacting with Participants

Several guidelines were devised to support the organisation of design workshops and the interaction with practitioners and researchers.

Be flexible in planning the study design. Adapting or changing the study methods according to participants' characteristics and preferences plays an important role in improving the interaction with participants and implicitly increases motivation and creates closer relationships. For example, in the first study, although the initial plan was to use think aloud protocol with one practitioner at a time, that was modified when a participant expressed her preference to come with her colleague (as explained in section 4.2.2.4). Also, having observed in the first exploratory study that the session with two participants was very fruitful and the interaction was more natural, the method for the second study was chosen to be constructive interaction which involved having two participants at the same time.

Organise pilot studies. Pilot studies proved to be useful to discover any problem related to the study design and to check if it fits into the limited slot with practitioners. Pilot studies are also useful in fixing some technical and usability problems. For instance, in the paper prototypes exploration study it was discovered that some items were missing, such as a pop-up window to get the name of the child

to whom the story is addressed before saving a story and a dropdown list with word choices for filling in partial sentences.

Minimise time needed for workshops. Both practitioners and researchers are people with busy agenda. Therefore the time allocated for studies should be minimised as much as possible and the sessions should be carefully planned to fit into the available time. For instance, a number of the sessions with teachers were conducted in the school environment, when they had one or two hour breaks between two classes. Therefore it was necessary to plan the sessions in order to avoid running out of time. In some cases, that was done by including a number of core activities which must have been performed during the session and a number of contingency activities.

Highlight practitioners' contribution. It was noted that one of the factors that increased motivation in practitioners was the confirmation that their expertise and ideas came to reality. That was achieved by continuously highlighting how their feedback in the previous iteration was materialised in the system. That not only provided them a sense of ownership, but it also increased their interest toward the new tool:

“Yes, I would be happy to help out again. I am interested to see how you have developed things.” (P13)

“When we discussed all these things it was not clear to me how one can put all of them into a system which is supposed to be simple and user friendly. Now, as I see it, I am very pleased” (P15)

Understand work culture and practical constraints. Understanding work culture and practical constraints is essential for planning successful participatory workshops. In a school with children with special needs there are certainly specific rules and constraints which differ from those in mainstream schools. For example, visitors, especially in big groups, can easily create emotional disturbances. Also, coming in rush times (e.g. when children come or leave the school) may impact negatively the study sessions.

Use appropriate language and attitude. Although practitioners form quite a homogeneous group in terms of expertise, and are highly educated people, their

computer skills can be very different from each other and their understanding of the technology may vary considerably. Therefore it is very important to avoid terminology which is unfamiliar to practitioners. This is also available for researchers who participate in the studies. They may not have the technical terminology for example. Besides the language an appropriate attitude must be adopted, because dominating attitudes can inhibit communication and creativity.

Make workshops enjoyable. The more relaxing and enjoyable the sessions are the more motivated the practitioners become to participate to further studies. In most of the sessions practitioners participated to the studies in their work day, some of them after a full work day. Therefore, it was important to create a relaxing and enjoyable atmosphere. When the sessions were longer than 1h, practitioners were invited to take breaks for coffee and snacks. The breaks helped practitioners from the mental effort for a short period, but also from the tension created by using the video camera (which was stopped during the breaks).

8.3.3 Specific Guidelines for Designing Computer-based Educational Tools for Children with ASC

When designing technology for children with ASC, the several guidelines can be particularly important.

Design for customisability. Children with autism are a very heterogeneous group with weaknesses, but also with abilities and strong interests in various domains (Baron-Cohen 2004). When designing technology for these children, it is essential to provide features to allow the user to easily adapt to each child's characteristics. One of the main drawbacks that resulted from focus group with practitioners was that the applications for educational materials for children with ASC are not "flexible enough". The subsequent studies revealed that there is a strong need to find ways to tailor technology to specific child's needs and skills. This need is sometimes overlooked or underestimated as it resulted from the analysis of the current tools for social stories (section 4.4), but also from the low use of these tools (see 4.1.3).

Design for engagement. Most children with ASC find technology appealing. However, it does not mean that children with ASC will engage with any technology,

so effort should be invested in design in order to create potential for engagement. One way to design for engagement is to include opportunities for rewards according to children's particular interests.

Design for equitability. Children with ASC may have other disorders or medical conditions. Matson et al (2011) report high rates of co-morbidity of physical and motor problems in children with ASC. Therefore, the design should ensure that all children are included, removing all barriers which may prevent them to use the technology.

8.3.4 Specific Guidelines for Designing Computer-based Educational Tools for Practitioners who Work with Children with ASC

Design for releasing practitioners' workload. Preparing educational materials for children with ASC is often challenging and time consuming. Practitioners also spend time in organising these materials. To address this challenge, computer-based tools should be intuitive, simple to use and should allow practitioners to create materials in less time and with less effort. The design of educational tools should be guided to reduce practitioners' workload.

Include Feedback and Guidance. Including feedback into a computer-based tool could help practitioners check that they follow good practices and recommended guidelines. The feedback may inform practitioners the related research and may provide links to allow them to get more information. During the formative evaluation of the social story tool, several practitioners remarked that the feedback regarding the content of social stories is important for those who are following Gray's guidelines. She also remarked that:

“It would be great to see it in practice [the tool which provides feedback on social story content]. You might find a pattern.” (P18)

Guidance should be included to help practitioners (especially the beginners) to create good educational materials. The guidance can reduce the mental effort and help practitioners work in less time compared with traditional approaches.

8.4 Future Work

This section presents a number of directions for future work that were identified during this research project.

8.4.1 Comparative Analysis of the Quality of Social Stories

It would be useful to conduct a large survey to compare the quality of the social story created with the ISISS tool and the social stories created with the other tools. This study may reveal what is the impact of using the ISISS tool on the social story quality, but also the criteria may be used to measure the quality of social stories.

A pilot survey was conducted to compare the quality of the social story and to collect which criteria practitioners consider the most important when evaluating the quality of social stories. In the second stage of the summative evaluation each practitioner developed two social stories on two different topics (which were called generic story A and story B), one with the ISISS tool and one with the tool they currently use. The 12 pairs of stories were grouped in four distinct categories, according to the allocation of the story to the tool (e.g. story A written with ISISS and story B written with other tool) and the order of using the tool (e.g. first ISISS tool, second other tool). A number of 81 distinct combinations of pairs of stories from each category were generated, each combination containing 4 stories written with the ISISS tool and 4 stories written with the other tools. Each participant was presented first with four stories from one of these 81 combinations (randomly selected), two stories written with the ISISS and two stories written with the other tool. The participant was asked to rank these stories from 1 to 4, with 1 being the best in terms of quality. Then, the participant was asked to rank the other four stories from the same combination in the same way. Additionally, the participant was asked to write down the criteria she considered the most important when assessing the quality of the stories. Before starting the ranking, the participants provided information about their experience in social stories, by selecting one of the following options: 0-1, 1-5, or more than 5 years.

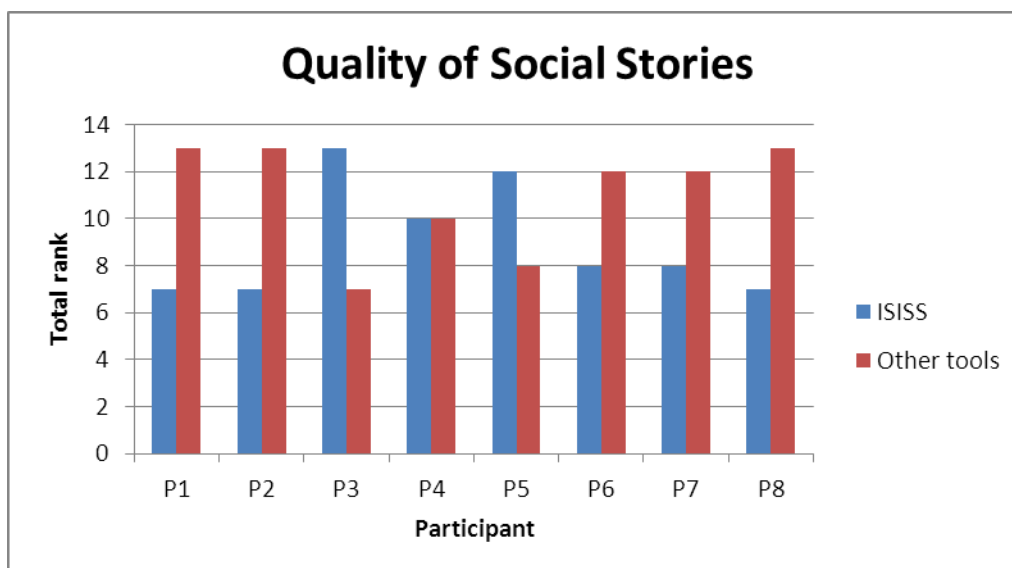


Figure 8.1: Comparative ranks for social stories (lower rank is better)

8 participants ranked the social stories in the pilot study. Three of them reported they have between 1 and 5 years of experience, whereas the other 5 reported they have more than 5 years of experience in working with social stories. Most of the participants (5 out of 8) ranked the stories written with ISISS better than the ones written with other tools, one participant ranked them equal and two participants (P3 and P5) ranked better the stories written with other tools compared with the ones written with the ISISS tool (see Figure 8.1). It is interesting to see how these results depend on the participant experience. In this case participants P3 and P5 (who scored the stories developed with ISISS lower than the ones developed with the other tools) have an experience between 1 and 5 years. Looking at the criteria these participants considered it can be noted that they refer to the language used in the story which is the less likely to be influenced by the tool which was used:

“Clear, use of positive language.” (P3)

“My criteria went on the understanding of what you are putting across to a child and also keeping the instructions simple. A clear cut message makes it easier for a child to understand.” (P5)

Based on the pilot study results, there is a tendency for the ISISS social stories to be rated more highly or at least of the same quality as the social stories produced with

other tools. Also, the data show that the practitioners who rated the stories produced with ISISS lower than the ones produced with the other tools are less experienced. However, a larger number of participants would be needed to get more accurate data.

From the participants' comments several criteria for the quality of the stories were suggested. All the participants took into account the language use in the social stories including simplicity, clarity of the sentences, and logical sequence of the sentences.

Most of the practitioners (6 out of 8) mentioned that it is important have short social stories. The other two who did not mentioned the length of the story as a criterion for the quality of social stories have both an experience in writing social stories between 1 and 5 years. They took into account the amount of words to evaluate the quality of the story. Related to this finding, it would be interesting to study if the ISISS tool encourages participants to keep the story short (as one of the practitioners mentioned during the first stage of evaluation, see section 7.2.4.1). Three participants considered the layout of the story as being an important criterion, while two participants took into account the choice of the pictures (e.g. how clear and relevant for the sentence content they are). Two participants mentioned that they evaluated the stories taking into account the number of directive sentences used in the stories. In other words they considered the Gray's recommendation regarding the ratio between sentences, and suggested that it should be considered as a criterion for the quality of social stories.

Two participants said that they would need to know more about the child for whom the social story was written to better evaluate the stories. Thus, for a future study it would be recommended that the background for the story to be provided (as presented to the participants in the second stage of the evaluation-see Appendix P).

A larger study would be expected to reveal what criteria are important in evaluating the quality of the social stories. A set of measures for the quality of social stories would make it possible to create an 'intelligent mode' option, which could provide practitioners with feedback during the process of writing a social story, and with hints to help them write a more efficient story (see 8.2.7).

8.4.2 Child's Engagement

The child's engagement was evaluated based on the practitioners' opinion about the opportunities that the ISS tool offers to the children to engage with the story. As mentioned at the end of the chapter 7, a longitudinal study with children with ASC would be useful to discover if the ISS tool helps them engage more with the social stories compared to other tools. Specifically, it would be interesting to see if the partial sentence social stories, the rewards added at the end of the stories and possible other features make any difference in engaging the child compared to the other tools.

8.4.3 Social Stories Impact on the Child's Behaviour

The ISS tool was built mainly for practitioners, but the child with ASC may use the tool accompanied by the practitioner or independently when reading or having read the social story. Since the majority of the children with ASC are attracted towards computers, it is expected that many of them prefer the social stories to be presented on computer. It would be useful to study what the impact of the computer-based social story on the children's behaviour would be. Is the story more efficient when presented on the computer, at least for those children who prefer computers? In other words, does the child progress faster towards the story target when using the computer-based social stories rather than paper-based social stories? What is the profile of the child who benefits more from the social stories produced with the ISS tool?

In conclusion, further work is needed to answer these questions.

8.4.4 The ISS Tool Impact on Practitioners' Activity

The evaluation of the ISS tool took place outside of the school environment and did not involve children with ASC. Future work is necessary to evaluate the impact of the ISS tool on practitioners' activity when working with children with ASC in the school environment. One aspect to be evaluated is how many and which features of the ISS tool would be used. Also, it would be interesting to see if the use of the ISS tool modifies the current practices in social story interventions. For example, would practitioners develop social stories which comply more with the Gray's

guidelines? Are there significant differences between the social stories developed with the ISISS tool and the ones developed with the other tools? Would practitioners monitor the progress of the child more frequently?

During the evaluation study some practitioners commented that, with the ISISS tool, they would not be reluctant to write a social story since it is easy and straightforward to use and thus they will write more social stories. However, it would be interesting to explore whether or not this is the case in a longitudinal study in the school environment.

8.4.5 Studying the Usage of the ISISS Tool with other Groups of Users

As mentioned above, the ISISS tool is mainly addressed to practitioners who work with children with ASC. It can be also used by children with ASC independently, but only to read the social stories.

ISSS can be used also by parents, provided they have an initial training in social stories. As a further extension of the current research it would be interesting to have parents using the tool. A usability study would be useful to further improve the system for this group of users.

Also, the ISISS tool can be used by researchers to collect large sets of data in order to study what features make a social story efficient or not. Researchers can extract information about the various features of the stories (e.g. sentences types), as well as the data about the progress of the child during the intervention. The information on the child's profile can be used to analyse the profile of the child for whom a particular social story is efficient. Studies can be conducted to bring empirical evidence to confirm or infirm the validity of Carol Gray's guidelines in developing social stories. Conducting studies with a large number of researchers in order to improve the ISISS tool as a research tool would be another future direction.

8.4.6 Further Development of the ISISS Tool

Further work can be done to improve the ISISS tool to be more efficient for researchers, practitioners, and parents of children with autism.

In order to make ISISS a better research tool several features could be added, such as:

1. A log file to track the user's actions while working with the tool;
2. An automatic way to process data from the log file, such as time spent for writing a social story, number of sentences, number of successful stories. Also, it would be interesting to automatically get reports on the content of the social stories as well as other story features to analyse which of these features make a social story to be successful and more efficient.
3. A Natural Language Processing algorithm to determine the types of sentences in a social story.

Several directions for further work were identified in order to improve the tool for practitioners and also for parents, including:

1. Transforming ISISS into an intelligent system to give users customised feedback and suggestions while working with the tool (e.g. suggestions to customise the social story based on the information on child's profile, feedback on various features of the social story, such as amount of words or language complexity, suggestions to modify the social story to be in accordance with the Gray's guidelines, etc.).
2. Extending the shared library to include a large set of social stories, especially on the topics which are most frequently used.
3. Adding a library of symbols to be used in social stories (e.g. Boardmaker symbols, subject to permission from the Mayer-Johnson company).
4. The features which were identified during the studies but were not considered of high priority, thus not implemented in the ISISS prototype (see Appendices M and N).

8.5 Contributions

The contributions of this research to knowledge are as follows:

1. The creation of a framework for social story interventions based on empirical data and research literature, with the aim of informing the design of a computer authoring tool for social stories.
2. The design, development and evaluation of a computer authoring tool (ISISS) that helps practitioners write, present, and assess social stories for children with ASC.
3. Empirical evidence from evaluation studies that using the authoring tool ISISS may improve practitioners' work (e.g. by releasing their workload, improving social story customisation, and engaging the child with the stories) and the quality of the social stories produced with this tool.
4. A set of guidelines for designing computer-based educational tools for ASC.

8.6 Conclusions

This research explored the way a computer-based authoring tool could be designed and implemented to support practitioners who work with children with ASC to improve their activity in social story interventions. A prototype was built following a methodology which combined UCD, PD and AR approaches, involving practitioners and researchers in HCI, Education and ASC with different roles at different stages of the research. This methodology ensured that the design and development of the tool were grounded in the current best practice and research. The methodology also offered the practitioners opportunities to reflect on their practices, to share their knowledge with researchers and to learn during the research studies and envision new directions for future practices. Moreover, the methodology increased practitioners and researchers' involvement in the design, development and evaluation of the tool. A social story authoring tool (ISISS) was built based on the current practice and research in social story interventions. The summative evaluation with practitioners demonstrated that ISISS offers a considerable improvement compared to the practitioners' current approaches.

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Appendix A

Activities and Methods for User-Centered Design (after Maguire 2008)

Planning (Section 3)	Context of use (Section 4)	Requirements (Section 5)	Design (Section 6)	Evaluation (Section 7)
3.1. Usability planning and scoping 3.2. Usability cost-benefit analysis	4.1. Identify stakeholders 4.2. Context of use analysis 4.3. Survey of existing users 4.4. Field study/user observation 4.5. Diary keeping 4.6. Task analysis	5.1. Stakeholder analysis 5.2. User cost-benefit analysis 5.3. User requirements interview 5.4. Focus groups 5.5. Scenarios of use 5.6. Personas 5.7. Existing system/competitor analysis 5.8. Task/function mapping 5.9. Allocation of function 5.10. User, usability and organizational requirements	6.1. Brainstorming 6.2. Parallel design 6.3. Design guidelines and standards 6.4. Storyboarding 6.5. Affinity diagram 6.6. Card sorting 6.7. Paper prototyping 6.8. Software prototyping 6.9. Wizard-of-Oz prototyping 6.10. Organizational prototyping	7.1. Participatory evaluation 7.2. Assisted evaluation 7.3. Heuristic or expert evaluation 7.4. Controlled user testing 7.5. Satisfaction questionnaires 7.6. Assessing cognitive workload 7.7. Critical incidents 7.8. Post-experience interviews

UCD Activities and Methods (*after Maguire 2008, p. 590*)

Appendix B

Methods and Techniques for User-Centered Design (after Wallach and Scholz 2010)

Stage	Methods and Techniques
Scope	Interdisciplinary scoping workshop
Analyse	Heuristics analysis (expert review); Job shadowing; Contextual interviews; Affinity diagrams; Personas; Mental models; Scenarios
Design	Scribbles; Wireframes; Prototypes; Mock ups; Evolutionary high-fidelity prototypes
Validate	Check against the requirements; Heuristic analysis to inspect the usability aspects; Empirical usability testing
Deliver	-

UCD Methods and Techniques (*compiled from Wallach and Scholz 2010*)

Appendix C

Common processes in user-centred design (after Monk 2000)

Process	Methods	Representations	Problems
Understanding the work context	Focus groups Interviews Observation	The rich picture	People are not practised at articulating what they do or why they do it.
Understanding the work	Focus groups Interviews Observation	Hierarchical Task Analysis (HTA) (Monk 1998, p 117) Work Objective Decomposition (WOD) and exceptions (Monk 1998, p 117) Scenarios	As above, and what is the equivalent of a task?
Testing a top level design against your understanding of work	Scenario walkthrough (Dix et al. 2004) Cognitive Walkthrough (Dix et al. 2004, p 321)	Storyboards Dialogue modelling (Monk 1998)	What is the equivalent of a task?
User testing of more detailed prototypes	Usability Labs. (Dix et al. 2004, p743) Cooperative Evaluation (Dix et al. 2004, p 343)	Paper prototypes Simulations	What is the task to be set?

UCD Common processes in user-centred design (after Monk 2000, p. 185)

Appendix D

UsabilityNet Methods for User-Centered Design

Methods table

you can select the most appropriate methods depending on three conditions

limited time/resources No direct access to users Limited skills/expertise

Planning & Feasibility	Requirements	Design	Implementation	Test & Measure	Post Release
Getting started	User Surveys	Design guidelines	Style guides	Diagnostic evaluation	Post release testing
Stakeholder meeting	Interviews	Paper prototyping	Rapid prototyping	Performance testing	Subjective assessment
Analyse content	Contextual inquiry	Heuristic evaluation		Subjective evaluation	User surveys
ISO 13407	User Observation	Parallel design		Heuristic evaluation	Remote evaluation
Planning	Context	Storyboarding		Critical Incidence Technique	
Competitor Analysis	Focus Groups	Evaluate prototype		Pleasure	
	Brainstorming	Wizard of Oz			
	Evaluating existing systems	Interface design patterns			
	Card Sorting				
	Affinity diagramming				
	Scenarios of use				
	Task Analysis				
Requirements meeting					

UsabilityNet methods (after <http://www.usabilitynet.org/tools/methods.htm>)

Appendix E

Activities, Methods and Techniques for User-Centered Design

Planning	Context of use	Requirements	Design	Evaluation
Usability planning and scoping Usability cost – benefit analysis Interdisciplinary scoping workshop Stakeholder meeting Analyse content Competitor analysis	Identify stakeholders Context of use analysis User survey Field study/user observation Diary keeping Heuristics analysis (expert review) Job shadowing Contextual interviews; Focus groups Interviews Observation Hierarchical Task Analyses (HTA) Work Objective Decomposition (WOD) and exceptions	Stakeholder analysis User requirements interview Focus groups Scenarios Personas Existing system/competitor analysis Task/function mapping Allocation of function User, usability and organizational requirements Affinity diagrams; Mental models; Contextual inquiry User Observation Context Brainstorming Evaluating existing systems Card sorting Requirements meeting	Brainstorming Parallel design Design guidelines and standards Storyboarding Affinity diagrams Card sorting Paper prototyping Software prototyping Wizard-of-Oz prototyping Organizational prototyping Conceptual Model Scribbles; Wireframes; Prototypes; Mock ups; Evolutionary high-fidelity prototypes Evaluate prototype Wizard-of-Oz Interface design patterns	Participatory evaluation Assisted evaluation Heuristic or expert evaluation Controlled user testing Satisfaction questionnaires Assessing cognitive workload Critical incidents Post-experience interviews Check against the requirements; Heuristic analysis to inspect the usability aspects; Empirical usability testing Scenario walkthrough Cognitive walkthrough Usability Labs Cooperative evaluation Paper prototypes Simulations Diagnostic evaluation Performance testing Subjective evaluation Critical incidence technique

UCD Activities, Methods and Techniques (*compiled from Maguire 2008, Wallach and Scholz 2010, Monk 2000 and UsabilityNet*)

Appendix F

List of Participants

F.1 Researchers

ID	Position	Areas of Research
E1*	Professor, School of Informatics, UoE	Adaptive multimedia technology, Participatory and User-Centred Design, evaluation of interfaces, interaction with pedagogical agents
E2*	Professor HCI, School of Computing, UoD	Augmentative and Alternative Communication, HCI, natural language processing, personal narrative and assistive technology
E3	PhD student, School of Computing, UoD	Augmentative and Alternative Communication, AT, HCI, Accessibility
E4	Psychologist PhD student in Psychology and Informatics, UoE	Assistive technologies, educational technologies for autism, Aging, HCI, Social cognition
E5	Research Fellow, School of Informatics, UoE	Spoken dialogue systems, speech technology for older people, eHealth, Usability
E6	Early-career researcher, School of Informatics, UoE	Educational technologies for autism, Technology Design
E7	Research Fellow, School of Education, UoE	Technology enhanced learning, embodied cognition, Education
E8	Chancellor Fellow, School of Education, UoE	Computer-based interventions for individuals with ASD, Theory Mind based interventions for ASD, Autism, Child development
E9	Lecturer Social Digital, College of Art, Science and Engineering, UoD	Participatory and User-Centred Design, systems and user interfaces design for interventions with children and therapy
E10	PhD student, School of Informatics	HCI, language processing
E11	PhD student, Web developer, School of Informatics, UoE	HCI, telemedicine, Software Engineering
E12	PhD student, School of Informatics	HCI, Participatory and User-Centred Design
E13	Research Fellow, Cognitive scientist, School of Informatics, School of Informatics, UoE	Human-Machine Interaction, improving the efficiency, interfaces and design of computer systems
E14*	Lecturer HCI, School of Informatics, UoE	Interaction design, design of new forms of digital media, user experience (UX)

* researchers who were members of the Expert Research Team (ERT)

F.2 Practitioners

Part. ID	Position	Experience with children with ASC (years)	Experience with social stories (years)	Number of children interacting with	FG	W1	W2	FE	SE
P1	teacher	15	10	18-20	√				
P2	teacher	17	12	25-30	√				
P3	nursery nurse	13	13	15-20	√				
P4	teacher	16	14	12-15	√				
P5	SLT	10	8	20-30	√				
P6	SLT	11	11	15-20	√				
P7	nursery nurse	14	12	12-20	√				
P8	teacher	7	7	10-15	√				
P9	teacher	4	4	8	√	√	√	√	√
P10	teacher	7	7	12	√				
P11	SLT	14	12	10	√				
P12	teacher	15	12	10-20	√				
P13	teacher	15	8	8		√	√		√
P14	SLT	15	12	20		√	√		√
P15	Teacher	14	11	10		√	√		√
P16	teacher	11	5	12			√		
P17	teacher	8	8	10			√		
P18	nursery nurse	8	8	11			√	√	
P19	teacher	17	15	14			√	√	
P20	teacher	25	12	8			√	√	
P21	nursery nurse	17	10	7			√	√	
P22	psychologist	5	5	5-10					√
P23	nursery nurse	5	3	21					√
P24	pupil support assistant	8	8	20-24					√
P25	SLT	3	1	25					√
P26	teacher	10	4	6					√
P27	SLT	14	14	9-10					√
P28	teacher	15	15	30-40					√
P29	teacher	13	12	6					√
P30	dental researcher	2	1/2	12					√

(FG=Focus Group; W1=Workshop 1: Exploring Practitioners' Current Practices; W2=Workshop 2: Exploring Low-fidelity Prototypes; FE=Formative Evaluation; SE=Summative Evaluation)

Appendix G

Documents for Focus Group

G.1. Consent Form

*Aurora Constantin, PhD Research
VTSS Meeting, May 2012*



CONSENT FORM

Focus Group

STUDY SUMMARY

The general goal of this study is to discover the procedures and practices used by experienced teachers and practitioners in the process of building applying, and assessing social stories.

This study is a bridge between practice and research and will serve as the basis of PhD research aiming to explore how a computer-based application can support teachers who work with children with ASC to develop, apply and assess social stories.

PARTICIPANTS' RIGHTS

You may withdraw from the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn/destroyed.

BENEFITS AND RISKS

There are no known benefits or risks for you in this study.

CONFIDENTIALITY/ANONYMITY

The data recorded will be strictly used for the purpose of PhD study. It will be anonymised for reporting purposes. Please tick the boxes below to indicate agreement.

- I agree to take part in this study and for the data collected to be used in research
- I agree to my contribution to be voice recorded
- I agree to outcomes of the research being used in research and teaching presentations
- I would be willing to take part in further research and agree to be contacted in the future

Participant's signature

Date

Participant's Name (please print)

Contact (email or telephone)

G.2. Focus Group Questionnaire

Aurora Constantin, PhD Research
VTSS Meeting, May 2012



DISCUSSION QUESTIONS

Focus Group

1. Do you use social stories? If so how often?
2. When do you use social stories and what for?
3. What materials and technology do you use?
4. How could it be made easier for you to do this?
5. Would you be willing to help me in my research to develop better materials to supporting making social stories?

Yes

No

If yes, please provide contact details:

Name: _____

School/Organization: _____

Email: _____

Phone: _____

(please, say which you prefer)

If no, would you like to complete a questionnaire/survey?

Yes

No

Thank you very much for your time!

Appendix H

Documents for the Study “Exploring Practitioners’ Current Practices for Social Stories Intervention”

H.1 Information Sheet

*Aurora Constantin, PhD Research
August 2012*



INFORMATION SHEET

Exploring Current Practices in Social Story Interventions

PROJECT TITLE

Exploring Social Communication Skills in Children with ASC through Social Stories and Humour

INVITATION

You are being invited to take part in a workshop which aims to inform the design for a PhD project. The general goal of PhD research is to explore how a computer-based application can support teachers who work with children with ASC to develop, present, and assess social stories. Particularly, this study seeks to discover what practitioners really do when working with children with ASC and using social stories. The research question addressed is: *“How do teachers develop, and present social stories? What are the ways they assess the efficacy of the social stories? Do teachers use humour in social stories?”* Briefly, this study will clarify the process of developing, presenting and assessing a social story, will reveal the limits of using social stories and will bring new ideas for the future steps in the current research.

WHAT WILL HAPPEN

This study will be divided in two parts. The first part will be a task analysis approach based on think aloud protocol. Think aloud is a way for data-gathering in which people are asked to describe their actions during task completion. Specifically, you will be asked to build a social story for a particular child and a particular challenging situation. The main researcher has previously invited you to think ahead about this story, the targeted situation and particular child. Your activity will be sound and video recorded, subjected to your permission. After the first part you will have a refreshment break. In the second part of the study, you will be invited to participate in an interview. This will mainly be focused on clarifying the reasons behind your decisions related to the materials you used for social stories, the way you customize the social story for the child, the steps you followed when working with social stories, as well as other connected issues which might be observed during the first part of the study.

TIME COMMITMENT AND LOCATION

The study typically takes 90 to 120 minutes and is conducted in one session. Please, feel free to take your time for completing the task.

The study will take place at the University of Edinburgh, Informatics Forum (room 4.02).

PARTICIPANTS' RIGHTS

You may decide to stop being a part of the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn/destroyed.

You have the right to omit or refuse to answer or respond to any question that is asked of you.

You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study begins. Please, feel free to ask any question related to this study at any time.

BENEFITS AND RISKS

There are no known risks for you in this study. You will receive a certificate of attendance in recognition of your contribution to this study.

CONFIDENTIALITY/ANONYMITY

No one will link the data you provided to the identifying information you supplied (e.g., name, email). All data collected will be exclusively used in research, conference presentations and publications.

FOR FURTHER INFORMATION

If you have any further questions regarding this study, please contact:

Aurora Constantin
PhD student
A.Constantin-2@sms.ed.ac.uk
Tel: 0753 245 3086

Dr. Helen Pain
Supervisor
helen@staffmail.ed.ac.uk
Tel: 0131 650 8485

Thank you for your time!

H.2 Consent Form

*Aurora Constantin, PhD Research
August 2012*



CONSENT FORM

Exploring Current Practices in Social Story Interventions

STUDY SUMMARY

The general goal of this study is to discover the practices and procedures used by practitioners in the process of building, presenting, and assessing social stories.

This study is a bridge between practice and research and will serve as the basis of PhD research aiming to explore how a computer-based application can support teachers who work with children with ASC to develop, present and assess social stories. Moreover, it will explore the impact of different features of social stories (including humour) on social communication skills.

PARTICIPANTS' RIGHTS

You may withdraw from the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn/destroyed.

BENEFITS AND RISKS

There are no known risks for you in this study. You will get a certificate of attendance in recognition of your contribution to this study.

CONFIDENTIALITY/ANONYMITY

The data recorded will be strictly used for the purpose of PhD study. It will be anonymised for reporting purposes. Please tick the boxes below to indicate agreement.

I agree to take part in this study and for the data collected to be used in research

I agree to my contribution to be voice recorded

I agree to my contribution to be video recorded

I agree to outcomes of the research being used in research and teaching presentations

Participant's signature

Date

Participant's Name (please print)

Contact (email or telephone)

H.3 Interview Questions

*Aurora Constantin, PhD Research
August 2012*

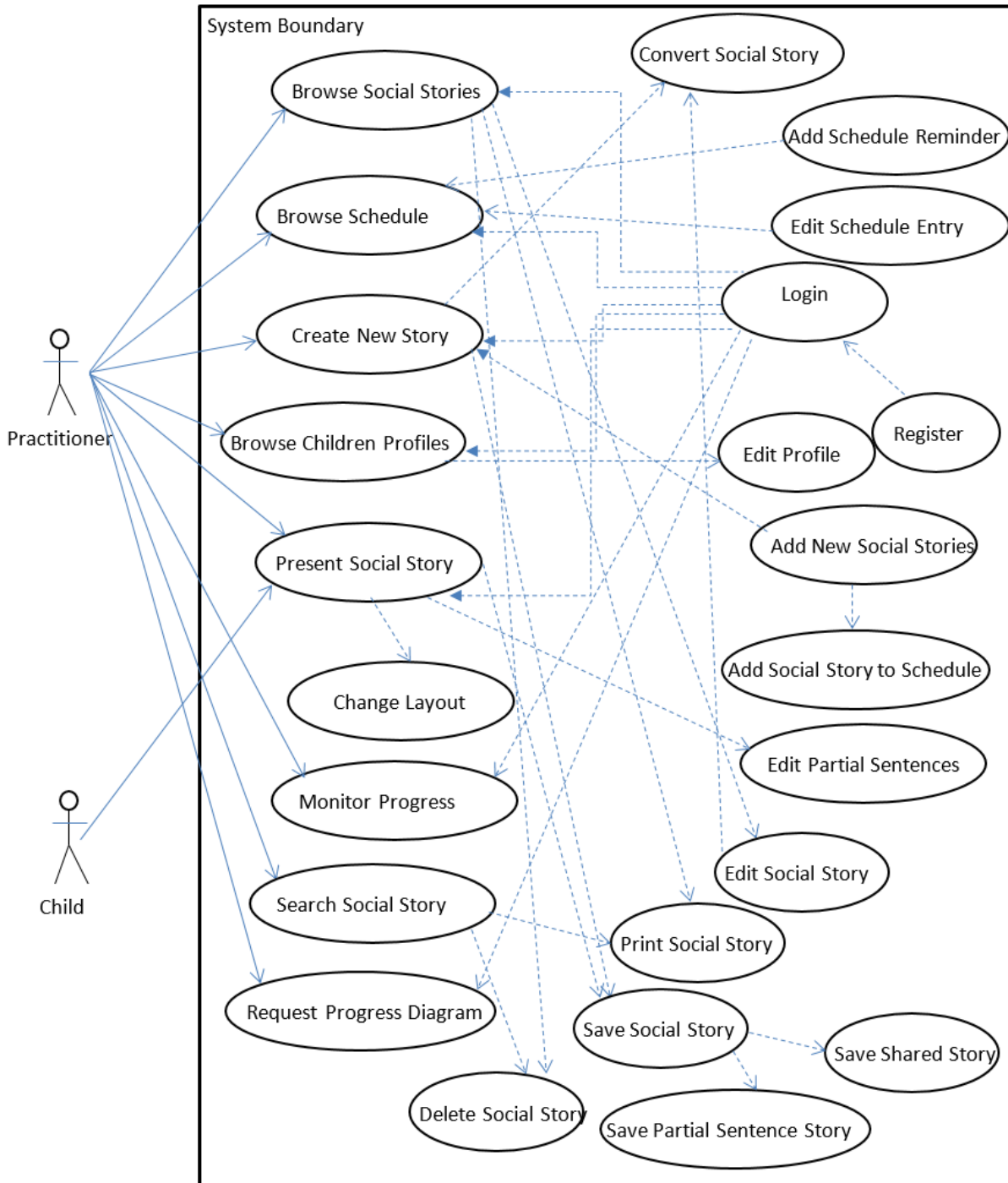
INTERVIEW QUESTIONS

Exploring Current Practices in Social Story Interventions

1. Please, tell me more about this child.
2. How do you assess the strengths and weaknesses of the child and how do you adapt the social stories accordingly? Please, give me a short example.
3. Do you need to record the profile of the child? If yes, do you use any standard form for that?
4. What formats of stories do you use? (e.g. with text and pictures, only text, or only pictures)
5. What other materials do you use for social stories?
6. What do you need in order to customize social stories?
7. Do you use more layouts to display/present social stories? If yes, please describe them.
8. Do you use rewards for children? If yes, what kinds of rewards?
9. What are the steps you follow in an intervention with social story?
10. What is the duration of a social story intervention?
11. How do you assess the impact of a social story on a particular child?
12. Do you use any software for building social stories? If yes, what features do you find useful in that software? Is there any feature which could be added or improved?
13. What do you consider essential for me to know about social stories when building a computer-based application to support your work?
14. Please, add any other observation you consider useful for this study.

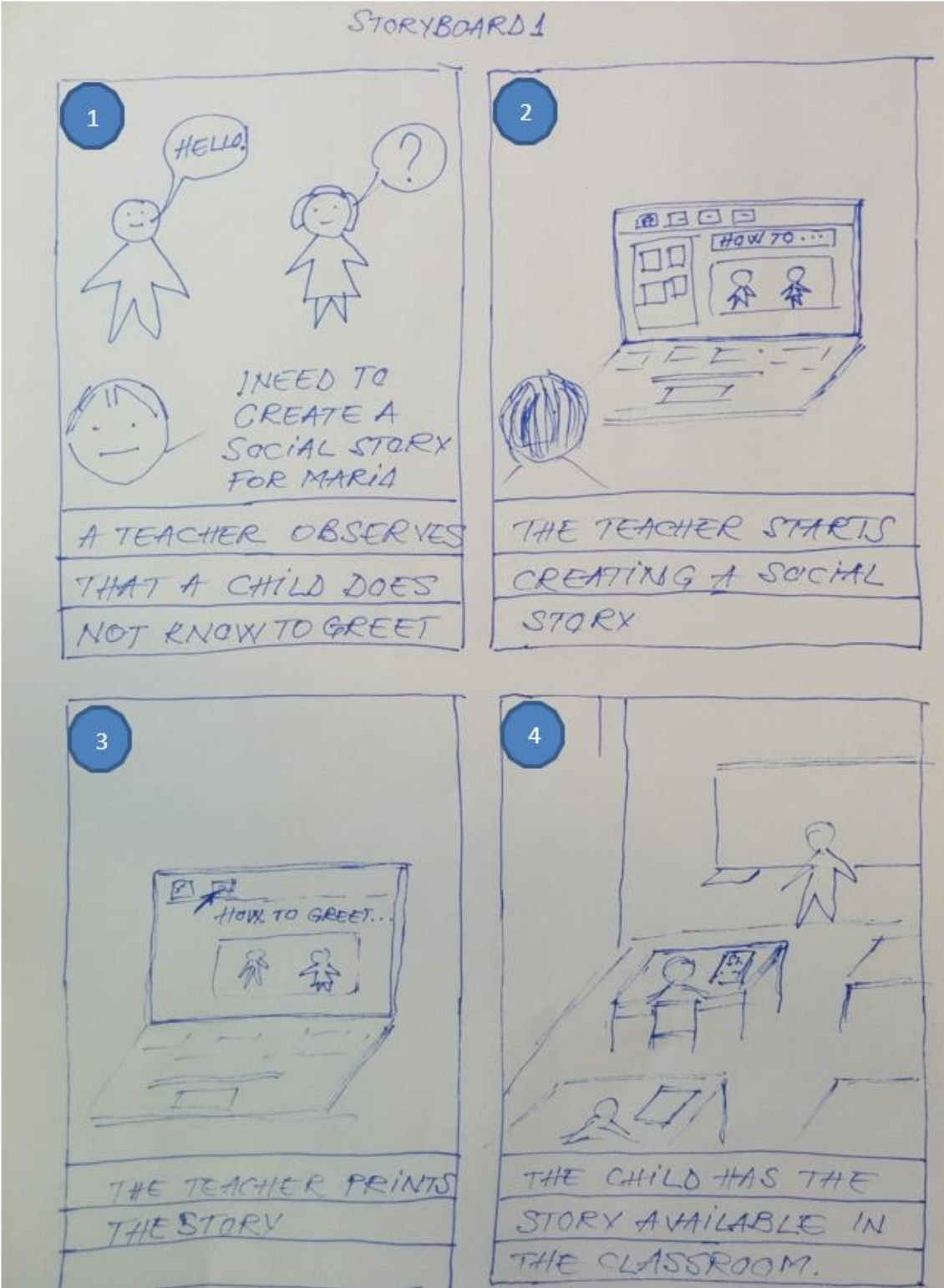
Appendix I

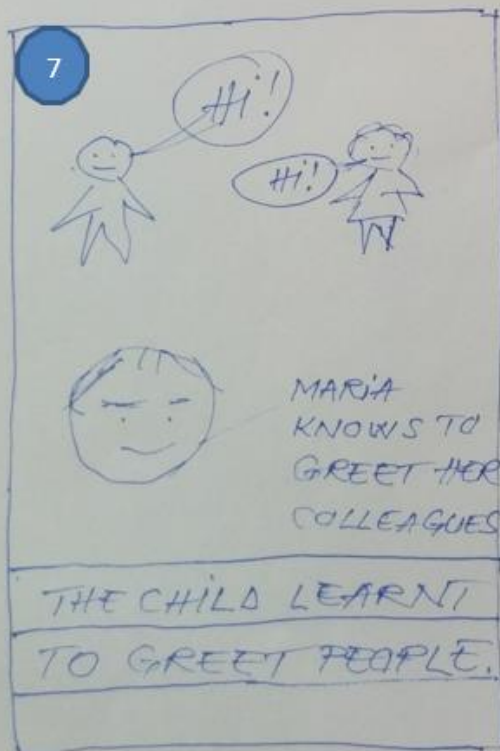
Use Case Diagram for the Social Story Authoring Tool



Appendix J


Storyboards





STORYBOARD 2

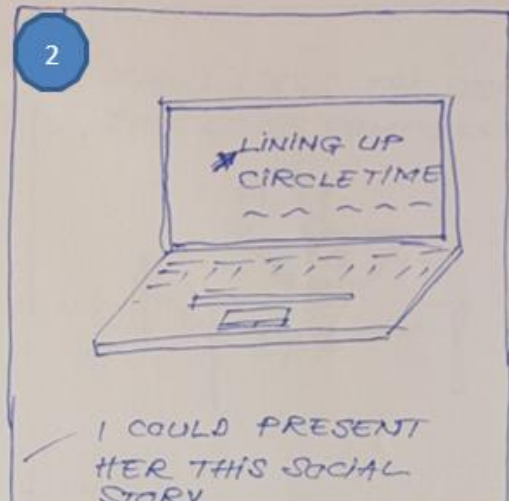
1



MARIA DOESN'T KNOW TO STAY IN LINE

A TEACHER OBSERVES A STUDENT IN THE SCHOOL YARD

2



I COULD PRESENT HER THIS SOCIAL STORY

THE TEACHER SELECTS A SOCIAL STORY FROM A LIBRARY

3



IT'S GREAT! I CAN ADD NEW PHOTOS.

THE TEACHER CAN CHANGE THE IMAGES


4



I CAN CUSTOMISE THE FONT AND THE SENTENCES

THE TEACHER CUSTOMISES THE STORY FOR HIS STUDENT

5




BRILLIANT! I CAN
HAVE THE STORY
READ OUT LOUD

THE TEACHER
LISTENS TO THE
STORY

6

MARIA LIKES THE STORY
SHE LOVES COMPUTERS



THE STUDENT LISTENS
TO THE STORY

7



LOOK! MARIA
STAYS IN LINE
NOW.

THE STUDENT LEARNT
TO STAY IN LINE

Appendix K

Documents for the Study “Exploring Low-fidelity Prototypes”

K.1 Information Sheet

*Aurora Constantin, PhD Research
December 2012*



PARTICIPANT INFORMATION SHEET

Exploring Low-fidelity Prototypes

PROJECT TITLE

Exploring Social Communication Skills in Children with ASC through Social Stories and Humour

INVITATION

You are being invited to take part in a workshop which aims to inform the design for a PhD project. The general goal of PhD research is to explore how a computer-based application can support teachers who work with children with ASC to develop, present, and assess social stories. Based on two low-fidelity prototypes, this study aims to discover usability problems (which can be understood in this case as ease of use and acceptability of the system for practitioners, performing specific tasks), but also to get a deep insight into practitioners' impressions and expectations related to the social story application. The research question addressed is: “Can technology facilitate the development, implementation and assessment of social stories? If so, in what ways?”

WHAT WILL HAPPEN

This study will be divided in two parts: constructive interaction and brainstorming.

Part1 - Constructive Interaction

Constructive interaction involves having two users who work on the system together and verbalize their thoughts. By verbalizing your thoughts, you will make it easier to find out what your impressions and expectations about the system are, and which parts of each prototype create problems. This also enables me to understand which prototype (or parts of prototype) you prefer.

In the first part you will be asked to test two prototypes, based on four scenarios (see below). Please, read carefully one scenario at a time and follow it with each prototype.

Scenario 1: Mr Wilson created a story called “Sharing” with complete sentences for John Smith. He decided to present it to the child, based on a daily schedule. He will present it to John on computer. He needs the story to be read by computer. He adjusts the volume before he starts presenting it. Then, he presents it to John, page by page.

Scenario 2: Mr Wilson created a story called “Sharing” with partial sentences to check John's comprehension. He opens the application and searches for the story. Once he finds it, he asks the child to go through the story and to complete the sentences.

Scenario 3: Mr Wilson has to write a social story about sharing. He decided to customize an existing social story. Thus, he searches through social stories library in order to find out a story about sharing and quickly customize it for John Smith. He chooses a story called “Sharing” with complete sentences. Then, he changes the title into “Sharing Things it’s OK” and add a new page after the title page, on which he writes “My name is John”. Finally he saves the story.

Scenario 4: Mr Wilson must create a new social story in a book story format, for a child called Derek Leeds. He has already the content (see below) and he just needs to edit it and add suitable pictures/symbols using the application. At the end, he saves the story.

<p><i>Sharing</i></p> <p><i>I may try to share with people. Sometimes they will try to share with me.</i></p> <p><i>Usually sharing is a good idea.</i></p> <p><i>Sometimes, if I share with someone they may be my friends.</i></p> <p><i>Sharing with other people makes them feel welcome and may make me feel.</i></p>
--

After completing all the scenarios you will be invited in a short interview to get your general opinions and to clarify the problems you encountered.

Part 2 – Brainstorming

This part involves two stages. In the first stage you will be asked to write down on post-its your ideas about specific topics and about the problems encountered, without discussing or criticising them. In this stage you should worry about how feasible your idea is. Please, write down any idea which comes in your mind, either it might seem unrealistic. In the second stage the ideas collected will be analysed, filtered and ranked according to their acceptability.

TIME COMMITMENT AND LOCATION

The study typically takes 90 to 120 minutes and is conducted in one session at the University of Edinburgh, Informatics Forum. Please, feel free to take your time for completing the task.

FOR FURTHER INFORMATION

If you have any further questions regarding this study, please contact:

Aurora Constantin
PhD student
A.Constantin-2@sms.ed.ac.uk
Tel: 0753 245 3086

Dr. Helen Pain
Supervisor
helen@staffmail.ed.ac.uk
Tel: 0131 650 8485

Thank you for your time!

K.2 Consent Form

*Aurora Constantin, PhD Research
December 2012*



PARTICIPANT CONSENT FORM

Exploring Low-fidelity Prototypes

STUDY SUMMARY

The general goal of this study is to discover which aspects of the process of developing social stories can be supported by a computer-based application and how, based on two low-fidelity prototypes that will be presented to you.

This study will be divided in two parts: constructive interaction and brainstorming (see Participant Information Sheet for details). While in the first part you will be required to evaluate the prototypes, based on four given scenarios, in the second part you will produce and analyse new ideas for improving the system, based on specified topics.

PARTICIPANTS' RIGHTS

You may withdraw from the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn/destroyed.

You have the right to omit or refuse to answer or respond to any question that is asked of you.

You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study begins. Please, feel free to ask any question related to this study at any time.

BENEFITS AND RISKS

There are no known risks for you in this study. You will get a certificate of attendance in recognition of your contribution to this study.

CONFIDENTIALITY/ANONYMITY

No one will link the data you provided to the identifying information you supplied (e.g., name, email)

The data recorded will be strictly used for the purpose of PhD study. It will be anonymised for reporting purposes. Please tick the boxes below to indicate agreement.

I agree to take part in this study and for the data collected to be used in research

I agree to my contribution to be voice recorded

I agree to my contribution to be video recorded

I agree to outcomes of the research being used in research and teaching presentations

Participant's signature

Date

Participant's Name (please print)

Contact (email or telephone)

K.3 Interview Questions

*Aurora Constantin, PhD Research
December 2012*

QUESTIONS AND TOPICS

Exploring Low-fidelity Prototypes

Phase1: Exploring Prototypes

1. What is your general opinion about prototype 1?
2. What is your general opinion about prototype 2?
3. Which one do you prefer? Alternatively, which parts from each prototype do you like more?
4. Which parts/aspects of the prototypes don't you like?
5. What are the problems you encountered with prototype 1?
6. Which elements would you like to improve in this prototype and how?
7. What are the problems you encountered with prototype 2?
8. Which elements would you like to improve in this prototype and how?

Phase 2: Brainstorming Topics

1. **Problems encountered.** Take each problem encountered in the first stage. Ask suggestions. Give paper, pens and pencils to draw and post-its. Don't analyse or criticise!
2. **New Features.** Invite them to suggest what features they would like to add to the system.
3. **Child Profile.** How do you like the profile of the child to look? Please, write down as many ideas as you can. Also, draw a sketch if you can express better your idea. Don't worry about how much artistic your drawing is.
4. **Browse Social Stories.** What criteria would you introduce to filter existing social stories? How would you rank the social stories?
5. **Rewards.** What rewards can be added for being used at the end of a social story presentation.
6. **Schedule.** How would you suggest designing the schedule for social stories?
7. **Reminder.** What kind of reminders you need?
8. **Social Stories Layouts.** What layouts for presenting the stories would you suggest?
9. **Monitor Progress.** How would you like to monitor the child's progress? How often?
10. **Progress Diagrams.** How would you like to visualize the progress of the child? What kind of diagrams you need/like to have?

Appendix L

Documents for the Study: Exploring High-fidelity Prototypes

L.1 Information Sheet

*Aurora Constantin, PhD Research
June 2013*



INFORMATION SHEET

Exploring High-fidelity Prototype with Practitioners

INVITATION

You are being invited to take part in a formative evaluation of ISISS (Improving Social Interaction through Social Stories), an authoring tool which supports practitioners to build, present and assess social stories for children with ASC. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask me if something is unclear or if you need more information.

ABOUT MY PROJECT

The general goal of PhD research is to explore how a computer-based application can support teachers who work with children with ASC to develop, present, and assess social stories.

ABOUT THIS STUDY

The specific goals of this study are to assess the ease with which users interact with the system, to identify any problem with the design which causes unexpected results or confusions, to find out solutions for the identified problems, and to improve the functionality and graphical interfaces.

YOUR ROLE

I would like to ask you to help me improve the tool. Thus, you are expected to be a collaborator, rather than a simple participant. You will be invited to perform some simple tasks (see the tasks list) using the authoring tool. During the task I will ask you to verbalize your thoughts. You are free to ask me questions to clarify any aspect of the system. After each task you will be asked some questions related to that task.

TIME COMMITMENT AND LOCATION

The study takes 1h and is conducted in one session at the Kaimes School, Edinburgh.

If you have any further questions regarding this study, please contact:

*Aurora Constantin
PhD student
A.Constantin-2@sms.ed.ac.uk
Tel: 0743 847 4264*

*Dr. Helen Pain
Supervisor
helen@staffmail.ed.ac.uk
Tel: 0131 650 8485*

L.2 Consent Form

*Aurora Constantin, PhD Research
June 2013*



PARTICIPANT CONSENT FORM

Exploring High-fidelity Prototype with Practitioners

Now that you have read the information sheet, it is up to you to decide whether you want to take part in my study. You may withdraw from the research study at any time without explanation. You can ask any data you have supplied to that point be withdrawn/destroyed.

You can omit or refuse to answer to any question that is asked of you.

Please, feel free to ask any question related to this study at any time.

CONFIDENTIALITY/ANONYMITY

The data recorded will be strictly used for the purpose of PhD study. It will be anonymised for reporting purposes.

If you are happy to take part in this study, please complete the consent by ticking each item:

- | | |
|---|--------------------------|
| I agree to take part in this study and for the data collected to be used in research | <input type="checkbox"/> |
| I agree to my contribution to be voice recorded | <input type="checkbox"/> |
| I agree to my contribution to be video recorded | <input type="checkbox"/> |
| I agree to outcomes of the research being used in research and teaching presentations | <input type="checkbox"/> |

Participant's signature

Date

Participant's Name

Contact (email or telephone)

My contact details:

Tel: 0743 847 4264

Email: A.Constantin-2@sms.ed.ac.uk

L.3 Task List 1

*Aurora Constantin, PhD Research,
June 2013*



LIST OF TASKS

Exploring High-fidelity Prototype with Practitioners

Section A

1. Find a story called "Circle time" in the library of shared stories and open it.
2. Present the story "Circle Time" to a child.
3. Find a story called "I need to keep my hands to myself" which is written for John Smith and show it to the child.
4. Open a story called "Walk in line" from the shared library, edit it and adapt for John Smith as follows. Add a first sentence: "My name is John Smith" and add a corresponding image. Delete the last sentence.
5. Annotate the new sentence you have just introduced and check the others. Please, feel free to change the sentences types if you find it necessary.
6. Save the story you have just edited for John Smith.

Section B

7. Write a new story called "When I feel angry" (please, see the text below). Add appropriate pictures.

When I feel angry

Sometimes I feel angry.

When I feel angry I will find my teacher, Mummy, Daddy or another adult.

I can say "I'm angry!"

It is ok to use words when I feel angry.

They will talk to me about what happened and about how I feel.

This might help me feel better.

8. Choose the goal and annotate the sentences types for the story you have written. Then, save the story for Helen Robertson.

Section C

9. Edit the profile for Mark Brown as follows:

Birthday: 1.06.2004; Class: 2nd primary; Tel: 0131 245 6789; Email: tbrown@gmail.com

10. Find images on Google using the keyword dog and upload them into the application.

L.4 Questions (1)

*Aurora Constantin, PhD Research
June 2013*

LIST OF QUESTIONS

Exploring High-fidelity Prototype with Practitioners

1. What features did you like/?
2. What features did you dislike?
3. Do you have any suggestion to improve the application in order to make this task easier?

Specific questions:

1. What suggestions do you have to improve the pictures/resources in the tab navigator?
2. What suggestions do you have to improve the child's profile page?
3. What information would you like to have on the child's profile page?
4. What is your opinion about adding a reward at the end of the story?
5. What would you add/change to feedback window?

L.5 Task List 2

*Aurora Constantin, PhD Research
November 2013*

LIST OF TASKS

Exploring High-fidelity Prototype with Researchers

1. Create a new story, "Talking at snack" for a child called John Smith (see the story below). Save a shared story version.

Talking with friends at snack

My name is John. *[descriptive]*

We have snack at school. *[descriptive]*

Friends talk and share at snack. *[descriptive]*

I can say "Hi" to my friends and talk to them. *[directive]*

Friends are happy when we talk at snack. *[perspective]*

2. Print the story "Talking at snack" to Pdf.
3. Change the settings (on homepage) as follows:
 - select "Get feedback on the story content"
 - select font family: Courier New
 - select font size: 24
 - select font colour: dark blue.
 - select background colour: light blueSave your settings.
4. Go on individual resources for Helen Robertson. Then search images on Google (Helen likes dolls, dogs and clowns) and save an image in reward category for Helen Robertson. Take a photo of you (suppose you are Helen) and save the photo in pictures category.
5. Open the *shared story* you have just created and customize it for Helen Robertson as follows:
 - edit the first sentence as follows: "My name is Helen".Annotate the sentences (see the sentences types above).
Save the story for Helen Robertson.
Save a partial sentence version of the story. Add a corresponding reward.

6. Go to 'My Library' and open the complete sentences story called "*Talking at snack*" you created for John Smith. Choose "Stacked Pictures" layout. Play the role of the child and go through the story.

7. Open the partial sentences story ("Talking at snack") for Helen Robertson. Now, play the role of the child and go through the story, choosing the appropriate word to fill in the sentences.

8. Edit the profile for Mark Brown as follows:
Likes: planes, clowns, animated gifts
Move the story "At Zoo" to archived stories.
Delete the story called 'Going to dentist'.

9. Assess the story ("Talking at snack") impact on the John's behaviour. Insert the frequencies of John's behaviour (instances of talking with friends during the snack time):

Date: 1 Oct 2013 Frequency: 0
Date: 8 Oct 2013 Frequency: 2
Date: 15 Oct 2013 Frequency: 4
Date: 22 Oct 2013 Frequency: 4
Date: 9 Nov 2013 Frequency: 5

When you finish, view the graph of behaviour frequencies, and then close the window.

L.6 Questions (2)

*Aurora Constantin, PhD Research
November 2013*

LIST OF QUESTIONS

Exploring High-fidelity Prototype with Researchers

During the tasks:

1. What features did you like/?
2. What features did you dislike?
3. Do you have any suggestion to improve the application in order to make this task easier?

After tasks:

1. Is it clear how to reach each system state (Libraries State, Shared Stories Library State, Create State, Profiles State, [Child Profile State](#))?
2. Is it clear how to navigate from one state to another?
3. Do you easily find general/individual resources?
4. Do you easily find how to add a new image to general/individual resources (either from the computer, or from Google or by taking a photo with the Webcam)?
5. Is it clear how to save a story?
6. Is it clear how to show a story to a child?
7. Do you easily find how to create a shared story?
8. Is it clear how to create a partial sentence story?
9. Does each window have a visible title?
10. Are the icons concrete and familiar?
11. Are field labels brief, familiar, and descriptive?
12. Are buttons labels brief, familiar, and descriptive?
13. Are the tooltips brief and descriptive?
14. Does the system provide feedback after interactions?
15. Does the system provide messages to prevent deleting important data?
16. Are the sentences in these messages clear enough?
17. Is only (and all) information essential to decision making displayed on the screen?
18. Are the icons logically grouped?
19. Are the buttons consistent from one window to another?
20. Are the icons consistent from one window to another?
21. Are the feedback messages consistent across the system?
22. Are the pop-up windows consistent across the system?

Appendix M

Results and Decisions in the Formative Evaluation with Practitioners

M.1 Usability problems

Usability Problem	Description
Visibility of <i>Show</i> button	Three of the practitioners did not notice the <i>Show</i> button without hints (e.g. "Look on the tools area")
Visibility of <i>Delete</i> and <i>Add Page</i> buttons	Three of the practitioners encountered problems to find these buttons; they considered
Tab Navigator on the resources area not well-organised	Most of the practitioners suggested that resources should be grouped into two categories: shared resources and individual resources
Visibility of the links to navigate between screens	One practitioner remarked that the links which allow the navigation between various screens are hardly visible and too crowded among other interface elements
Buttons font size	Two practitioners considered that the font size on some buttons should be magnified to make the text more visible
Edit/Done button on the profile page	One practitioner found this button confusing. She suggested adding the button after the text fields. Once the text fields are filled the user can see the Done button and presses it to save data
The field <i>New Child</i> on the <i>Save</i> window	Several practitioners were confused by this text area. After selecting the name of the child on the drop down list, they hesitated whether or not this field has to be considered or not. One practitioner suggested this field should not appear since the user does not need to fill in.
Double-click the <i>Libraries</i> button on the <i>Homepage</i>	When double-clicking the <i>Libraries</i> button on the <i>Homepage</i> a participant in the pilot study noticed that she is taken directly to the <i>Shared Stories</i> libraries. The reason was that both the <i>Libraries</i> button and the <i>Shared Stories</i> button on the <i>Libraries</i> screen were placed almost on the same position. The second click was applied on <i>Shared Stories</i> button on the next screen, and the user could not notice this intermediary screen (<i>Library</i> screen), having no chance to choose between visiting the <i>Shared Stories</i> library and the <i>My Stories</i> library. The suggestion was to change the position of the buttons on the <i>Libraries</i> screen.

M.2 Suggestions

Suggestion	Description
Comments on individual stories	Several practitioners suggested that it may be useful if the user has the option to add comments on the social story written for a student, including the target behaviour/skill.
Rank the stories	Two practitioners considered useful to have an option to rank the story according to its impact on the child.
Speech bubbles	One practitioner suggested having speech bubbles as an option to be added to the photos.
Story content	Having a summary of the story content (available from the student profile), in terms of how many sentence of various types it contains was suggested by a practitioner.
Individual Evaluation Plan (IEP)	One practitioner suggested adding the IEP on the student profile. The IEP is an individualised document for a student who receives special education to help parents and school staff to work together on improving the student's educational results
Screens background	One practitioner commented that the screens "have too much white". He suggested that a different colour would be more appropriate, as white colour seems to be not too attractive.
Select a specific story page	One practitioner remarked that it might be useful to go straightforward to a particular story page rather than navigate page by page
Group general resources into categories	Two practitioners suggested that it would be useful to organise resources into categories.
Drag and drop images from Google on story area	One practitioner commented that she would like to have the option to drag an image directly on the story area rather than having it saved on the resources area and then using drag and drop to add it to the story.

Appendix N

Results and Decisions in the Formative Evaluation with Researchers

N.1 Usability Problems-Stage I

Problem	Description
Picture container on the <i>story</i> area	The place to drag the picture on the <i>story</i> area is not obvious; it seems to be text area
Picture size in two layouts	Picture size is too small in <i>Stacked Pictures</i> and <i>Parallel Pictures</i>
Visibility of story goal	Make <i>Goal</i> drop box visible
Visibility of annotation tool	Make annotation tool visible
Drag and drop a picture from a window to another	Dragging a reward photo from the <i>resources</i> are to the Partial Sentence Story window is cumbersome
Sentences in Text Only layout	Sentences are too close to each other in <i>Text Only</i> layout
<i>Weaknesses</i> field on Student Profile	<i>Weaknesses</i> was considered as being not appropriate by one of the researchers since it is a negative term
Instructions on the <i>Create Shared Story</i> and <i>Create Partial Sentence Story</i> windows	Instructions are difficult to read on the <i>Create Shared Story</i> and <i>Create Partial Sentence Story</i> windows as they appear like a 'blob of text'
The font size in tooltips	The font size in tooltips is too small
Information in <i>Learn More</i> about sentence types	The information on the <i>Sentence Types</i> window is hard to be read.
<i>Individual Resources</i> does not reset when returning	When returning to the <i>Individual Resources</i> item on <i>Resources</i> area, the list of students should appear instead of the screen for the last visited student
Close the window in child's interface	The window for showing a story to a child should have a <i>Close</i> button at the end of the story
Clarify the instruction in <i>Create Partial Sentence Story</i> window	Not clear what to do and how to create a partial sentence story

N.2 Suggestions – Stage I

Suggestion	Description
Change the <i>Strengths</i> text area title	Change the <i>Strengths</i> text area title to <i>Strength and Skills</i>
Save the favourite layout on the <i>Student Profile</i>	Add the layouts on the <i>Child Settings</i> window to allow practitioners to select the favourite layout for a particular child
Add comments on the graph in <i>Story Assessment</i> window	Add comments in a tooltip while the pointer is on the graph in <i>Story Assessment</i> window
Change the letter weight on the <i>Shared Stories</i> screen for the populated letters	Change the letter weight on the <i>Shared Stories</i> screen to make visible if there are stories starting with that letter
Replace all similar words once on <i>Create Shared Story</i> window	When a word is replaced with another word in a sentence, replace all similar words in the story on <i>Create Shared Story</i> window
Scale the space between dates on the graph in the <i>Story Assessment</i> window	The space between the dates should reflect the time interval in graphical representation of the behaviour on the <i>Story Assessment</i> window
Print in a specific folder	When printing a story provide the option to print it in a particular folder
Replace the links to navigate between screens with buttons and place them on the <i>Tools</i> area	The buttons are more visible than the links since they display both images and text. Also the space available on the <i>tools area</i> on the left top corner favours their visibility.
Add an image container for the image reward on <i>Create Partial Sentence Story</i> window	When an image was added as reward in <i>Create Partial Sentence Story</i> window, the name of picture was appended in a text area. Researchers suggested that it is more natural to add a miniature of the image reward.

N.2 Bugs – Stage I

Bugs	Description
Story is not cleared when the <i>Create</i> page is left	When visiting <i>Create</i> screen from <i>Profiles</i> , the previous story is not cleared.
Save a story on a new created profile does not work	When saving a story on a new created profile it is not saved on child's profile
If the sentence is empty, a text "null" appears when showing the story	"Null" appears in the text areas which must be empty.
Save a shared story with the same title does not work	When trying to save a shared story with a title which already exists is not saved
<i>Accept Replacement</i> in the <i>Create Shared Story</i> window is not properly handled	Clicking on <i>Accept Replacement</i> in the <i>Create Shared Story</i> window is not handled properly when the field is empty
<i>Save</i> button freezes	<i>Save</i> button freezes after pressing it several times

N.3 Decisions and Justifications – Stage I

Decision	Justification for the decision (HCI principles which support the decision)	Priority
Picture container on the <i>story</i> area	Several experts considered confusing the space on the image container. It was decided to add a “Drag photo here” placeholder image to indicate the make this visible and indicate the affordable action (HCI principles: ‘familiarity’ and ‘predictability’)	High
Picture size in two layouts	Magnifying the pictures in the Stacked Pictures and Parallel Pictures layouts was considered more appropriate as more children can easier notice the details (HCI principle: ‘flexibility in use’)	High
Visibility of story goal	Several of experts spent a considerable time to discover the story goal drop down list. The decision was to add a label above the list	High
Visibility of annotation tool	Several of experts spent a considerable time to discover the annotation tool. The decision was to add a label above the list	High
Drag and drop a picture from a window to another	It is cumbersome to use drag and drop <i>from resources area</i> (<i>Create</i> screen) to the reward image container on the <i>Create Partial Sentence Story</i> . The decision was to embed the <i>Create Partial Sentence Story</i> into the <i>Create</i> screen. (HCI principle: ‘low physical effort’)	High
Sentences in Text Only layout	The sentences in Text Only layout are more readable if the space between sentences is magnified. It is expected to increase user satisfaction	High
<i>Weaknesses</i> field on Student Profile	The title <i>weaknesses</i> was replaced with <i>Additional Information</i> to avoid a negative effect on users	High
Instructions on the <i>Create Shared Story</i> and <i>Create Partial Sentence Story</i> windows	The instructions on the <i>Create Shared Story</i> and <i>Create Partial Sentence Story</i> are separated in paragraphs to make the text easier to be read. (HCI principle: ‘low fidelity effort’)	High

The font size in tooltips	The tooltips background was changed to make the instructions more visible	High
Information in <i>Learn More</i> about sentence types	The information on the <i>Sentence Types</i> window was organised in paragraphs to make the text easier to be read	High
<i>Individual Resources</i> does not reset when returning	When returning to the <i>Individual Resources</i> it opens with the list of children. It eliminates the confusion	High
Close the window in child's interface	A <i>Close</i> button was added at the end of the story	High
Clarify the instruction in <i>Create Partial Sentence Story</i> window	The information about creating a partial sentence story was added	High
Change the <i>Strengths</i> text area title	The title <i>Strengths</i> was changed to <i>Strengths and Skills</i>	High
Save the favourite layout on the <i>Student Profile</i>	This was consider not a high priority since the layout can be easily selected when presenting or printing a story	Low
Add comments on the graph in <i>Assessment Graph</i> window	Adding the comments when the pointer is moved on the graph were considered important to understand and reflect on child's progress. However, it was considered not of high priority since the practitioner have this information on the same screen on <i>Story Assessment</i> window	Medium
Change the letter weight on the <i>Shared Stories</i> screen for the populated letters	This suggestion was not considered important since it is supposed to have a huge number of shared stories to cover all the letters	Low
Replace all similar words once on <i>Create Shared Story</i> window	When the user choose to replace a 'sensitive' word in the <i>Create Shared Story</i> window all similar words in a story are replaced at the same time to reduce the effort spent by the user (HCI principle: 'low physical effort')	High
Scale the space between dates on the Assessment Graph	This was considered not of medium importance since the dates appears on the graph and decided to be implemented depending on the time constraints	Medium

window		
Print in a specific folder	A browse window was introduced before saving the PDF file so that the user can choose the location of the file	High
Replace the links to navigate between screens with buttons and place them on the <i>Tools</i> area	The buttons are more visible than the links since they display both images and text. Also the space available on the <i>tools area</i> on the left top corner favours their visibility. (HCI principle: 'predictability')	High
Image reward on <i>Create Partial Sentence Story</i> window	When an image was added as reward in <i>Create Partial Sentence Story</i> window, the name of picture was appended in a text area. Researchers suggested that it is more natural to add a miniature of the image reward.	High

N.4 Usability Problems - Stage II

Usability Problem	Description
Allow selection by clicking on image in <i>Story Layouts</i> window	When clicking the image on the <i>Story Layouts</i> window the layout is not selected
Confusion at the end of showing a story with partial sentences	When the partial sentence story is finished it is not obvious how to close the window. Suggestion: add a <i>Close</i> button when showing a story with partial sentences at the end of the story
Confusion when closing the <i>Assessment Graph</i> window	No clear how to close the <i>Assessment Graph</i> window. Suggestion: add a <i>Close</i> button on <i>Assessment Graph</i> window
Consistency regarding the size and position of various windows	Similar windows should appear in the same position and have the same size (e.g. pop-up windows to confirm the effect of an action, such as save a story or print a story to PDF)
Consistency in edit/save information on the <i>Profiles</i> screen	Consistency: edit/done is not consistent with the way the sentences are saved in Create state. Suggestion: eliminate the button and save the data automatically when leaving the window
Consistency in colour	Change the pop-up window bar colour-make them consistent with the main window (e.g. <i>Add New Student</i> window)
Consistency in dialog boxes	Not all pop-up windows display the similar button in the same position (e.g. <i>yes/save</i> on the left and <i>cancel/no</i> on the right)
The image reward cannot be cleared on the <i>Create Partial Sentence Story</i> window	It is not possible to clear an image on the reward image container once it was added. Suggestion: add a <i>Clear</i> button next to the image reward container
No page number in PDF	The number of the pages should are not displayed in PDF
The colour does not work well for some people to distinguish between current and archived stories	Add the stories on the <i>Profiles</i> screen in a table and add labels for the current and archived stories.

N.5 Suggestions – Stage II

Suggestion	Description
Drag and drop pictures from one tab item to another	Drag and drop pictures from one item to another on the <i>resources area</i> (<i>Create</i> screen), for example from <i>General Resources</i> to <i>Individual Resources</i>
Display the title of the story on <i>story area</i>	Display the title of the story on <i>story area</i> (<i>Create</i> screen) when navigating through the story
Display the name of the child on <i>story area</i>	Display the name of the child on <i>story area</i> (<i>Create</i> screen) when navigating through a story written for a particular child
Save details automatically	Save details in a cell on <i>Story Assessment</i> window automatically when leaving the cell
More information on the <i>Create Partial Sentence Story</i> clearer	More information is needed on the <i>Create Partial Sentence Story</i> to make clearer how to create a partial sentence story. Suggestion: “The child will be given with three options. The word you clicked will automatically be one of the options. Introduce the other two options”
Add tooltips on the labels in the <i>Settings</i> window and more information on pressing <i>Learn More</i> buttons	Make clearer the explanation on the <i>Settings</i> window. Suggestions: tooltips on labels and new windows when pressing the <i>Learn More</i> button for more details
Add more information about the Gray’s on the <i>Feedback</i> window	In the <i>Feedback</i> window add the goal of the story and about the Gray’s recommended ratio between sentences. Add suggestion about what to change if the ratio is not respected.
Add story modified date on <i>Profiles</i>	Add the date when the story was last modified on the <i>Profiles</i> screen
Change the background colour for the tooltips	To make the message more visible the suggestion was to change the background colour for tooltips
Option to have book story format as landscape in PDF	Provide a landscape layout for the BookStory format when printing in PDF
Magnify the font size on <i>Graph Assessment</i> window	The font size on the Graph Assessment window is too small-magnify it
Specific settings for children with special needs	Add specific options for children with special needs on the <i>Settings</i> window. For example add <i>Visual Disabilities</i> in Settings with the option to have a high contrast, or options for colour blind children
Specific settings for a child	Save specific settings for a particular child on the <i>Student Profile</i> screen (e.g. font family, size, colour, etc.)
Add an “Drag photo here” placeholder image on the <i>Create Partial Sentence Story</i>	Add an “Add Photo” placeholder image on the <i>Create Partial Sentence Story</i> to make visible the container for adding an image reward

N.6 Bugs – Stage II

Usability Problem	Description
Visibility of <i>Show</i> button	Three of the practitioners did not notice the <i>Show</i> button without hints (e.g. “Look on the tools area”)
Visibility of <i>Delete</i> and <i>Add Page</i> buttons	Three of the practitioners encountered problems to find these buttons; they considered
Tab Navigator on the resources area not well-organised	Most of the practitioners suggested that resources should be grouped into two categories: shared resources and individual resources
Visibility of the links to navigate between screens	One practitioner remarked that the links which allow the navigation between various screens are hardly visible and too crowded among other interface elements
Buttons font size	Two practitioners considered that the font size on some buttons should be magnified to make the text more visible
Edit/Done button on the profile page	One practitioner found this button confusing. She suggested adding the button after the text fields. Once the text fields are filled the user can see the Done button and presses it to save data
The field <i>New Child</i> on the <i>Save</i> window	Several practitioners were confused by this text area. After selecting the name of the child on the drop down list, they hesitated whether or not this field has to be considered or not. One practitioner suggested this field should not appear since the user does not need to fill in.
Double-click the <i>Libraries</i> button on the <i>Homepage</i>	When double-clicking the <i>Libraries</i> button on the Homepage a participant in the pilot study noticed that she is taken directly to the <i>Shared Stories</i> libraries. The reason was that both the <i>Libraries</i> button and the <i>Shared Stories</i> button on the <i>Libraries</i> screen were placed almost on the same position. The second click was applied on <i>Shared Stories</i> button on the next screen, and the user could not notice this intermediary screen (<i>Library</i> screen), having no chance to choose between visiting the <i>Shared Stories</i> library and the <i>My Stories</i> library. The suggestion was to change the position of the buttons on the <i>Libraries</i> screen.

N.7 Decisions and Justifications – Stage II

Decision	Justification for the decision (HCI principles which support the decision)	Priority
Allow selection by clicking on image in Story Layouts window	It is common in the interface design to click on the icon attached to a radio button to select that button (HCI principle: ‘familiarity’)	High
Confusion at the end of showing a story with partial sentences	At the end of the partial sentence story a <i>Close</i> button was added as most of the experts suggested (HCI principle: ‘predictability’)	High
Confusion when closing the <i>Assessment Graph</i> window	At the end of the partial sentence story a <i>Close</i> button was added as most of the experts suggested (HCI principle: ‘predictability’)	High
Consistency regarding the size and position of various windows	Several experts noticed that the pop-up windows appear in different places and have different sizes. The decision was to make all the similar windows of the same size and place them in the same position (HCI principle: ‘consistency’)	High
Consistency in edit/save information on the <i>Profiles</i> screen	The decision was to eliminate the buttons and eliminate the button and save the data automatically when leaving the window (HCI principle: ‘consistency’)	High
Consistency in colour	The decision was to change the pop-up window bar colour and make them consistent with the main window (HCI principle: ‘consistency’)	High
Consistency in dialog boxes	The decision was to place <i>yes/save</i> buttons on the left hand side and <i>no/cancel</i> buttons on the right hand side similar to MS Word which is used by most of practitioners (HCI principle: ‘consistency’ and ‘familiarity’)	High
The image reward cannot be cleared on the <i>Create Partial Sentence Story</i> window	A Clear button was added next to the image reward container on the <i>Create Partial Sentence Story</i> window (HCI principle: ‘consistency’)	High
No page number in PDF	Page number was added to PDF as most of the experts suggested (HCI principles: ‘familiarity’ and	High

	‘predictability’)	
The colour does not work well for some people to distinguish between current and archived stories	Two labels were added for the current stories and for the archived stories to make visible these two categories (HCI principle: ‘predictability)	High
Drag and drop pictures from one tab item to another	This suggestion was not considered of high priority since the tool offers the options of copy/paste and move the pictures from one tab item to another	Low
Display the title of the story on <i>story area</i>	The title was displayed on the <i>story area</i> (on the top) (HCI principle: ‘simple and intuitive to use’)	High
Display the name of the child on <i>story area</i>	The name of the child was displayed on the <i>story area</i> (HCI principle: ‘simple and intuitive to use’)	High
Save details automatically in a cell on <i>Story Assessment</i>	This was decided to be implemented as it involves less effort for users and is also consistent with the way the text is saved the <i>story area</i> (HCI principles: ‘low physical effort’ and ‘consistency’)	High
More information on the <i>Create Partial Sentence Story</i>	More information was added to instructions on the <i>Create Partial Sentence Story</i> to make clearer how to create a partial sentence story (HCI principle: ‘simple and intuitive to use’)	High
Add tooltips on the labels in the <i>Settings</i> window and more information on pressing <i>Learn More</i> buttons	It was decided to implement this suggestion as it is consistent with the other features which have tooltips to indicate their affordability and to make clearer what options are available by adding more information in a separate window (HCI principles: ‘consistency’ and ‘simple and intuitive to use’)	High
Add more information about the Gray’s on the <i>Feedback</i> window	This suggestion was considered of medium priority and will be implemented only if time permits	Medium
Add story modified date on <i>Profiles</i>	This suggestion was considered of medium priority and will be implemented only if time permits	Medium
Change the background colour for the tooltips	This suggestion was considered important as the background for tooltips may make these features	High

	more visible and consequently support the ease of use (HCI principles: ‘consistency’ and ‘simple and intuitive to use’)	
Option to have book story format as landscape in PDF	This suggestion was considered of medium priority and will be implemented only if time permits	Medium
Magnify the font size on <i>Graph Assessment</i> window	The font size was magnify to increase the visibility (HCI principle; ‘low physical effort’)	High
Specific settings for children with special needs	This suggestion was considered of medium priority and will be implemented only if time permits	Medium
Specific settings for a child	This suggestion was considered very important to release practitioners’ workload (Guideline: ‘ease practitioners’ workload’)	High
Add a “ Drag photo here” placeholder image on the <i>Create Partial Sentence Story</i>	A “ Drag photo here” placeholder image was added to the reward image container on the <i>Create Partial Sentence Story</i> to improve make it more visible (HCI principle: ‘predictability’)	High

Appendix O

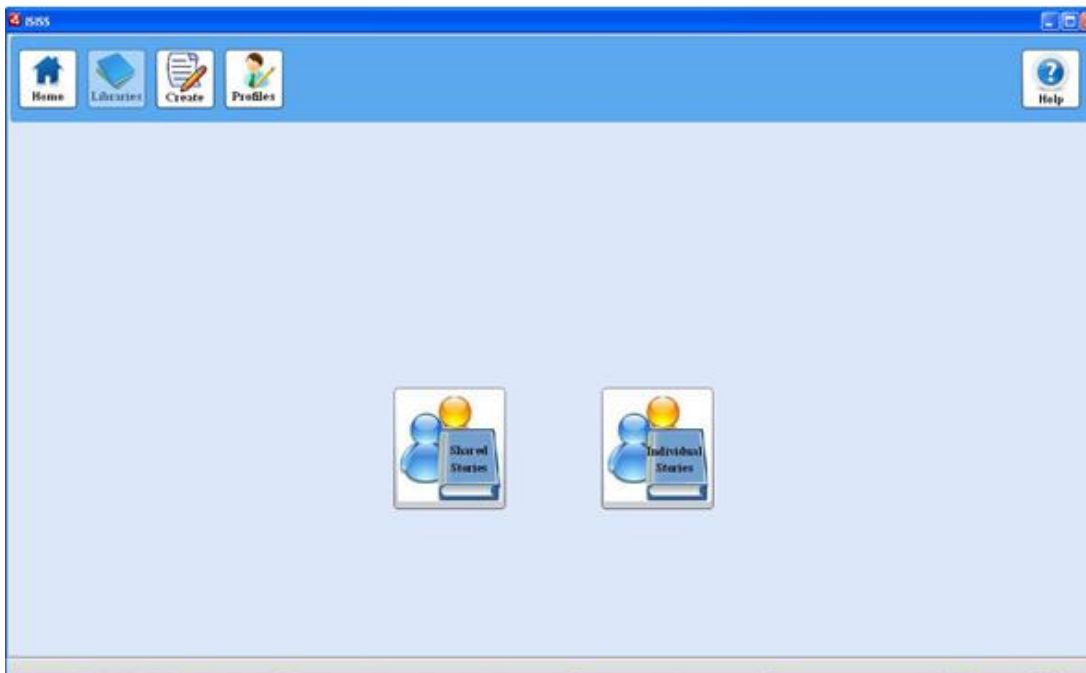
System Walkthrough

Open a story from Shared Story library

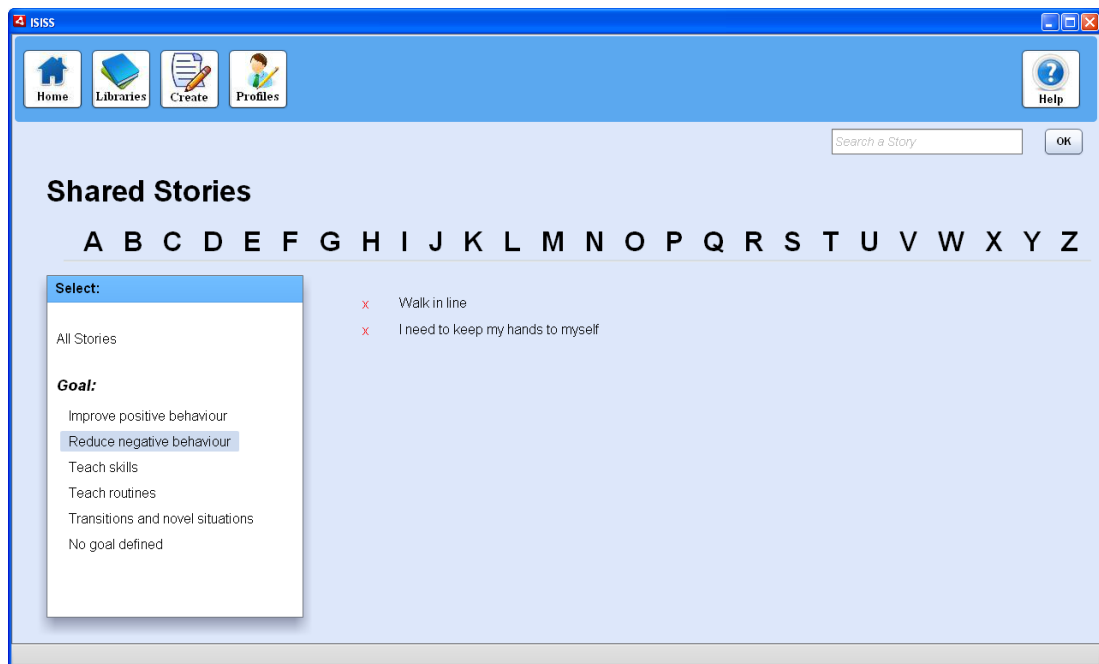
-click *Library* button.



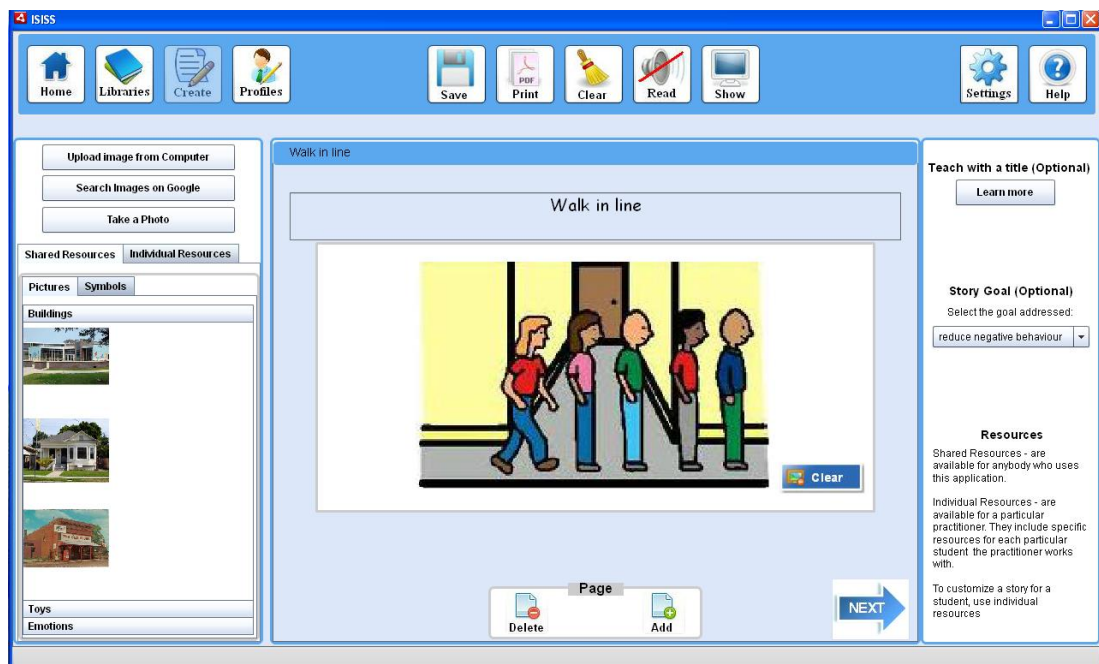
-click on *Shared Stories* button.



-after selecting a letter or a goal all the corresponding stories will be displayed.

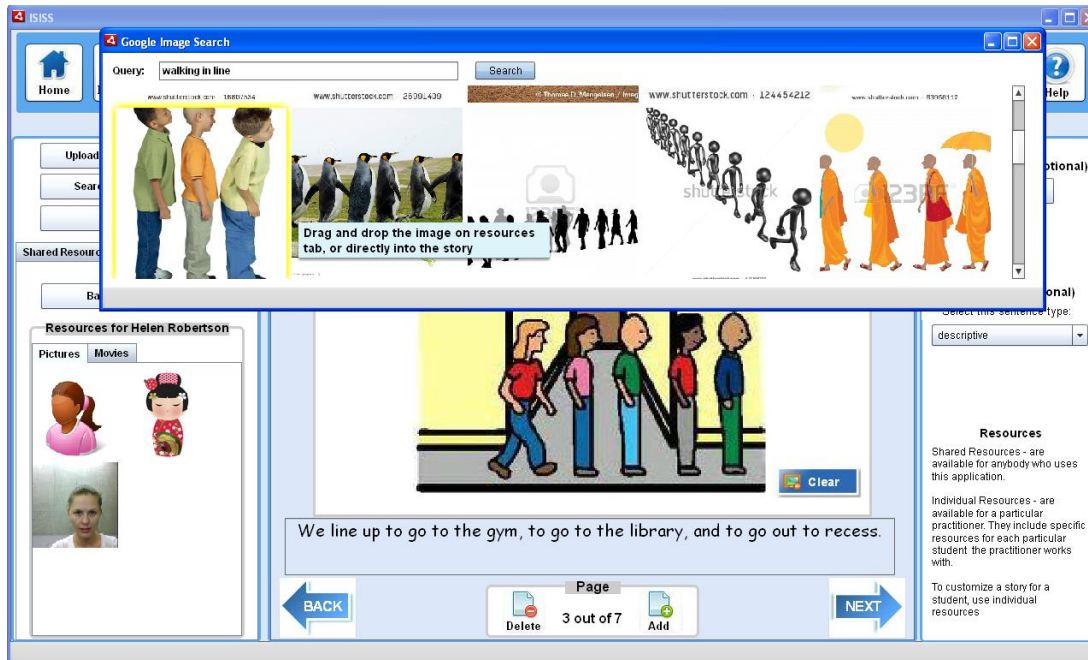


-a story can be open by clicking on the link with its name



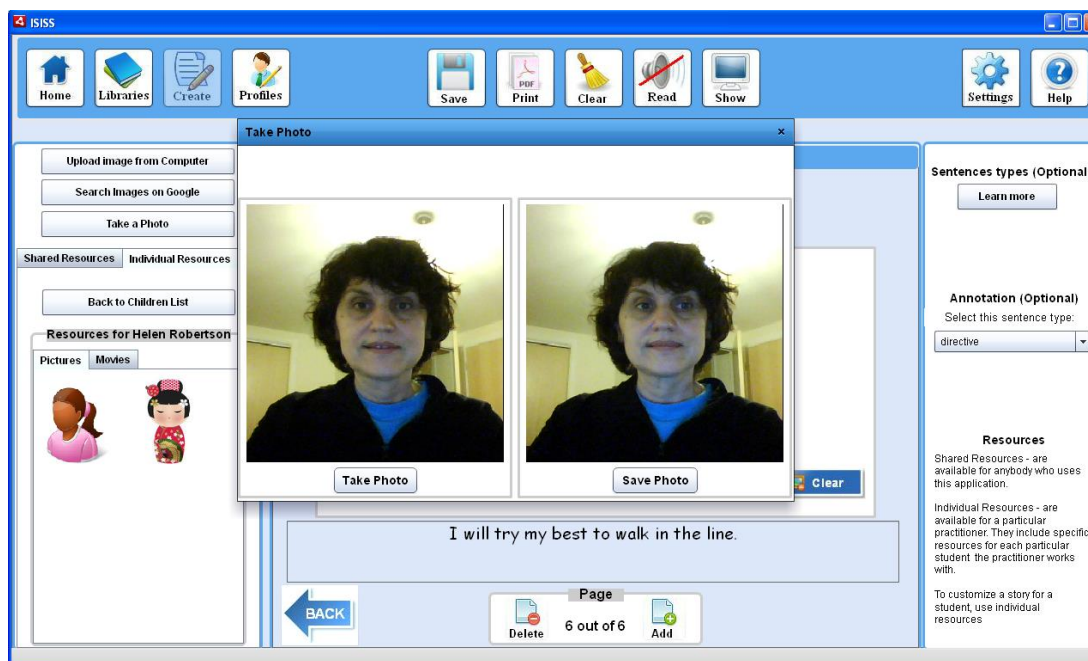
Search an Internet image

-clicking on Search Images on Google opens a window where a query can be introduced to find a certain image.

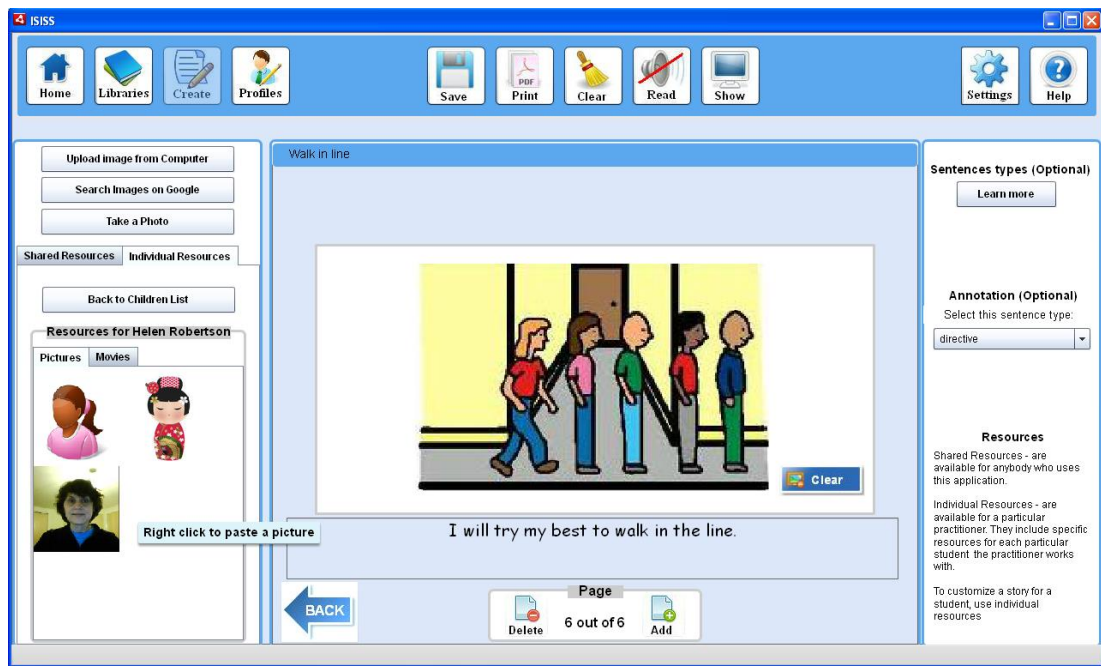


Take a photo and save it in *Individual resources*

-click on *Take a Photo* opens the *Take Photo* window. By clicking on *Take Photo* button a shot is taken and displayed in the right hand side of the window.

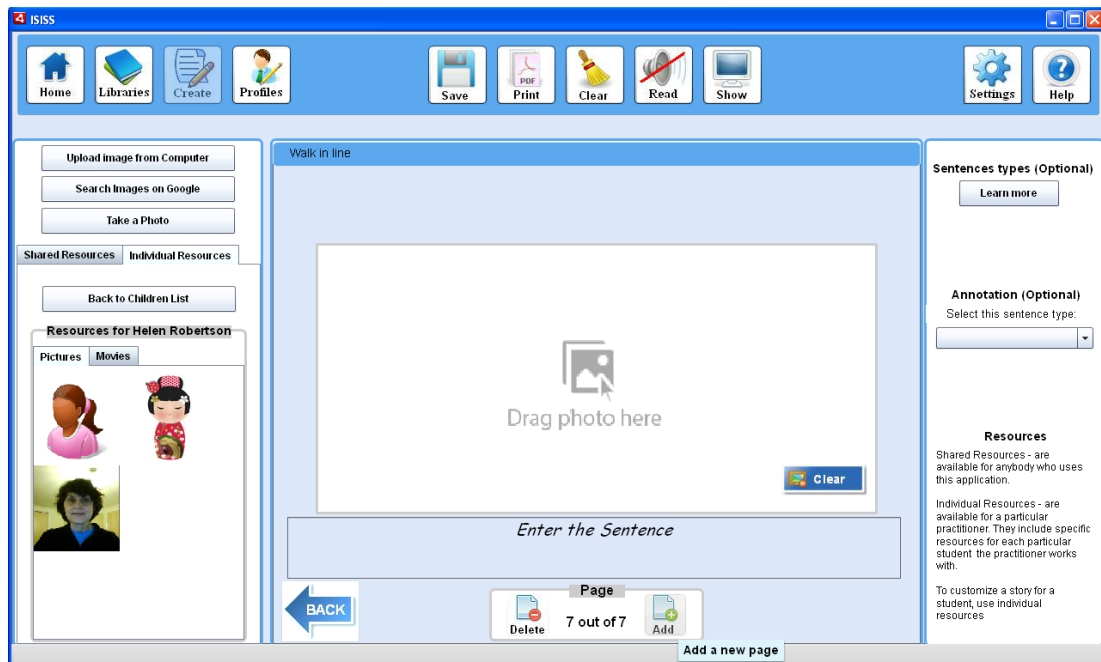


-the photo is saved by clicking *Save Photo*.

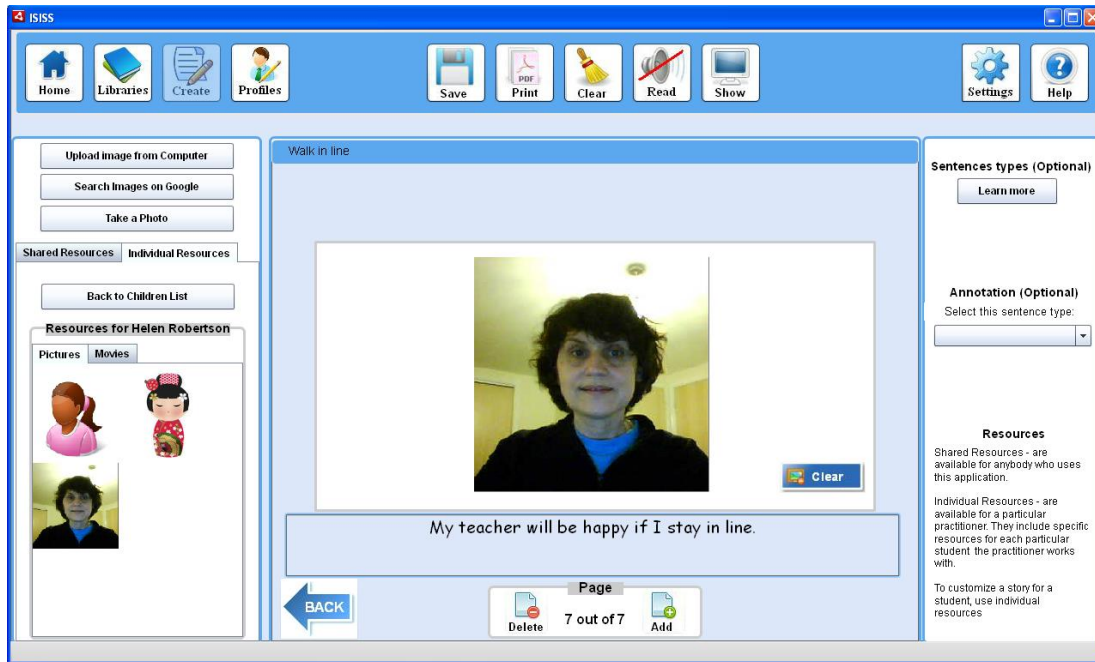


Add a new page

-to add a new page press *Add* button. A blank pages is added after the current page.

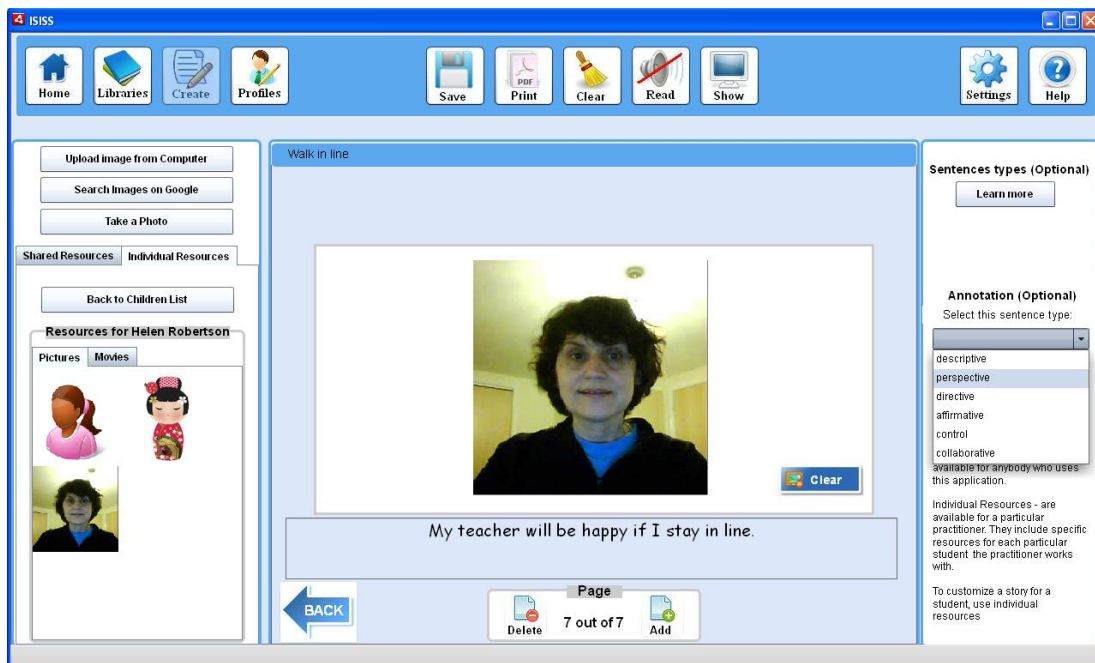


-a photo can be added on the page from the *Resources area* and a sentence can be added



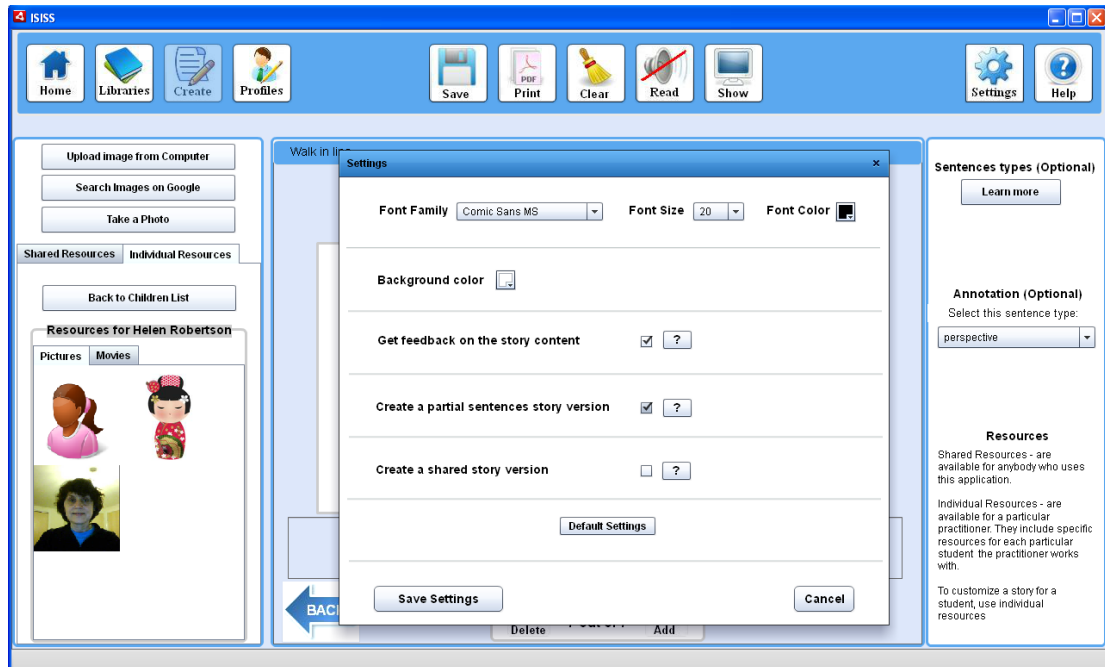
Annotate a sentence

-in order to annotate a sentence the type of sentence can be selected from the drop down list on the right hand side



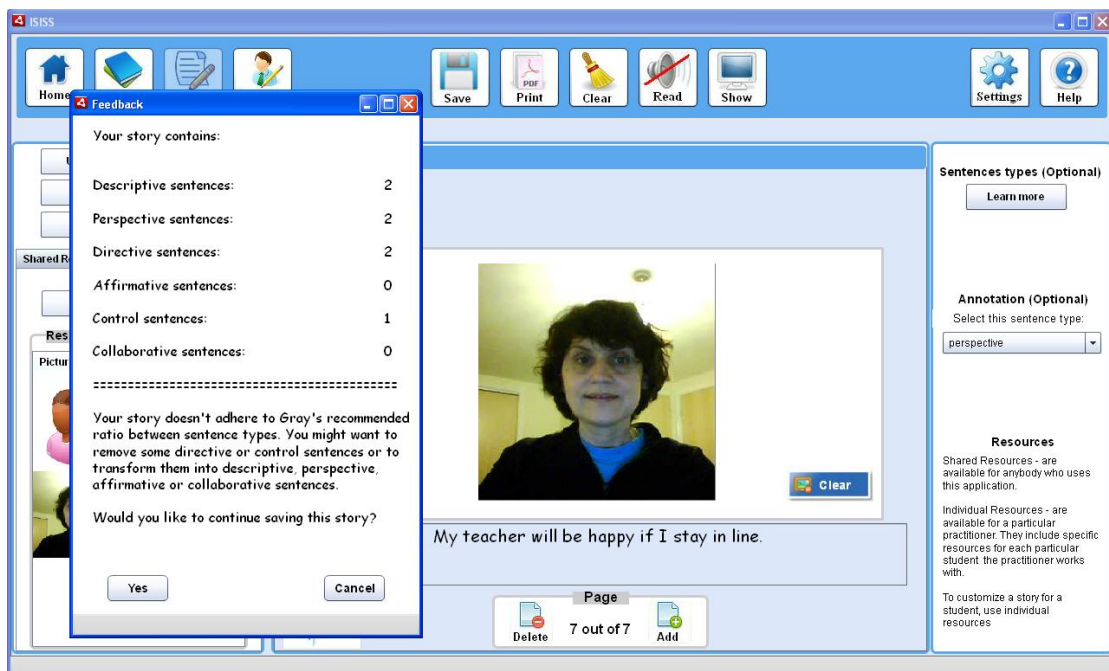
Settings

-setting options allows the user to select the font characteristics, to get feedback for the story content, to create a partial sentence story version and a shared story version

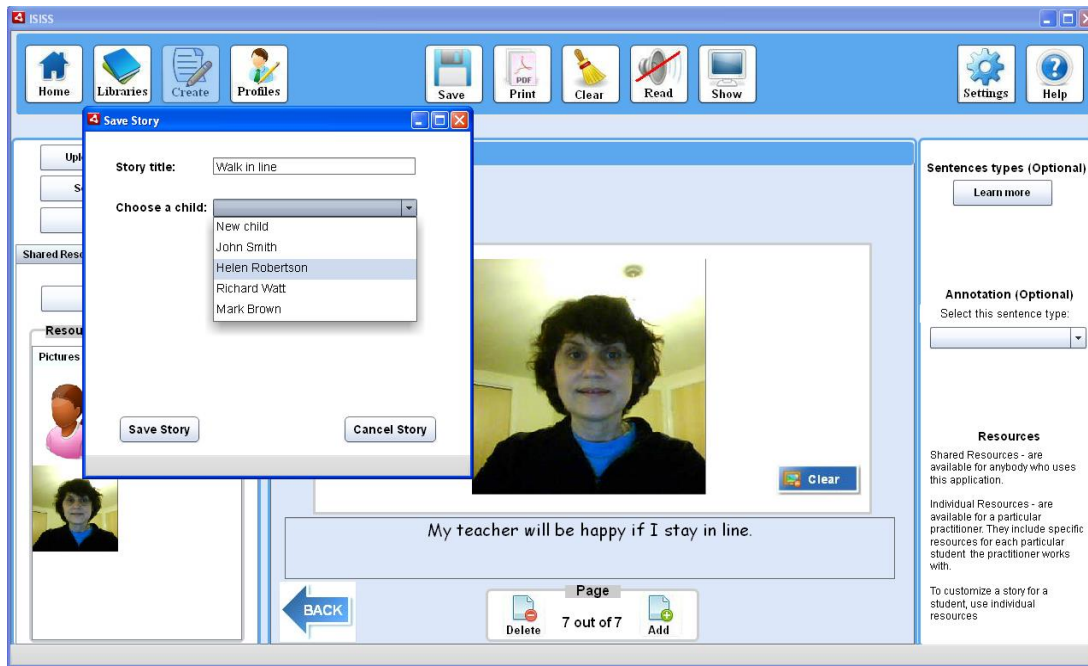


Save story for a particular child

-click on *Save* button to save a story. If *Get feedback on the story content* was selected in *Settings*, a feedback on the story content is displayed in a separate window

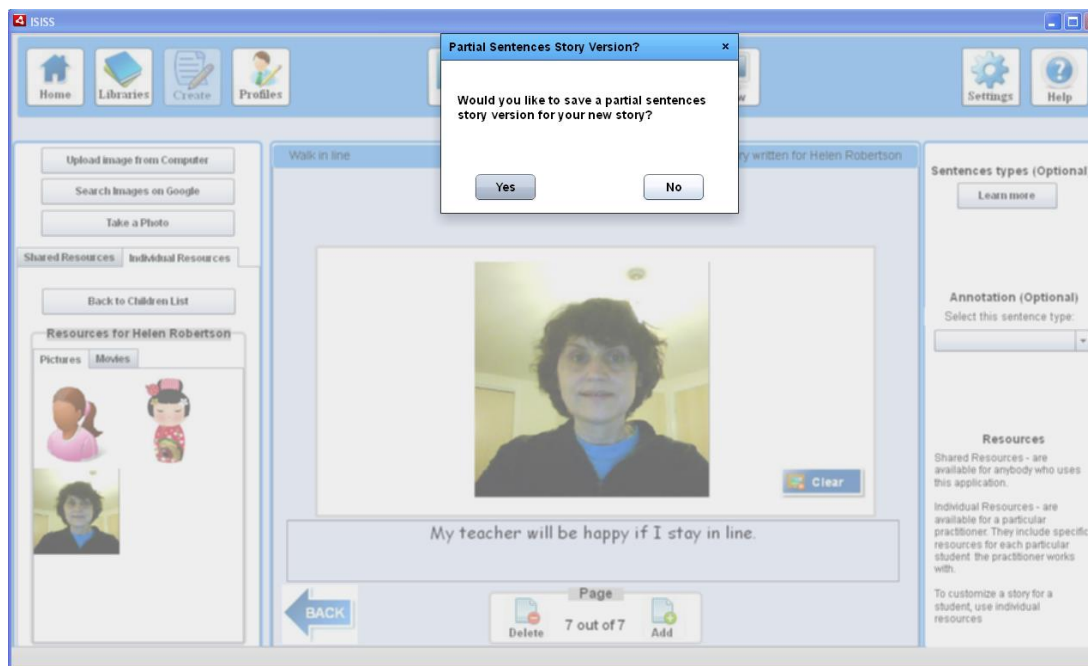


-select a name of a child in the drop down list to save the story for that child. If the child does not exist in the list, select *New child* item to display a text area for introducing the new name

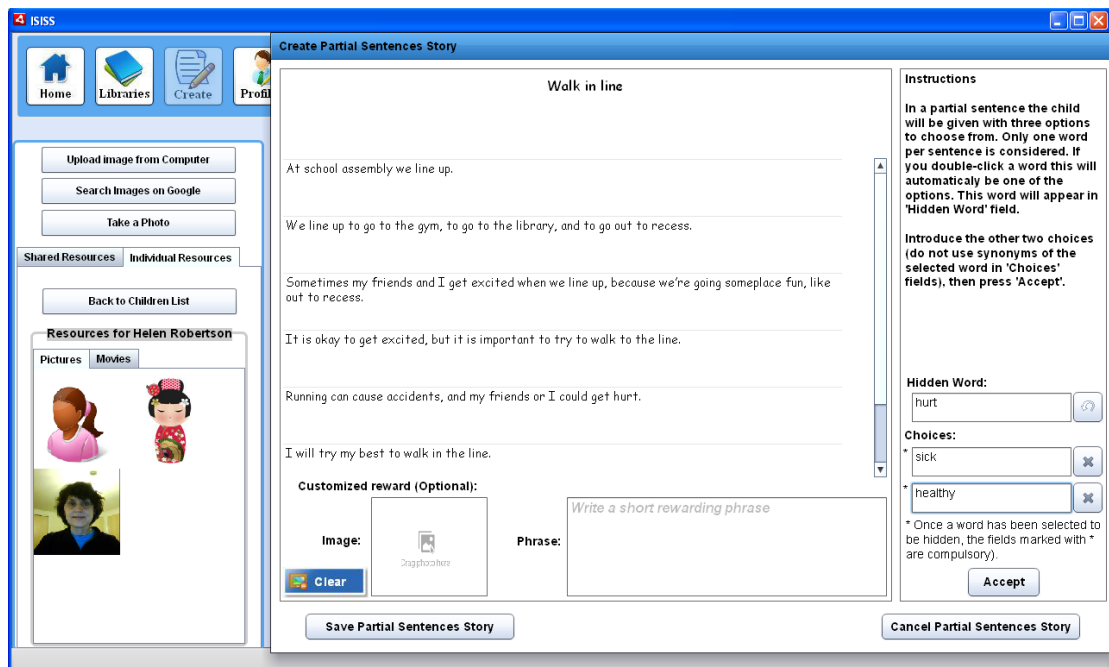


Save a story version with partial sentence

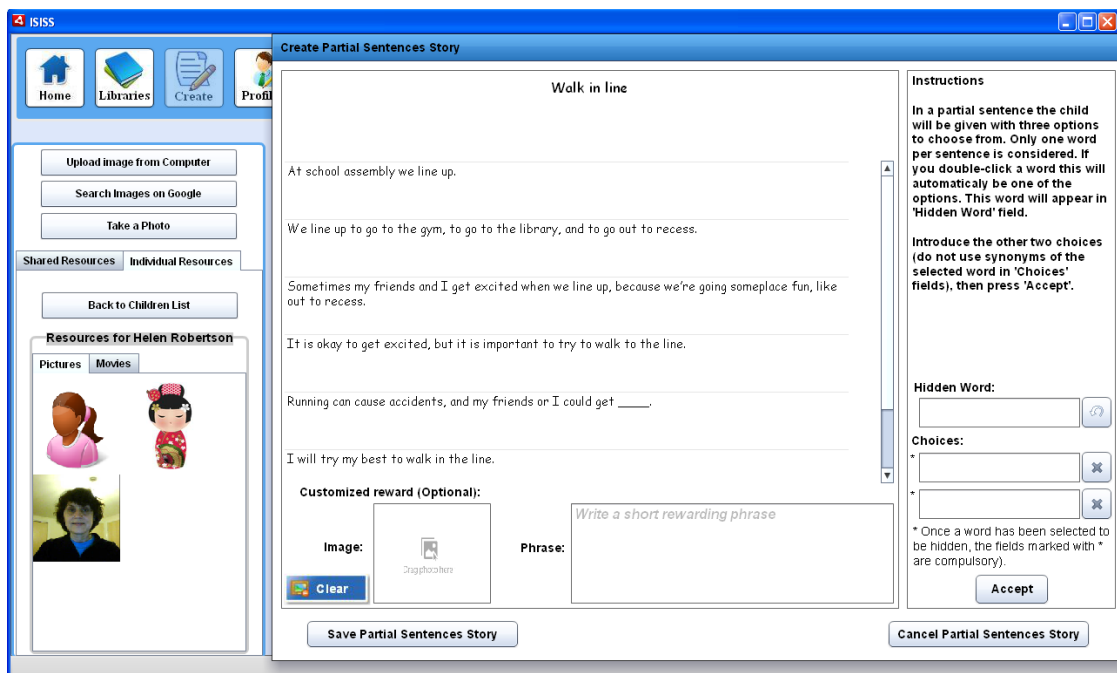
-if *Create a partial sentence story version* was selected in *Settings* window a pop-up window will be displayed to allow the user to choose or not to create a partial sentence story version.



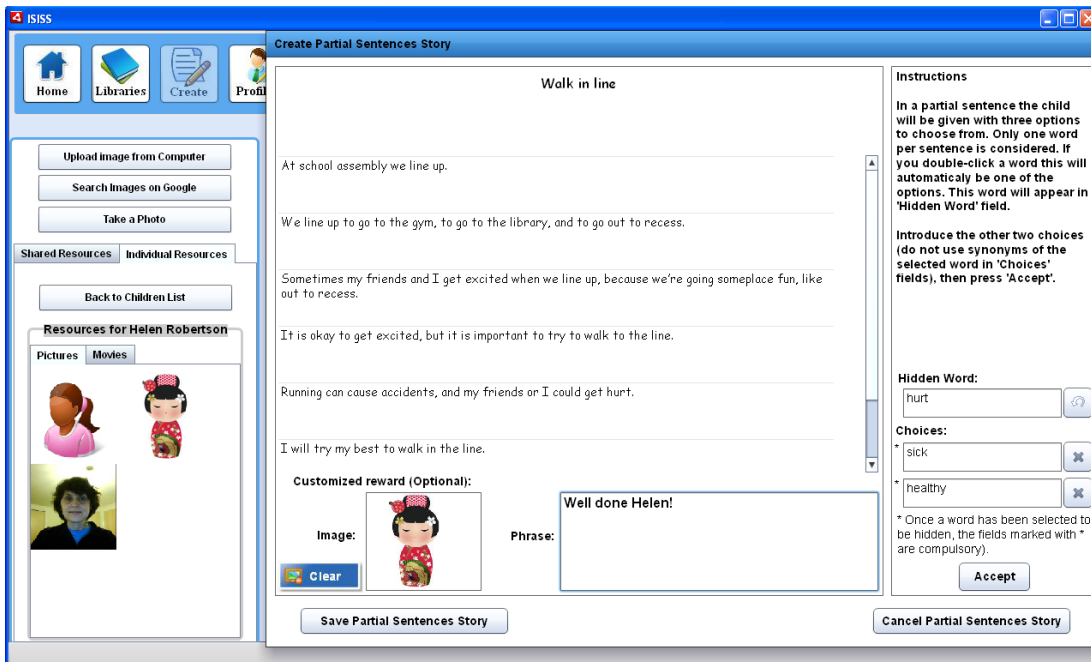
-if the user chooses to create a partial sentence story version then a window appears having displayed the story content. By double-clicking on a word it appears in a text area under the label *Hidden word*. This will be one of the three options that the child will have to choose from when navigation through these stories. The other two options are introduced by the user when creating the story in the text areas under the label *Choices*.



-once *Accept* button is pressed the selected word will be replaced by a line

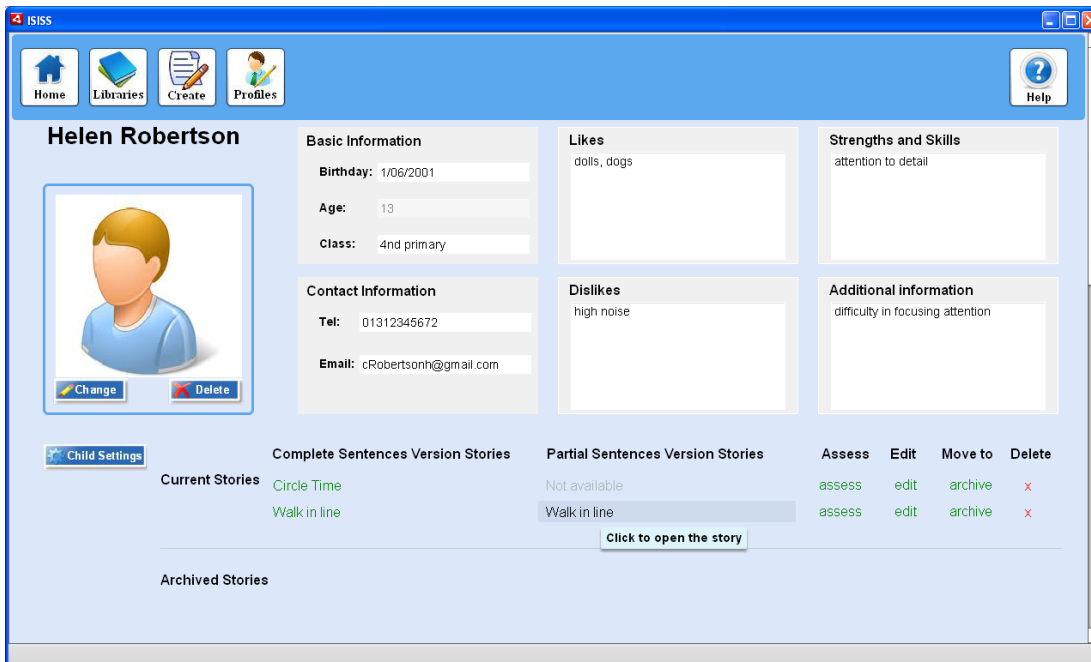


-a reward can be added to the story (image and text)

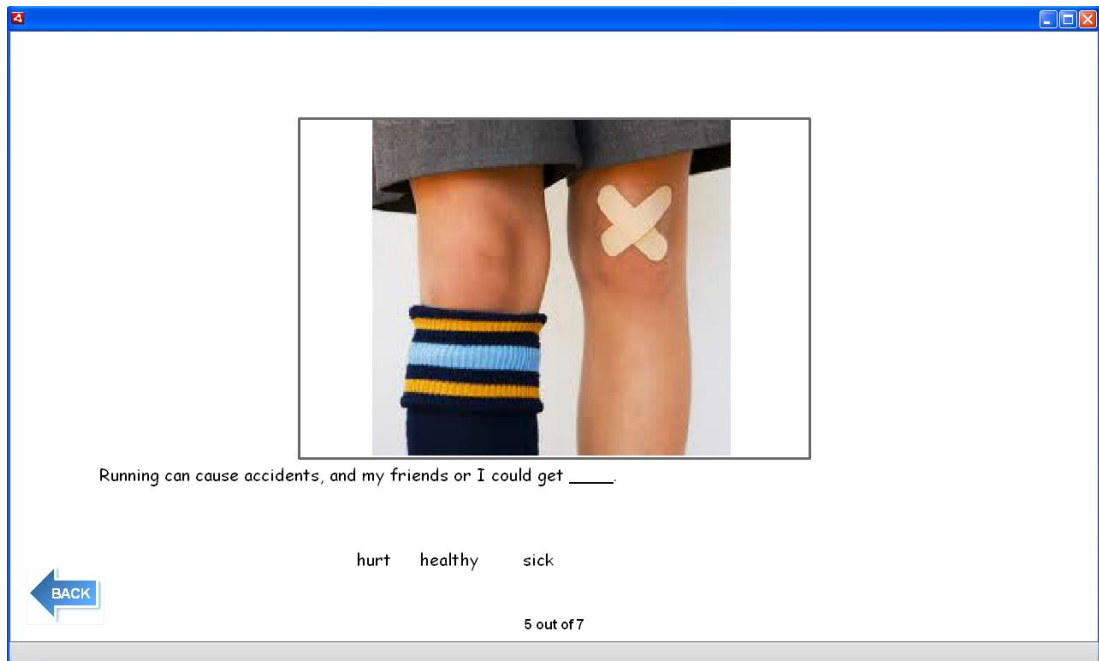


Present a story with partial sentences

-once the story is saved it can be open from the child's profile screen



-the child has to click on the correct word to fill in the sentence



Running can cause accidents, and my friends or I could get ____.

hurt healthy sick

← BACK

5 out of 7

-if a wrong choice is clicked then the word becomes red (the child cannot go further as the *Next* button is not visible)



Running can cause accidents, and my friends or I could get ____.

hurt healthy sick

← BACK

5 out of 7

-if the correct choice is clicked the word becomes green and moves slowly to fill the sentence. The Next button appears and the child can navigate further through the story.



A screenshot of a reading application window. At the top center is an image of a person's legs, one with a bandage on the knee. Below the image is the text: "Running can cause accidents, and my friends or I could get hurt." Below the text are two words: "healthy" and "sick". The word "sick" is highlighted in red. At the bottom left is a "BACK" button with a left-pointing arrow. At the bottom right is a "NEXT" button with a right-pointing arrow. In the center bottom, it says "5 out of 7".

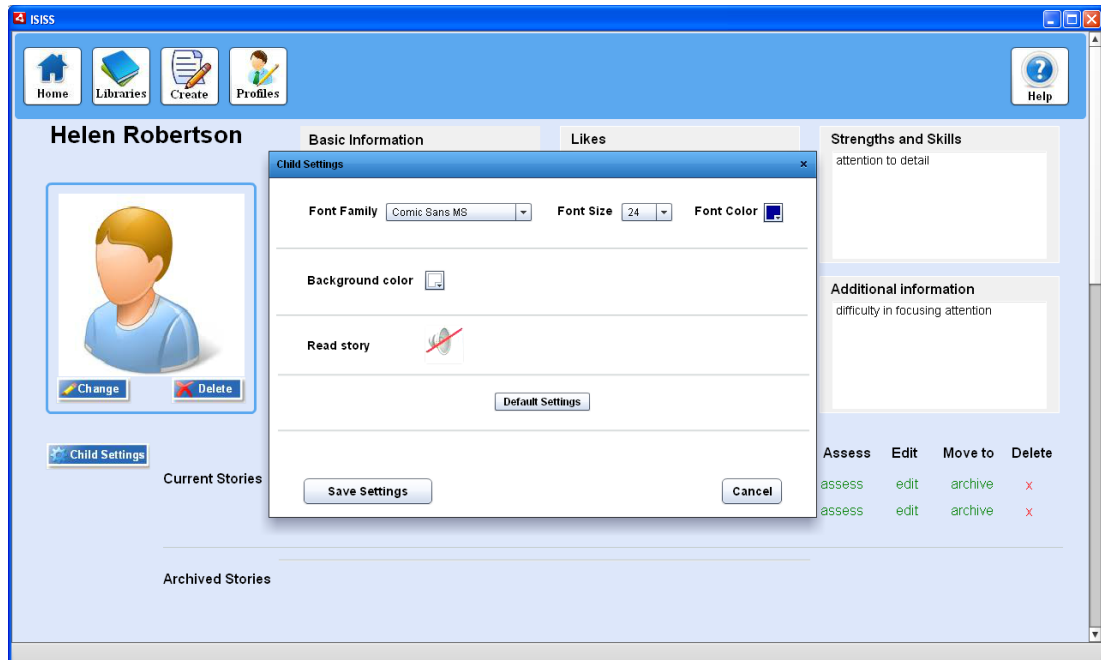
-the reward will appear after the last sentence.



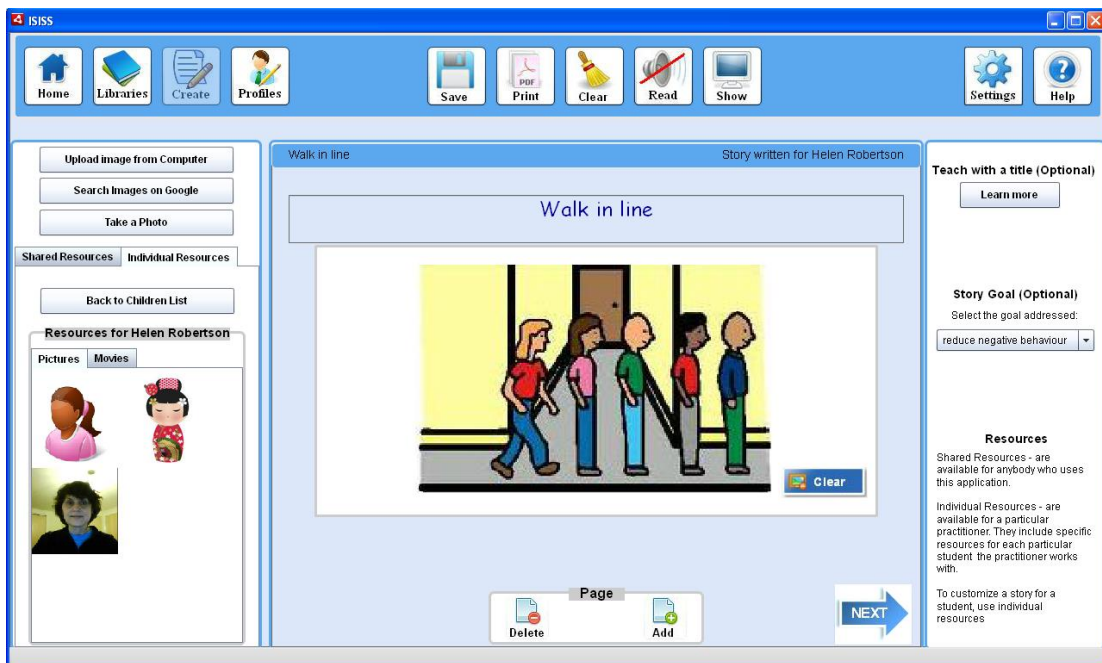
A screenshot of a reading application window. At the top center is the text: "Well done Helen!". Below the text is an image of a colorful Japanese doll (Kokeshi). At the bottom left is a "BACK" button with a left-pointing arrow. At the bottom right is a button labeled "X Close Window".

Setting for a child

- clicking on *Child Settings* button on the *Child's profile* screen a window appears. The user can select font characteristics, background. There is also an option to read the story out loud.



-if a story for that child is opened, then the specific settings are applied

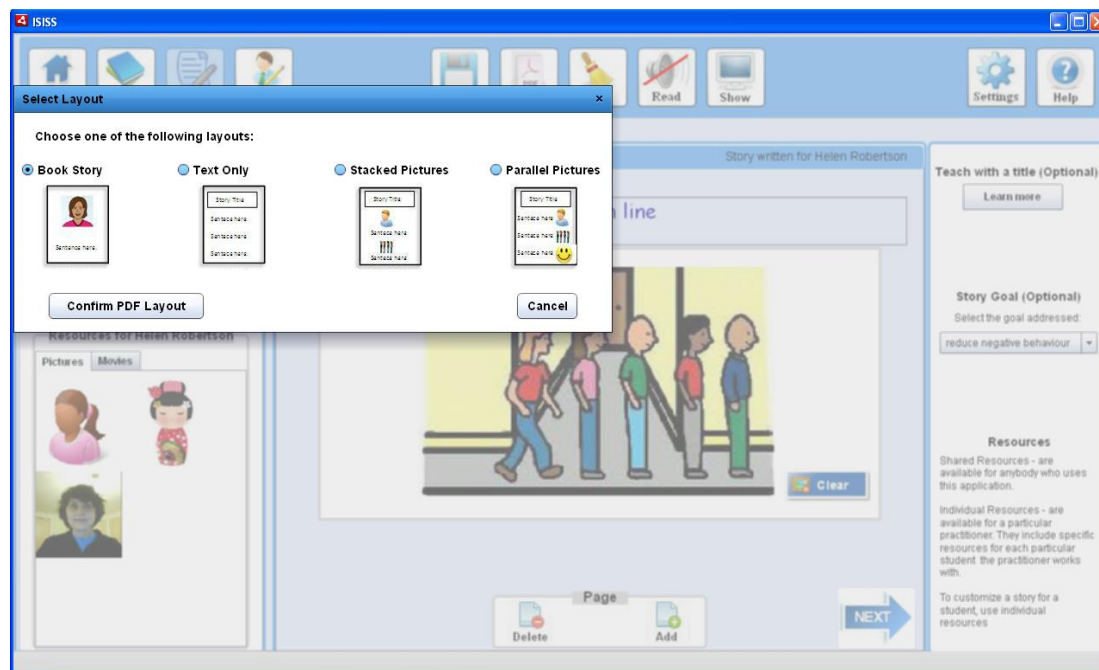


Print a story to PDF

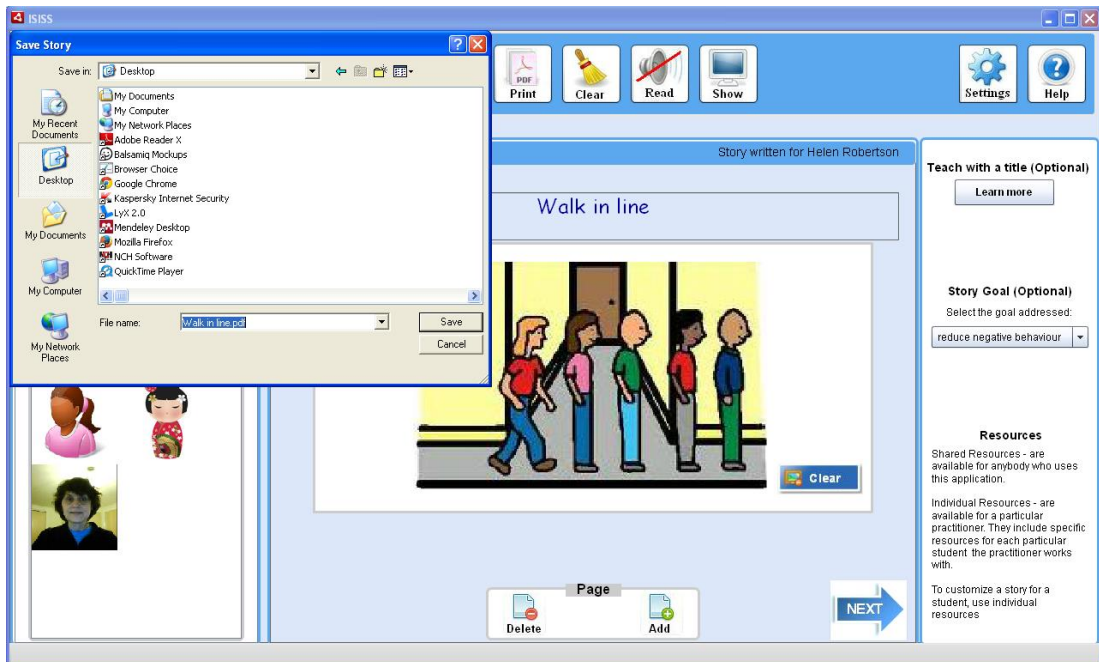
-in order to print a story to PDF, *Print* button should be pressed while the story is open



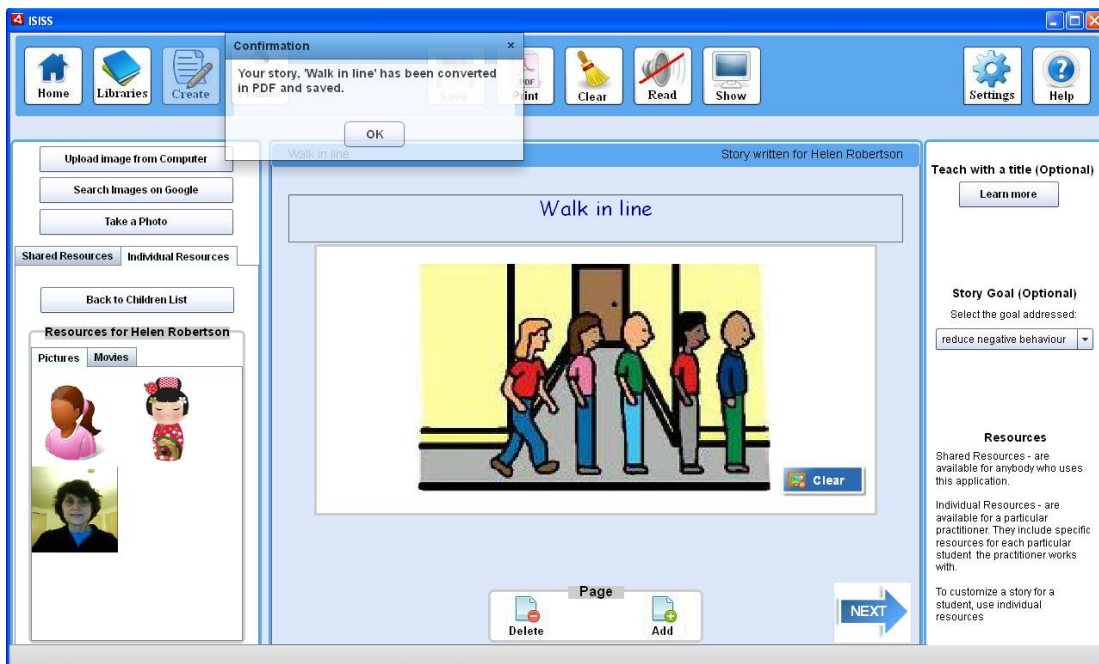
-a window appears to allow the user to select the appropriate layout for the story



-once the layout is selected and the selecting is confirmed by pressing the *Confirm PDF layout* button, a window appears to permit the user to save the file in a specific location.

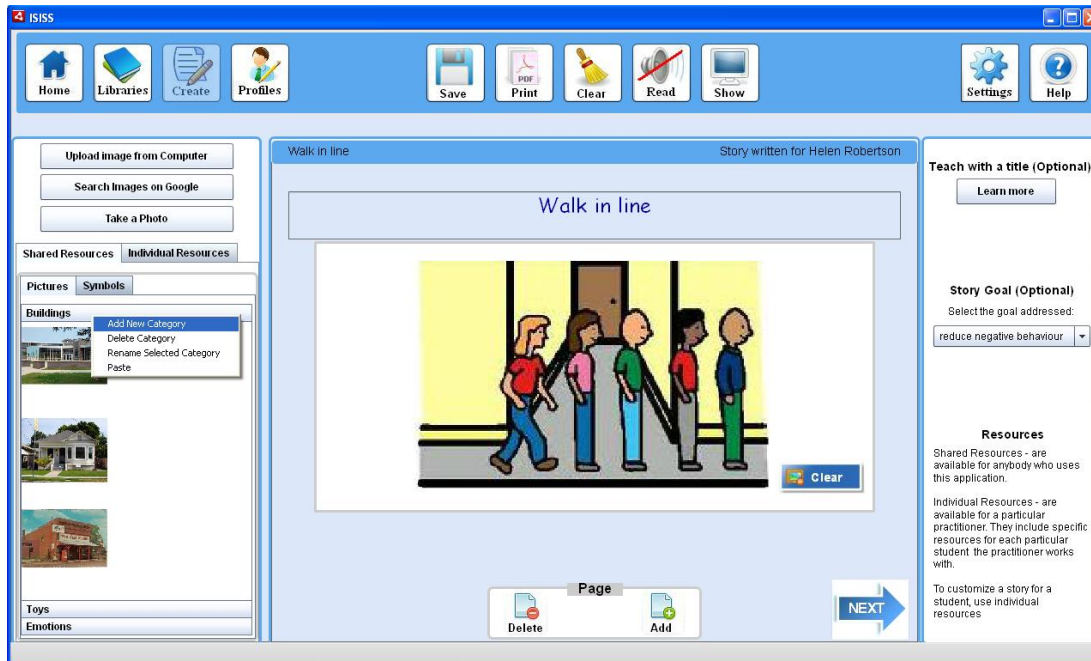


-a pop-up window confirms that the story was saved.

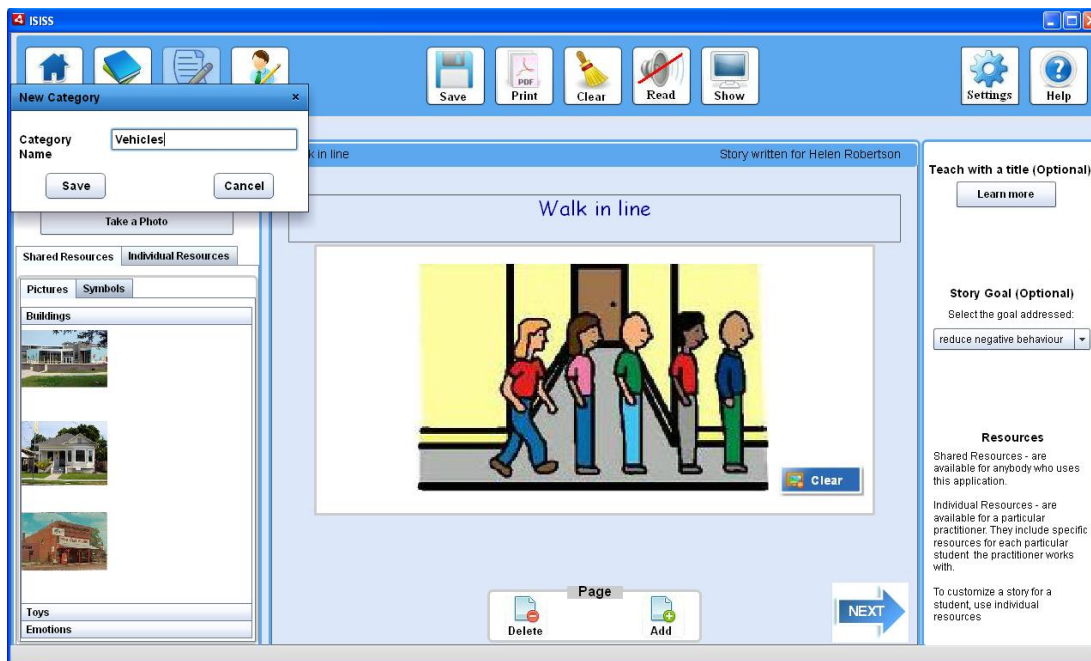


Create a new category in *Shared resources*

-right click on the *Shared resources* area display a menu which allows adding, deleting or renaming a category



-to add a new category the name of the category should be entered in New Category window which appears when selecting *Add*

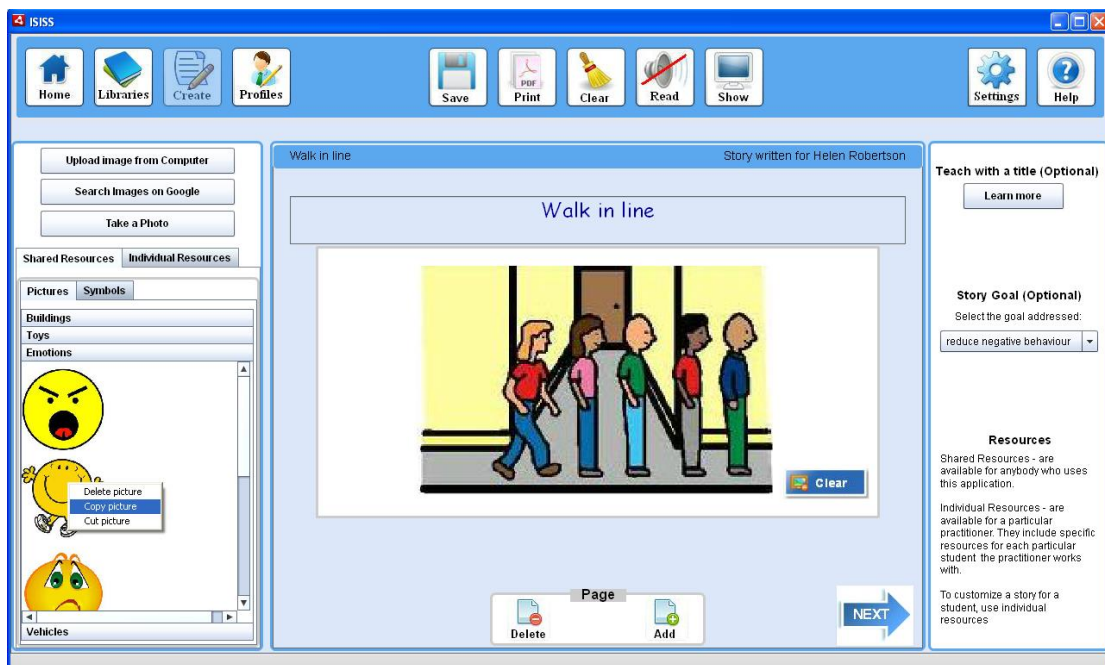


-once pressing *Save* button in the *New Category* window the new category appears on the shared resources.

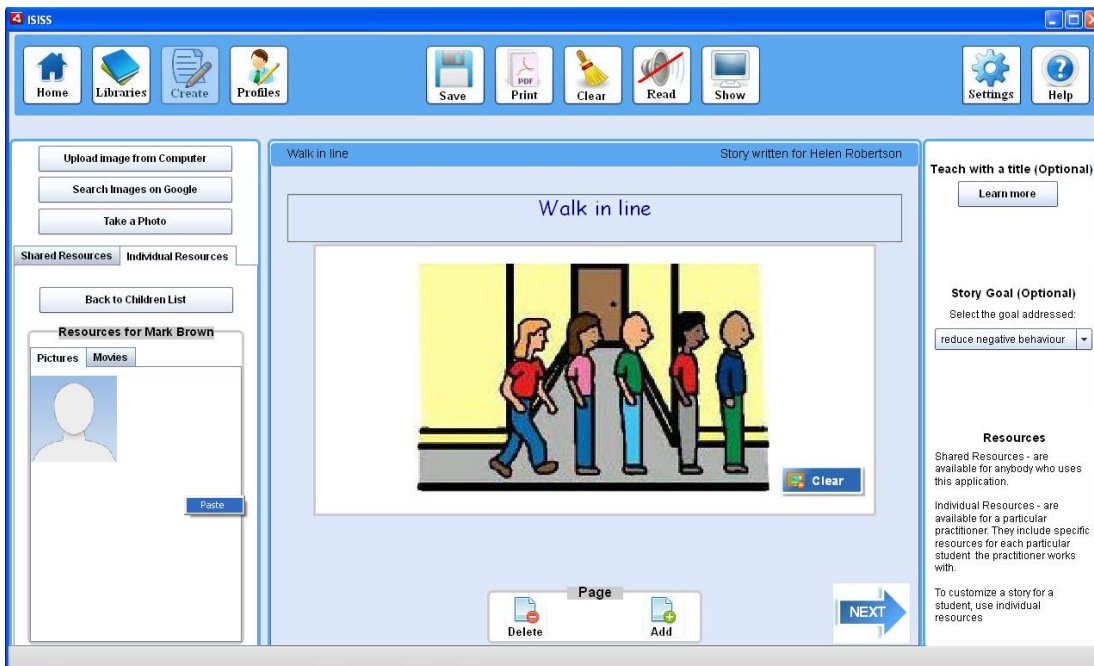


Copy and paste an image

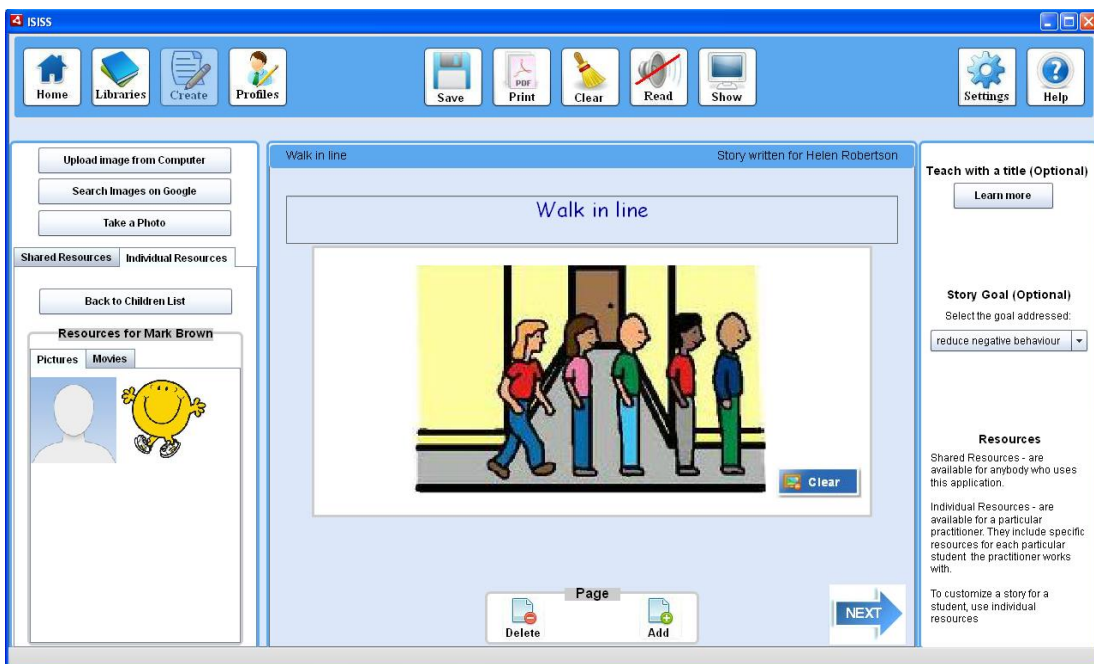
-an image can be copied by selecting the *Copy* item from a right click menu on the corresponding image



- while the cursor is on a white field on the Shared resources area the image a right click displays a menu with *Paste* item



-by pressing *Paste* item the image which was copied is added on the resources area



Assess a story

-in order to assess a story press *Assess* link on the Child's Profile screen for the corresponding story.

John Smith

Basic Information
 Birthday: 15/04/2003
 Age: 11
 Class: 2nd primary

Contact Information
 Tel: 01312345678
 Email: tSmith@gmail.com

Likes
planes, dogs

Strengths and Skills
attention to detail

Dislikes
unpredictable noise

Additional information
difficulty in perceiving emotional states

Child Settings

Complete Sentences Version Stories	Partial Sentences Version Stories	Assess	Edit	Move to	Delete
Current Stories Circle Time I need to keep my hands to myself Going to the doctor	Circle Time Not available Not available	assess assess asse	edit edit edit	archive archive archive	x x x
Archived Stories Walk in line	Walk in line	assess	edit	current	x

Click to view details about the story such as: assessments, comments, etc

-*Story Assessment* window is displayed with a table that includes the story title, the child name and a table to record the frequency of the target behaviour

Story Title: Circle Time
Child Name: John Smith

Behaviour Description: The frequency of behaviour represents how many times the child did not listen to the teacher during 30 min of circle time.

Date	Frequency of behaviour	Comment
1 Sep 2013	11	This is the first comment
7 Sep 2013	10	This is the second comment
14 Sep 2013	11	This is the third comment
21 Sep 2013	9	This is the fourth comment
28 Sep 2013	3	This is the fifth comment
5 Oct 2013	2	The sixth comment
08 Oct 2014		

Add Session **Remove Session** **See Graph**

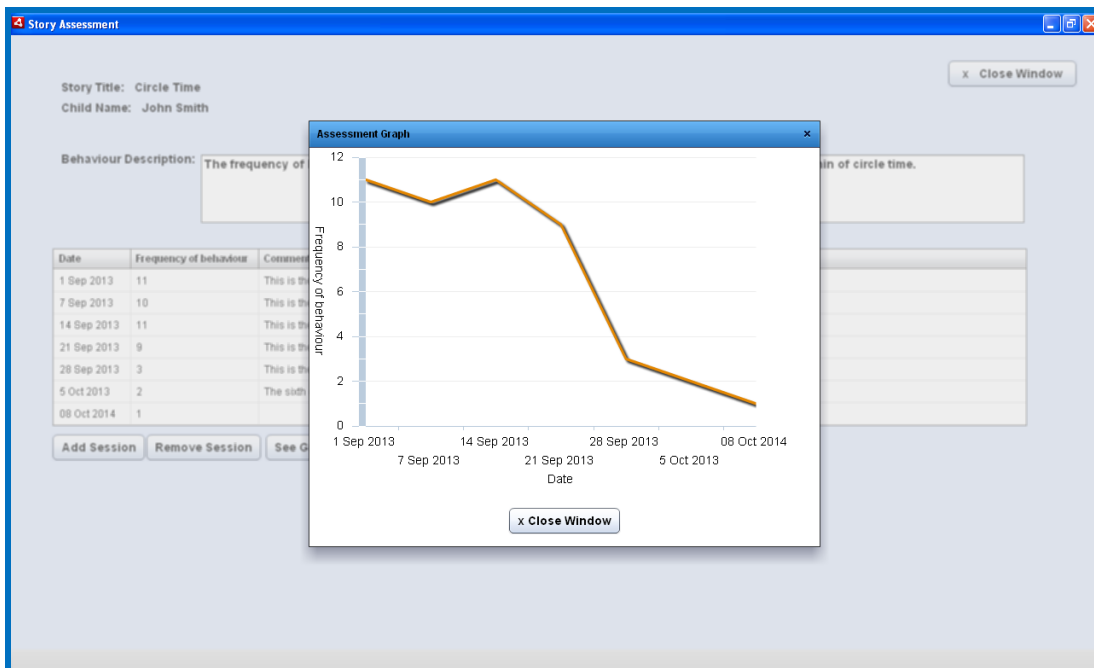
-clicking on *Add session* button allows the user to introduce the frequency of behaviour for a particular date and a corresponding comment.

The screenshot shows the 'Story Assessment' window. At the top, it displays 'Story Title: Circle Time' and 'Child Name: John Smith'. Below this is a 'Behaviour Description' field containing the text: 'The frequency of behaviour represents how many times the child did not listen to the teacher during 30 min of circle time.' A table below the description lists the following data:

Date	Frequency of behaviour	Comment
1 Sep 2013	11	This is the first comment
7 Sep 2013	10	This is the second comment
14 Sep 2013	11	This is the third comment
21 Sep 2013	9	This is the fourth comment
28 Sep 2013	3	This is the fifth comment
5 Oct 2013	2	The sixth comment
08 Oct 2014	1	

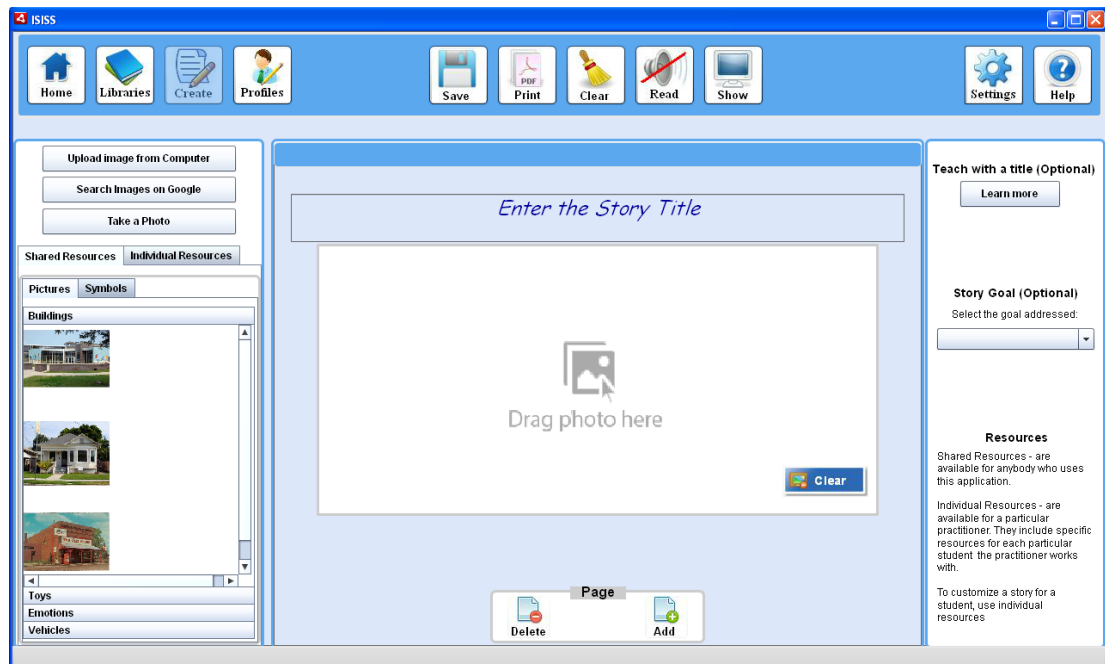
At the bottom of the window are three buttons: 'Add Session', 'Remove Session', and 'See Graph'.

-the child's progress through the story can be visualised by clicking the *See Graph* button



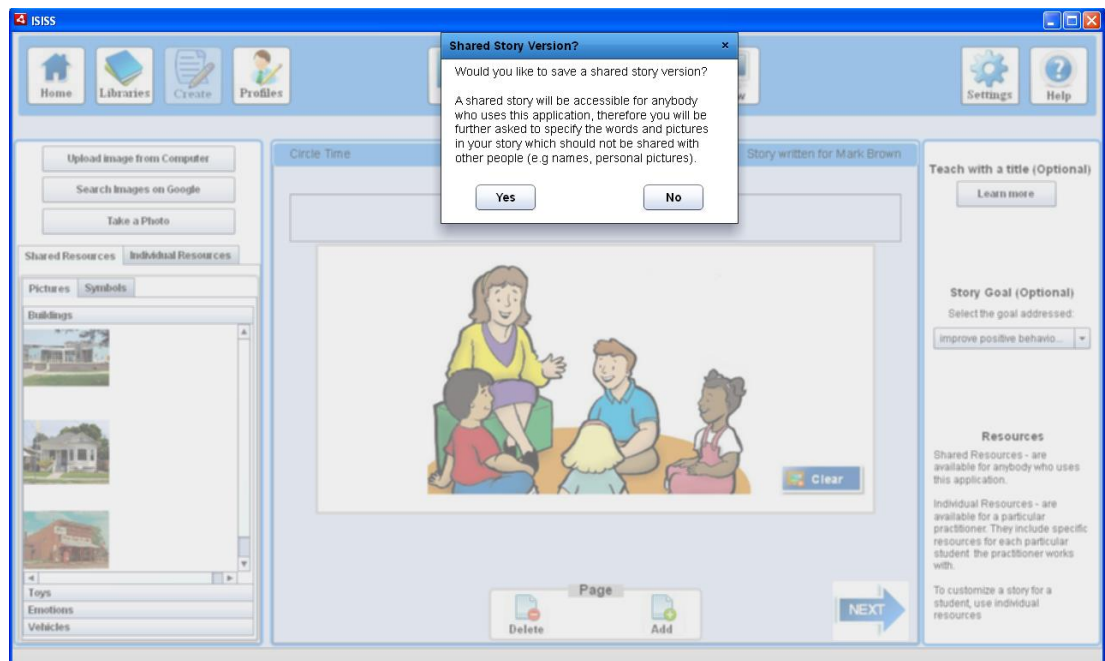
Create a new story

- a click on *Create* button takes the user to Create screen where a story can be created from scratch by writing the title and sentences in the corresponding text area and adding a photo from Resources area or using the tools on the left hand side: *Upload Image from Computer*, *Search Images on Google* or *Take a Photo*.

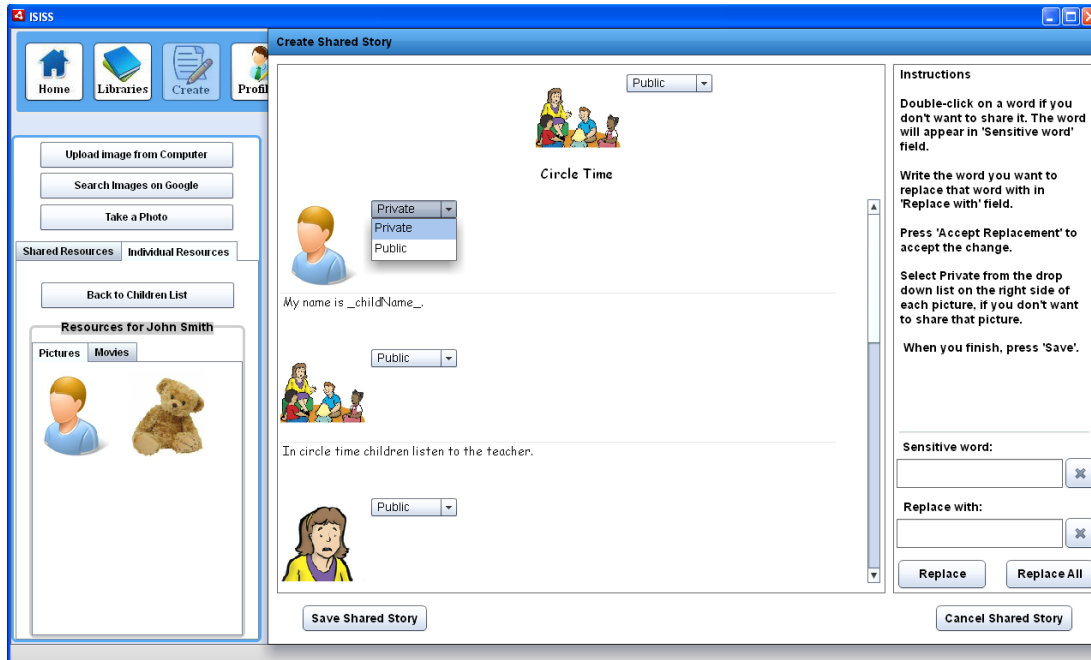


Save a shared story version

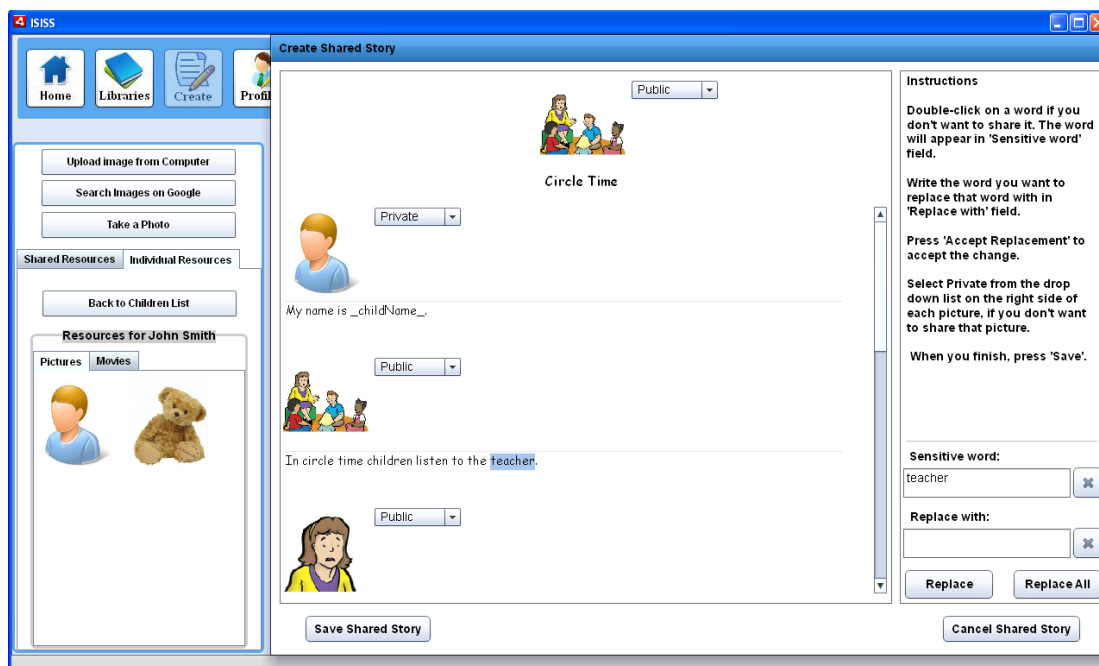
-while saving a story (if *Create Shared Story* version is selected in *Settings*) a pop-up window appears to ask the user whether



-if the user confirms that she wants to create a shared story version a window is appears which displays the story on the left hand side. The user can choose whether or not the images will be displayed or not by selecting *Public* or *Private* in a drop down list.



-also the words which should not be displayed (names of people, names of schools, etc.) can be replaced. The name of the child is automatically replaced by “_childName_”



Appendix P

Documents for the Study: Summative Evaluation

P.1 Information Sheet

*Aurora Constantin, PhD Research
March 2014*



INFORMATION SHEET

Summative Evaluation with Practitioners (Stage I)

INVITATION

You are being invited to take part in a summative evaluation of ISISS (Improving Social Interaction through Social Stories), an authoring tool which supports practitioners to develop, present and assess social stories for children with ASC. Before you decide to participate, you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask me if something is unclear or if you need more information.

ABOUT MY PROJECT

The general goal of PhD research is to explore how a computer-based application can support practitioners who work with children with ASC to develop, present, and assess social stories.

ABOUT THIS STUDY

The goal of this study is to determine whether ISISS enhances practitioners' activity of developing, presenting and assessing social stories.

YOUR ROLE

I would like to ask you to help me discover whether or not ISISS reduces your workload, facilitates social story customisation, provides opportunities for the child to engage with the social story, is easy to use and is effective. I am also interested in finding out (with your help) what is the user satisfaction when working with this tool. Thus, you will be invited to perform some simple tasks (see the tasks list) using the authoring tool. During the task I will ask you to verbalize your thoughts. You are free to ask me questions to clarify any aspect of the system. After each task you are asked to report how difficult was and how confident did you feel to perform that task using ISISS. At the end you will be asked to fill in a questionnaire focused on user satisfaction. Then you will attend a short interview where you will be asked about the workload, customisation, child's engagement and ease of use related to the tool. All these concepts will be clearly defined before the interview.

TIME COMMITMENT AND LOCATION

This study takes about less than 1h and 30 min and is conducted in one session in Informatics Forum, University of Edinburgh.

Important Note: Please remember that it is the tool which is evaluated and not your performance!

If you have any further questions regarding this study, please contact:

*Aurora Constantin
PhD student
A.Constantin-2@sms.ed.ac.uk
Tel: 0743 847 4264*

*Dr. Helen Pain
Supervisor
helen@staffmail.ed.ac.uk
Tel: 0131 650 8485*

P.2 Consent Form

*Aurora Constantin, PhD Research
March 2014*



CONSENT FORM

Summative Evaluation with Practitioners

Now that you have read the information sheet, it is up to you to decide whether you want to take part in my study. You may withdraw from the research study at any time without explanation. You can ask any data you have supplied to that point be withdrawn/destroyed.

You can omit or refuse to answer to any question that is asked of you.

Please, feel free to ask any question related to this study at any time.

CONFIDENTIALITY/ANONYMITY

The data recorded will be strictly used for the purpose of PhD study. It will be anonymised for reporting purposes.

If you are happy to take part in this study, please complete the consent form and sign it.

- I agree to take part in this study and for the data collected to be used in research
- I agree to my contribution to be voice recorded
- I agree to my contribution to be video recorded
- I agree to outcomes of the research being used in research and teaching presentations

INFORMATION

Position _____

Areas of interest _____

Knowledge about social stories _____

Participant's signature

Date

Participant's Name

Contact (email or telephone)

My contact details:

Tel: 0743 847 4264

Email: A.Constantin-2@sms.ed.ac.uk

P.3 List of Tasks

Please, perform the following tasks using *ISIS* tool. Tick the appropriate box to report how difficult it was to perform the task using *ISIS*. Also, tick the appropriate box to report how confident did you feel to perform the task using *ISIS*.

Task 1: Open a story from *Shared Story library*, called “Walk in line”.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 2: *Search on Google* an appropriate picture and add it to the story, under the title.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 3: Go on *Individual Resources*. Then select Helen Robertson. Take a photo of you with the webcam and save it on the pictures category for Helen Robertson.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 4: Add a new page at the end of the story. Write the sentence: “*My teacher will be happy if I walk in line*”, and add your photo.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 5: *Annotate* the last sentence with “*perspective*”.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 6: You would like to get a feedback for the content of the story you have just completed. Also, you want to create a story with partial sentences. Go to *Settings* and choose “Get feedback on the story content” and “Create a partial sentences story version”.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 7: *Save* the story for Helen Robertson. Create at least one partial sentence in the story. Before saving the partial sentences story version, add a picture as a reward from Helen Robertson individual resources.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 8: Go to *Profiles* to Helen Robertson and open the partial sentences story version. Go through this story and fill in the partial sentences.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Tasks 9: You want to change the *settings* for Helen Robertson on the student's profile. Choose the font size to be 24 and the font colour to be blue.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 10: Open the story ‘Walk in line’ from Helen Robertson profile, in *‘Edit’* mode.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 11: *Print* the story to Pdf. Save the document on the desktop.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 12: Create a new category of picture in Shared Resources. Call it “Vehicles”. Search on the Google a corresponding picture and add it to this category. Copy this picture and paste it into John Smith’s Individual resources.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 13: Go on John Smith profile. You want to *assess* the impact of the story called “Circle Time” on John Smith’ behaviour. Add a new session:

Date: 20 March 2014 Frequency: 0.

Remove the first session and then look at the graph.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 14: Go to “*Create*” page, change *Settings* to default settings and unselect “Create a partial sentence story version”, but leave selected “Create a shared story version”.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 15: You want to *create* a new story. Please, write the story provided below and add corresponding pictures using Google Search and individual resources.

Snack Time

My name is Richard.

We have snack time at school.

Friends talk and share food at snack time.

I can say ‘Hi’ to my friends.

Friends are happy when we talk at snack time.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 16: Enable “*Read*” option. You can *show* the story in the student’s interface.

Go through the story and listen to it.

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

Task 17: *Save* this story for Richard Watt. Save also a shared story version. Then *search* for this story in the shared library

Difficulty	Very difficult	Difficult	Easy	Very easy
Confidence	Very unconfident	Unconfident	Confident	Very confident

Any other comment:

P.4 SUS Questionnaire

*Aurora Constantin, PhD Research
March 2014*

Practitioner ID: 1

SYSTEM USABILITY SCALE (SUS)

Summative Evaluation with Practitioners (Stage I)

1. I think that I would like to use this system frequently.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. I found the system unnecessarily complex.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. I thought the system was easy to use.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. I think that I would need the support of a technical person to be able to use this system.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. I found the various functions in this system were well integrated.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. I thought there was too much inconsistency in this system.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. I would imagine that most people would learn to use this system very quickly.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. I found the system very cumbersome to use.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. I felt very confident using the system.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. I needed to learn a lot of things before I could get going with this system.

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Scoring SUS

- For odd items: subtract one from the user response.
- For even-numbered items: subtract the user responses from 5
- This scales all values from 0 to 4 (with four being the most positive response).
- Add up the converted responses for each user and multiply that total by 2.5. This converts the range of possible values from 0 to 100 instead of from 0 to 40.

P.5 Questions for Interview

*Aurora Constantin, PhD Research
March 2014*

INTERVIEW QUESTIONS

Summative Evaluation with Practitioners (Stage I)

I. General Questions

1. How long have you worked with children with autism?
2. How long have you worked with social stories for children with autism?
3. How many children with autism do you interact with regularly?
4. What level of ability are these children?
5. What tool are you currently using to develop social stories?

II. Practitioners' Workload

Definition: The effort expended (both mental and physical) to achieve your goals (e.g. developing a social story, or assessing a social story).

Main question:

Do you think that using ISISS tool makes any difference in terms of workload, compared with the tool(s) you are currently using?

Other questions:

1. How do you find re-using a social story from shared library?
2. How do you find creating a new social story?
3. How do you find using the shared resources?
4. How do you find importing Google images?
5. How do you find taking photos with the webcam?
6. How do you find annotating the types of sentences?
7. How do you find monitoring the progress of the child during the story intervention?

III. Customisation

Definition: Tailoring the social story (e.g. pictures, font features, rewards) to the child's needs and skills.

Main question:

Do you think that using ISISS tool makes any difference in terms of customising social stories, compared with the tool(s) you are currently using?

Other questions:

1. How useful do you find the information on the child's profile?
2. How useful do you find using individual resources?
3. How useful do you find the layouts for social stories?
4. How easy did you find customizing existing social stories?

5. How useful do you find using 'Read' feature?

IV. Child's engagement

Definition: The potential of the tool to offer the children opportunities of engaging in the social story presentation

Main question:

Do you think that using ISIS tool makes any difference in terms of child's engagement, compared with the tool(s) you are currently using?

Other questions:

1. How useful do you find introducing a reward at the end of the partial sentence story for child's engagement with the social story?
2. How useful do you find the individual resources and information about a child for the child's engagement with the social story?
3. How useful do you find partial sentence story for child's engagement with the social story?

V. Ease of use

Definition: How easy do you find using the system's features, finding information to take decisions and navigating through the system?

Main question:

Do you think that using ISIS tool makes any difference in terms of ease of use, compared with the tool(s) you are currently using?

Other questions:

1. How would you describe the layout of the system?
2. How easy do you find to navigate through the system?
3. How useful do you find the information to take decision?

P.6 Information Sheet

*Aurora Constantin, PhD Research
March 2014*



INFORMATION SHEET

Summative Evaluation with Practitioners (Stage II)

INVITATION

You are being invited to take part in a summative evaluation of ISISS (Improving Social Interaction through Social Stories), an authoring tool which supports practitioners to develop, present and assess social stories for children with ASC. Before you decide to participate, you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask me if something is unclear or if you need more information.

ABOUT MY PROJECT

The general goal of PhD research is to explore how a computer-based application can support practitioners who work with children with ASC to develop, present, and assess social stories.

ABOUT THIS STUDY

The goal of this study is to determine whether ISISS enhances practitioners' activity of developing, presenting and assessing social stories.

YOUR ROLE

I would like to ask you to help me discover whether or not ISISS reduces your workload, facilitates social story customisation, provides opportunities for the child to engage with the social story, is easy to use and is efficient. I am also interested in finding (with your help) the user satisfaction when working with this tool. You will be invited to write two social stories. For each story you will get a background, containing details about the child and the behaviour the social story should address. You will write one story with ISISS and one story with the tool you are currently using for the social stories. After developing the stories, you will be asked to answer a short questionnaire.

TIME COMMITMENT AND LOCATION

This study takes about 1h and 30 min and is conducted in one session in Informatics Forum, University of Edinburgh.

Important Note: Please remember that it is the tool which is evaluated and not your performance!

If you have any further questions regarding this study, please contact:

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P.7 Story Background

*Aurora Constantin, PhD Research
March 2014*

STORIES BACKGROUNDS Summative Evaluation (Stage II)

Story A

Amy is 10 years old and was diagnosed with classic autism at the age of 4. She lives at home with her parents and younger brother and attends a specialist school for Children with Autism Spectrum Conditions where she has 1:1 support from a Special Needs Assistant during the school day. She communicates verbally in short sentences, occasionally augmenting her communication with signing when she is tired or anxious. Amy really likes the 'minion' characters from Despicable Me, and playing with musical toys like xylophones and drums.

Amy is able to use the toilet independently though currently is unable to wash her hands independently afterwards, and when supported to wash them with her SNA/parents becomes very distressed and upset. It may be the case that Amy dislikes the feeling of water on her hands as the water from the taps can be cold, and Amy has hypersensory sensitivity to temperature. As yet, the importance of hand washing hasn't been successfully communicated with Amy as it can take a long time for her to become calm again after being in contact with cold water. It is important for Amy to wash her hands after using the toilet to stop the spread of germs and to stop her and others becoming unwell from this.

Amy has engaged with Social Story Interventions before with mixed levels of success.

Please, write a story in book story format to promote the positive behaviour of hand washing after using the toilet. Amy is expected to have a greater understanding and clearer expectations of hand washing with the support of her SNA and parents.

Story B

James is 11 years old and received a diagnosis of classic autism at age 4. James lives with his sister, parents, and his dog Spot. James attends a specialist school for children with Autism Spectrum Conditions where he is in a class with three other children with similar additional support needs. James communicates verbally in short sentences. James used to use PEC cards but now only uses these when he is anxious. James loves playing with his dog, Spot, colouring in, and everything about trains.

James has to go to the doctors to get a set of vaccinations. James can get very anxious when meeting new people and has found going to the doctors to be particularly distressing in the past. The waiting area is brightly lit, smells of disinfectant and has lots of people in it that James doesn't know. James has hypersensitivity to both light and smell, and so finds the doctors' waiting room a very distressing place. It is important for James to get the vaccinations to stop both him and his classmates and friends becoming poorly.

James has engaged well with Social Story Interventions in the past.

Please, write a social story in book story format to promote the positive behaviour of attending a doctor appointment with his Dad. James is expected to have a greater understanding and clearer expectation of what will happen when having vaccinations at the doctor.

|

P.8 Comparative Questionnaire

COMPARATIVE QUESTIONNAIRE

Summative Evaluation (Stage II)

Please, read carefully the following definitions and then mark on the same scale ISISS system and the other tool you used for writing social stories.

Dimension	Definition
Practitioners' Workload	The effort expended (both mental and physical) to achieve your goals (e.g. developing a social story, or assessing a social story)
Customisation	Tailoring the social story (e.g. pictures, font features, rewards) to the child's needs and skills.
Child's engagement	The potential of the tool to offer the children opportunities of engaging in the social story presentation
Ease of use:	How easy do you find using the system's features, finding information to take decisions and navigating through the system?
User satisfaction*	User attitude as a tendency to respond favourably or unfavourably to a computer system.

Example:

Workload



Please, use **(I)** for ISISS and **(O)** for other tools.

*N. P. Melone. A theoretical assessment of the user-satisfaction construct in information systems research. Management Science, 36:76–91, 1990

Workload



Customisation



Child's Engagement



Ease of use



User satisfaction



Appendix Q

Coding Schema for Verbal Behaviour

Theme	Subthemes	Examples
Practitioners' Workload	overall comments	<i>It is more efficient for the whole process for editing; sharing the stories...and all the options are already there in one tool. (+)</i>
	shared story library	<i>Shared stories...you need to write some stories over and over again, for example 'Hand washing'. If you have an example that's very helpful, you save a lot of work. (+)</i>
	Google image search	<i>The big thing is being able to drag and drop images from Google. That's lovely...this is a brilliant feature. (+)</i>
	shared resources	<i>If three children in the school will be going to have stories about snacks it will be useful to have photos of the kind of things we have for snacks. At least if you have shared resources you can be consistent with these images. (+)</i>
	create a new story	<i>Create a new story is simple and straightforward as everything is there. That's brilliant! (+)</i>
	annotate sentences	<i>I think it is a really great part or it [ISISS]. I like that bit [annotation]. (+)</i>
	monitor the child's progress	<i>It is good for people working with children with autism to monitor the behaviour. I think it is a really great part of it [ISISS].” (+)</i>
	view the child's progress	<i>From the social story perspective seeing a graph is quite clear. And I like that. It is a good way of very objectively assessing how effective it's been. And it makes my work easier. (+)</i>
	other remarks	<i>It [ISISS] encourages me to write very simple short sentences. (+)</i>
Customisation	general comments	<i>For customisation I found your system much, much better. (+)</i>
	individual resources	<i>The individual resources are really, really strong feature (+)</i>
	child profile	<i>You have a profile for each child, and you can do it [customisation] easily. With my tool it is possible but not practical. (+)</i>
	settings for child's preferences	<i>Just having a feature to customise for the child it does make a difference. It's much easier</i>
	automatic convert to various layouts	<i>it is a handy technique if you had a story with pictures rather than rework to modify that story ... you just click and that's it. (+)</i>
	read out aloud	<i>The child doesn't have to rely on the adult to read the story. They can use themselves and have more ownership on that.</i>

Engagement	general comments	<i>You can better engage the child with this tool [ISISS]. (+)</i>
	partial sentence social stories	<i>If they participate in feeding in it they get ownership. I think it really helps the engagement. (+)</i>
	rewards	<i>The rewards are great actually. I really like adding a reward at the end. I think it is really useful for engagement. (+)</i>
	individual resources	<i>Having the children to choose the pictures from their own library it would be very nice. (+)</i>
	other remarks	<i>Children might be encouraged if they look at the target. You might use that (graph of child's progress) for children to engage. (+)</i>
Ease of Use	general comments	<i>I find it very easy. Everything is there; it is linked very logical with different features. (+)</i>
	navigation	<i>I am surprised by how easy it is. I thought it is very hard to navigate. I couldn't imagine how you will put all together. But it is good, very simple. (+)</i>
	screen layouts	<i>In terms of layouts everything is how you want it to be and where you want it to be. No unexpected searching. I like it. It is good! (+)</i>
	information to take decision	<i>It's very obvious what's expected [...] For anyone who would be using it it's very simple to use. (+)</i>
Efficiency	general comments	<i>You can go very quickly. You save time. (+)</i>
User satisfaction	general comments	<i>It is nice I like that. Excellent, excellent! (+)</i>