SCAFFOLDING CHILDREN'S COLLABORATIVE STORY-TELLING THROUGH CONSTRUCTIVE AND INTERACTIVE STORY-MAKING

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Thesis abstract

The main aim of this research was to investigate how children's collaborative storytelling could be scaffolded through technologically mediated resources and how these resources can be made more effective by scaffolding around them. The benefits of providing children with resources, encouraging them to construct their own representations and to interact with each other while they make their story were investigated with respect to the quality of their subsequent storytelling.

The first piece of work presented in this thesis is a qualitative case study aimed at exploring how the collaborative storytelling task could be resourced with and without technology, as well as the effectiveness of scaffolding around the technology through adult guidance, and whether the potential benefits could be maintained once the additional guidance was withdrawn. Although the study found that the (technology mediated and non-technological) resources provided did not support for children's engagement in discussion and storytelling, providing scaffolding around these resources was effective at promoting discussion and good collaborative storytelling. Specifically, adult guidance designed to encourage children to articulate their story ideas through questions was shown to benefit children's engagement in discussion and the quality of their collaborative storytelling. Moreover, the children continued to engage in discussion and to produce well structured, rich and coherent stories once the additional guidance was withdrawn.

The second study presented in this thesis was of an experimental nature. It built on the findings from the case study by employing more structured resources as well as making the task more ecologically valid for the children through the introduction of a real audience and the matching of the participants with familiar peers (i.e., school mates). The study investigated the benefits of encouraging children to construct their own representations by comparing a task where children were presented with pictures they could manipulate and a task where children were encouraged to construct their own dynamic drawings over these pictures. The study found that children's collaborative stories were longer when the children

were encouraged to construct their own dynamic drawings. The stories were also qualitatively better, as they contained more structural elements and were richer in style. However no differences were found between the stories in the two tasks with respect to extent to which children were able to build coherently on each others' contributions. This is argued to have been due to the fact that little shared understanding was established among the children about their collaborative story as a result of a lack of engagement in interactive discussion.

The third study was also experimental in nature, and it investigated the benefits of complementing children's construction with scaffolding specifically aimed at encouraging them to discuss their story as this was being made. The study compared a task where children making a story together were encouraged to construct their own dynamic drawings with a task where they were also required to use a set of question prompts to discuss their ideas. It was found that when they were required to engage in reciprocal questioning, the children discussed their story more. The quality of the children's collaborative stories was also better when the children were supported through question prompting. Not only were the stories longer, but they also contained more structural elements and were richer in style. Moreover, when they were telling their stories, the children built more coherently on each other's contributions. Finally, a correlation was found between the number and type of questions asked by the children while they were making their stories together and the quality of the stories produced. These findings suggest that the engagement in discussion combined with the construction of dynamic drawings encouraged children to articulate and elaborate on their story ideas, therefore enabling the production of longer and better stories. Also, the children's engagement with each others' ideas may have facilitated the establishment of a shared understanding about the collaborative story, thus making it possible for children to build on each others' ideas during storytelling.

Publications arising from this thesis

The work carried out for this thesis was started in 2003, and portions of this work appear in the following publications:

Cappelletti, A., Gelmini, G., Pianesi, F., Rossi, F., & Zancanaro, M. (2004). Enforcing Cooperative Storytelling: First Studies. Paper presented at the International Conference on Advanced Learning Technologies (ICALT).

Gelmini, G., & O'Malley, C. (2005a). Evaluating the Benefits of Hyperlinks and Animation in Collaborative Storytelling with KidPad. Paper presented at the Computer Assisted Learning Conference (CAL).

Gelmini, G., & O'Malley, C. (2005b). Computer Support for Collaborative Storytelling. Paper presented at the 11th Biennial Conference of the European Association for Research on Learning and Instruction (EARLI).

Gelmini-Hornsby, G., O'Malley, C., & Ainsworth, S. (2009). Guided reciprocal questioning supports children's collaborative story-telling. Paper presented at the 13th Biennial Conference of the European Association for Research on Learning and Instruction (EARLI).

Gelmini-Hornsby, G. (2010). Computer support for children's collaborative story-making in the classroom. In K. Makitalo-Siegl, J. Zottmann, F. Kaplan & F. Fischer (Eds.), Classroom of the Future. Orchestrating Collaborative Spaces. Rotterdam, NL: Sense.

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Chapter 1: Introduction

1. The problem space

This thesis investigated how providing children with a set of resources, encouraging them to construct their own representations and to interact with each other while they made their story affected their subsequent storytelling. In order to do this, the work carried out here examined how technologically mediated resources can scaffold children's storytelling, and how these resources can be made more effective by the provision of scaffolding around them.

In the Literature Review (Chapter 2, Section 1), storytelling is presented as an activity which has been argued to be an important aspect of children's learning, as it constitutes a tool for shaping and understanding experiences and entering a culture (Bruner, 1986, 1990). Telling stories also promotes a variety of academic skills, such as creative, critical and abstract thinking, as well as listening, comprehension and recall skills. Therefore, storytelling represents an important part of literacy teaching from the early years of formal education (DCSF)[1], when children are beginning to be good at telling stories, but still need appropriate scaffold to become able to do so proficiently.

Importantly, when they tell stories, children learn to shape a message for others and therefore develop the fundamental skill of communicating effectively to a listener as well as writing for an imaginary reader. It has been widely recognised that good storytelling includes both plot driving complexity (i.e., elements such as introduction of characters and settings, initiating events, attempts by the characters to achieve a goal, and a resolution) and elements which make it interesting and rich (i.e., use of linguistic devices to add emphasis to ideas, accounts of the characters' internal responses to the story events, such as the

[1] http://nationalstrategies.standards.dcsf.gov.uk/node/104310 [Accessed 10 May 2010]

characters' feelings, intentions, and motives). In the psycholinguistics literature, the former aspect has been defined as referential complexity, while the latter has been defined as evaluative richness.

Developmentally, it has been demonstrated that although children as young as three can tell stories, it is not until around the age of nine that they become proficient at telling referentially complex and evaluatively rich stories. The initial years of primary education are an important milestone in children's journey to becoming skilled storytellers, as at this age they can appreciate a good story, but they are not always able to produce stories themselves which are complex and rich enough to enable its understanding and appreciation by a naive audience or readership. Therefore, it is important to understand how children's storytelling abilities can be supported.

Part 2 of the Literature Review addresses this aspect by reviewing existing research on scaffolding children's storytelling. Based on a framework introduced by Chi (2009), the literature is organised into research aimed at supporting children's storytelling through resources, i.e., by encouraging learners to passively watch the presented resources, actively manipulate them, or be constructive with them, and through collaboration, i.e., by interacting with an expert or a peer.

The literature on supporting children's storytelling shows that providing children with resources such as story pictures helps them tell better stories (Pearce, 2003), and that when the pictures represent a story with an overarching goal, children perform even better (Hudson & Shapiro, 1991). It has also been argued that encouraging children to tell stories collaboratively with an adult or with a peer is an effective way of promoting good storytelling (Daiute & Dalton, 1993; Hayes & Casey, 2002; Preece, 1992).

Research on supporting children's storytelling through technology has attempted to bring these two areas together, by exploring how technology can provide resources for children to tell stories together. Technologies have been developed which allow children to actively manipulate pictures of characters and settings by selecting and assembling them (Machado, Paiva, & Prada, 2001; Marshall, Rogers, & Scaife, 2004; Steiner & Moher, 2002; Steiner & Moher, 1992), and to be constructive through recordings (Ananny, 2002; Marshall et al., 2004; Raffle, Vaucelle, Wang, & Ishii, 2007) and drawings (Raffle et al., 2007; Stanton, Bayon, Neale, Ghali, Benford, Cobb, Ingram, O'Malley, Wilson, & Pridmore, 2001). Evaluation of these technologies shows that these can be valuable ways of resourcing children's collaborative storytelling. However, many of these studies involved additional support through automatic or adult guidance. Moreover, the studies explored different tasks (for example involving children of different ages), and evaluated different aspects of their storytelling. Therefore, further research is needed in order to explore the potential of resourcing children's collaborative storytelling through technology.

2. Scaffolding in and around technology

The notion of scaffolding was originally formulated to designate a specific approach to teaching which involved contingent tutoring by a more knowledgeable adult to a child (Wood, Bruner, & Ross, 1976). This notion was influenced by Vygotsky's conception of the zone of proximal development, which is the distance between the ability of a learner to perform a task independently and the level of potential development in collaboration with a more capable individual (Vygotsky, 1978). The implication in this notion is that individuals have learning potential that can be reached with scaffolding. Although this metaphor has been transformed and applied to a variety of learning contexts which no longer necessarily involve the presence of an adult and a child, the main principle remains, stating that the purpose of scaffolding is to help an individual approach a task which would otherwise be slightly beyond his or her capabilities.

In the last few decades, the concept of scaffolding has evolved to refer to a broader range of learning contexts. As Sherin, Reiser and Edelson (2004) argue, the scaffolding metaphor has been transformed and extended to include not only human-human interaction, but also the features and functions of technological artefacts to support learning. Specifically, Quintana and colleagues stressed how technology can help simplify a task, for example by providing constrained resources which learners can focus on (Quintana, Reiser, Davis, Krajcik, Fretz, Duncan, Kyza, Edelson, & Soloway, 2004). They also argue that technology can provide rich tools for transforming a task in order to allow learners to manipulate and modify representations to include new ideas or to make connections explicit.

This thesis embraces this approach by examining how specific technology mediated resources can be used to transform the collaborative storytelling task in order to make it more accessible and productive for learners. Specifically, this thesis examines the benefits of providing rich technological tools for children to manipulate and construct representations with, and to interact with each other in order to tell stories together. Moreover, this thesis examines how scaffolding can be enhanced through activities specifically designed around technological mediation.

Another aspect intrinsic to the notion of scaffolding is that of internalisation. Providing learners with tools can not only transform their approach to a task with the tool, but also their subsequent approaches to the task in the absence of these tools. Learners' ability to access a task productively in the absence of these tools can be argued to be related to their mastery of the knowledge and understanding involved in the task, and this is often referred to as internalisation (Vygotsky, 1978). Salomon, Perkins and Globerson (1991) represented this distinction between the benefits of approaching a task through technological tools and those of approaching a task once the tool is no longer needed by referring to the former in terms of 'effects with', and the latter in terms of 'effects of'. On one hand, tools can be an intrinsic part of an activity, as their presence is necessary in order to transform the activity in such a way as to make it accessible for learners. On the other hand tools can be internalised and subsequently withdrawn from an activity. This thesis encompasses both approaches, by examining the effects of learning with tools that are integral part of a learning task, as well as the effects of tools once these are removed from the activity.

3. Research Questions

As the literature suggests that children's storytelling can be supported through provision of resources and through peer interaction, the basic pedagogical scenario examined in this thesis involves children telling stories together with resources. Firstly, this thesis considers the features of the resources provided as well as what types of activities children are encouraged to perform with these. As the literature on computer supported collaborative storytelling shows, technology can provide a range of rich tools for children to manipulate and construct representations with; through these tools, children's reflection on the stories they make together as well as their interaction with each other can be facilitated (Abnett, Stanton, Neale, & O'Malley, 2001; Ananny, 2002; Marshall et al., 2004; Stanton, Neale, & Bayon, 2002). Secondly, this thesis considers scaffolding children's collaborative storytelling by explicitly encouraging children's collaboration through discussion, and whether the potential benefits related to this scaffolding might be maintained once the scaffolding is no longer available. As the literature on collaborative learning in other domains shows, it is possible to support children's collaboration by encouraging them to articulate their ideas for each other and generally to engage in productive discussion (Brown & Palincsar, 1989; King, 1999; Wegerif, 1996; Yarrow & Topping, 2001).

In the light of these findings, it was expected that scaffolding children's collaborative storytelling through resources and explicit encouragement to engage in discussion would be related to better storytelling. Specifically, it was expected that their stories would not only be referentially more complex and evaluatively richer, but also that the children would develop a shared understanding about the stories they made together, thus enabling them to build coherently on each others' contributions.

The research questions guiding the work presented in this thesis are related to these two aspects, i.e., scaffolding through resources and through explicit encouragement to engage in discussion. Specifically, Research Questions are based on evidence presented in the Literature Review showing that encouraging learners to construct their own representations benefits their learning more than encouraging them to actively manipulate presented resources. The research questions are also based on evidence showing that encouraging learners to engage in interactive discussion, i.e., discussion where learners articulate and build on each others' ideas, facilitates their learning even more than constructing representations. On the basis on this evidence, the following research questions are asked:

1. What are the features of good resources for children's collaborative storytelling?
2. Does encouraging children to construct their own representations over provided resources lead to better collaborative storytelling than just manipulating these resources?
3. Does encouraging children to engage in interactive discussion whilst making stories lead to better collaborative storytelling?
4. Do children still engage in and benefit from interactive discussion once they are no longer encouraged to do so?

This thesis followed a mixed methodology, with a sequential exploratory design consisting in an initial phase employing qualitative methods, followed by a subsequent phase employing quantitative methods (Creswell & Plano Clark, 2007; Greene, Caracelli, & Graham, 1989). As this thesis was driven by the above research questions, an empirical approach was deemed to be more suitable than a naturalistic one, because it allowed for the effects of specific interventions to be observed and tested. The initial qualitative phase was represented by a case study (i.e., the StoryTable Case Study), addressing Research Question 1 and beginning to explore Research Questions 3 and 4. The findings from this case study informed the design of more systematic manipulations, where Experimental Study 1 addressed Research Question 2, and Experimental Study 2 addressed Research Questions 3 and 4.

4. Findings

4.1 Resourcing children's collaborative storytelling

The first question addressed in this thesis was about how to resource children's collaborative storytelling, i.e., what the features might be of good resources for children making stories to actively manipulate and base their story on, to construct their own representations, and to encourage interactive discussion. This question was addressed in the StoryTable Case Study, where a qualitative approach was deemed suitable to allow for the exploration of a variety of ways in which children can be encouraged to be active, constructive and interactive together.

The StoryTable Case Study involved five pairs of children between the age of four and eight making stories together, and it explored children's use of different types of resources with and without technology. The case study found that the children easily engaged with the opportunities to actively manipulate the resources provided and to construct with them. Moreover, older children showed a greater potential to benefit from these resources, as they engage in discussion while making their stories and ultimately told better stories together. Therefore, subsequent experimental manipulations involved six and seven year old children, instead of younger ones.

However, the resources did not appear to provide enough support for children to engage with each other through discussion. Generally, the quality of the children's collaborative stories was relatively poor both referentially and evaluatively, and the different contributions did not appear to build coherently on one another. It was concluded that the type of resources provided might not have been structured enough to encourage good storytelling. It was also argued that the transience of the audio modality might have prevented reflection and discussion on the stories recorded. Therefore, subsequent experimental manipulations involved use of more structured story resources such as picture sequences representing a well structured story, and use of a more persistent modality such as drawing.

The case study also provided the suitably open format to shed light on emerging aspects of the collaborative storytelling task. It was found that novel technology and an unfamiliar storytelling partner might add to the complexity of the task, thus making it harder for children to tell good collaborative stories. Therefore, subsequent experiments involved children who were familiar with each other (i.e., children from the same classroom, and who had worked together before) and a technology which was less complex and which the children had plenty of practice using. It was also noted that the absence of a real audience for the children to tell their stories to might detract from the task validity. Therefore, subsequent experimentations included a real audience in the task design.

4.2 The benefits of self constructed representations

Research Question 2 asked whether encouraging children to construct their own representations over provided resources lead to better collaborative storytelling than just manipulating these resources. This question was addressed in Experimental Study 1, which compared a task where children were encouraged to actively browse through some presented pictures as well as construct their own drawings, with a task where children are only allowed to actively browse the presented pictures.

Twelve triads of children participated in both the active browsing task and the active browsing combined with drawing construction task, while the order in which the children were presented with the tasks was counterbalanced. The children were recruited from a local primary school, where the study took place. They were trained to use a desktop application called KidPad, which allows them to create dynamic drawings over a set of presented pictures. The children were subsequently asked to create a story together using KidPad with or without the dynamic drawings. The benefits of constructive drawing were evaluated in the quality of the children's collaborative storytelling.

It was found that when children constructed their own drawings, their collaborative stories were longer. The quality of the stories was also increased, as the stories were found to be referentially more complex and evaluatively richer than when they were simply presented with story pictures to actively browse through. Overall, these findings suggested that being constructive benefited children's collaborative storytelling more than simply being active. The effectiveness of this type of scaffolding is an important finding, as the developmental literature shows that children the age of those participating in this study would not usually be able to tell stories of this level of complexity and richness in the absence of support (Berman, 1995; Nicolopoulou, 1996; Peterson & McCabe, 1983).

However, in this study, no differences were found between the stories created during the two tasks with respect to extent to which children were able to build coherently on each others' contributions. This might have been due to the fact that little shared understanding was established among the children about their collaborative story, and this might have been due to a lack of engagement in interactive discussion during story-making (Dillenbourg & Traum, 2006; Schwartz, 1995). In the light of these considerations, the subsequent experimental manipulation focused on explicitly encouraging children's interactive engagement with each others' ideas, with the expectation that this would facilitate the production of better collaborative stories.

4.3 The benefits of encouraging interactive discussion during story-making

Research Question 3 asked whether explicitly encouraging children to articulate and discuss their ideas about their collaborative story would benefit their collaborative storytelling. This question was addressed in the StoryTable Case Study and in Experimental Study 2, and both focussed on scaffolding discussion around the provided technological resources.

The StoryTable Case Study explored the benefits of encouraging discussion through adult guidance, by observing how a pair of children engaged with each other as a result of an adult facilitator encouraging them to articulate and discuss their ideas through questions and suggestions. The children were found to engage with each other by providing reciprocal suggestions and feedback. Moreover, the children were able to tell referentially complex and evaluatively rich stories, and to use their contributions to build coherently on their partner's ones. This suggested that encouraging children to articulate and discuss their ideas by asking them questions about their story benefited not only their ability to engage in discussion while making their story, but also their ability to tell good stories as a result.

Experimental Study 2 built on these findings through a systematic manipulation comparing a task where children were encouraged to discuss their ideas while making their story, with a task where they were not so supported. In this study, a method called Guided Reciprocal Peer Questioning was adapted for the storytelling domain, which required that children use a set of question prompts to ask each other questions about their story. Therefore, no adult guidance was provided here, except from the minimal training involved in teaching the children about reciprocal questioning.

Given the findings from Experimental Study 1 on the benefits of constructing drawings with the computer, both tasks in this study involved the construction of drawings with the same computer application. Eighteen pairs of children were recruited from the same local primary school as in Experiment 1. The children were trained to use KidPad, and they subsequently made one story under the conditions of the reciprocal questioning task and one without.

The findings show that when children were prompted to engage in reciprocal questioning, they were more engaged with each other than when not so supported. Specifically, the children were more on task and asked each other more questions and provided related answers. The type of questions asked also differed in the two tasks, as the children performing the reciprocal questioning task asked more questions aimed at eliciting discussion about elements in the story which went beyond the content represented in the pictures. One concern about the quality of the questions asked was that the children might feel restricted in their discussion by the prompts provided. However, this was shown not to be the case, as the provided questions constituted on average less than 70 % of the questions asked.

The central objective of the intervention in this study was to improve the quality of the children's collaborative stories, and this study found that when children performed the reciprocal questioning task, their stories were longer as well as evaluatively richer. This showed that encouraging children to ask each other questions during story-making was related not only to increased engagement in interactive discussion, but also that it was related to an increased quality in the children's collaborative storytelling. The relation between the benefits of asking questions and better quality in the children's collaborative storytelling is shown by the positive correlation between these two: the more questions were asked, the longer and evaluatively richer the stories produced were.

When the children performed the reciprocal questioning task, they also built more coherently on each other's contributions. This suggested that encouraging children to engage in interactive discussion during story-making through reciprocal questioning could have contributed to their achieving a better mutual understanding about their collaborative story. As it has been suggested, increased shared understanding enables learners not to build coherently on each other's contributions, thus allowing for the production of better collaborative outcomes (Barron, 2003; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996).

4.4 The lasting benefits of encouraging interactive discussion during story-making

Research Question 4 asked whether children would still engage in and benefit from interactive discussion once they are no longer encouraged to engage in it. This question was addressed in the StoryTable Case Study and in Experimental Study 2.

The StoryTable Case Study began to address this question by exploring whether the children in this study would continue to articulate and discuss their story as well as continue to tell good stories together once the adult guidance was gradually withdrawn. The children were observed over four sessions, during which the adult facilitator contributed fewer and fewer questions and suggestions to the discussion, until in the last session, she left the children to make their story autonomously. It was found that children continued to engage in interactive discussion throughout the story-making sessions; even in the fourth and unsupported session, they continued to articulate ideas and provide feedback for each other. The quality of their collaborative stories also remained good, as the children were able to include plot driving events and to enrich their stories with evaluative elements, as well as build coherently on each others' contributions.

Experimental Study 2 investigated these findings further, by systematically manipulating the order in which the discussion support was provided and addressing Research Question 4 through a quantitative approach. The analysis compared children's engagement in interactive discussion when they were given the non-reciprocal questioning first, with their engagement in interactive discussion when they were given this task second, i.e., after they had been given the reciprocal questioning task. The study also analysed the quality of children's collaborative storytelling in these two cases, to investigate whether the children would continue to tell good stories together once the reciprocal questioning support had been withdrawn.

It was predicted that when the non-reciprocal questioning task were given after the reciprocal questioning task, the children would engage in interactive discussion more than when the non-reciprocal questioning task came first. This would suggest that the children had internalised the reciprocal questioning strategy, and were therefore able to apply it even in the absence of explicit support. The same prediction was made about the quality of the children's collaborative stories.

The predictions were supported, as the children who were given the non-reciprocal questioning task second engaged in interactive discussion more than those who were given the non-reciprocal questioning task first, by asking more questions and providing relevant answers. These children also continued to tell better stories together; specifically, their stories were longer and evaluatively richer than those told by the children who were given the non-reciprocal questioning task first. These findings suggest that the children had internalised the reciprocal questioning strategy, and that engagement in interactive discussion during story-making is related to better collaborative storytelling even when the reciprocal questioning support is withdrawn.

5. General Conclusions

Overall, this thesis found that children's collaborative storytelling could be scaffolded through the use of technology mediated tools, thus adding to the literature on computer supported collaborative storytelling (Ananny, 2002; Marshall et al., 2004; Raffle et al., 2007; Stanton et al., 2002). Children readily engage with the opportunities technology provides for them to engage with resources through active manipulation and the construction of representations. However, some resource features can be more effective than others, and careful attention should be paid when designing these resources and the activities around them in order to ensure that children's collaborative storytelling benefits from these. It was found that the resources provided should be structured enough to allow children to understand and elaborate on these resources, and that recording their stories might not be a sufficiently shareable and persistent modality to enable reflection and discussion. Moreover, it was found that presenting children with a novel technology and encouraging them to use it to tell stories with a partner they are not familiar with may detract from the quality of the stories produced, as children might perceive the task to be too complex or artificial. Another lesson learnt was that in order for the storytelling task to be as ecologically valid as possible, a real audience should be involved for the children to tell their stories to.

This thesis also found that providing resources for children to construct their representations with benefits their collaborative storytelling more than simply providing them with resources to actively manipulate. Constructive production of dynamic drawings was related to children's production of longer and referentially more complex stories. These findings added to the literature on using technological tools to scaffold children's storytelling, but also to the literature on scaffolding learning through constructive activities with and without technology and in domains other than storytelling (Ainsworth, 2006; Bodemer, Ploetzner, Feuerlein, & Spada, 2004; Chi, 2009; Hoadley, Hsi, & Berman, 1995; Prangsma, Van Boxtel, & Kanselaar, 2008; Suthers & Hundhausen, 2003).

Moreover, this thesis found that children's engagement in interactive discussion during story-making can be promoted through additional guidance around technology. Adult encouragement has been shown to benefit children's use of technological resources. In combination with the use of resources providing opportunities for children to engage in active manipulation and construction of representations (in the case of StoryTable), guidance outside these resources could effectively promote children's engagement in interactive discussion during story-making. When encouraged to articulate their own ideas for each other and given suggestions on how to improve on the quality of their stories, children were able to produce good stories together.

Another finding in this thesis is that children can be encouraged to engage in interactive discussion through minimal training in reciprocal questioning when working with a peer. Children readily engaged with the encouragement to use the provided question prompts to take turns at questioning each other about their collaborative stories, and which resulted in task focussed, interactive discussion about the stories being made. In combination with the use of technology mediated tools for the construction of representations, this activity proved to be effective at scaffolding children's collaborative storytelling. The children's stories were not only longer, but also evaluatively richer and more coherent, thus showing an improvement in the quality of the stories which children around their age would be able to produce without scaffolding (Berman, 1995; Nicolopoulou, 1996; Peterson & McCabe, 1983).

Finally, it was found that the benefits of encouraging children to engage in interactive discussion during story-making could be maintained once this support was removed. In the case of the adult guidance, when the support was gradually withdrawn, it was observed that the children continued to interact with each other and to tell good stories together. In the case of reciprocal questioning, similar results were found experimentally: once the children were no longer provided with question prompts or required to take turns at reciprocal questioning, they still maintained their ability to engage with each other through interactive discussion and to tell good stories together.

To conclude, this thesis has shown that technological resources can provide effective scaffolding for children's collaborative storytelling. However, these resources need to be embedded within carefully designed pedagogical practices and their goals need to be made transparent to students for productive engagement to occur. Therefore, the potential of technology is better tapped into when this is situated within what Salomon, Perkins and Globerson (1991) define as a whole 'cloud of correlated variables', where technology, activities, goals and settings exert a combined effect to provide optimal scaffolding

6. Thesis Overview

This thesis includes a Literature Review (Chapter 2), a Case Study (Chapter 3), two experimental studies (Chapters 4 and 5), and a General Discussion. In Chapter 2, existing research on storytelling is presented and organised into four parts. In Part 1, the value of storytelling as an educational activity is argued for, the elements of a good story are illustrated, and children's development of the ability to tell good stories is charted. In Part 2, research on scaffolding children's storytelling is reviewed, and a framework is presented through which the literature and the ensuing research questions are organised. Part 3 defines the space of existing technologies for children's storytelling and discusses how their different features benefit children's storytelling; thus motivating the choice of the two technologies (StoryTable and KidPad) used in this thesis. Finally, Part 4 introduces the technologies used in this thesis, by describing their functionalities and key features.

Chapter 3 presents the first study carried out for this thesis, consisting of a qualitative case study addressing Research Question 1 and beginning to explore Research Questions 3 and 4. The case study is divided into three sets of observations: the first two sets address Research Question 1 through observations of children's use of a StoryTable and a paper based mock-up, while the third begins to addresses Research Questions 3 and 4 through insight into children's use of StoryTable in combination with additional adult guidance.

Chapter 4 presents the second study in this thesis, where an experimental manipulation is carried out to address Research Question 2. The study compares the potential benefits of encouraging children to complement a set of presented pictures with their own representations constructed in KidPad over the potential benefits of simple active manipulation of the presented pictures.

Chapter 5 presents the third case study, where another experimental manipulation is designed to address Research Questions 3 and 4. The study compares the potential benefits of encouraging children to engage in reciprocal questioning while they construct representations in KidPad over the potential benefits of simply constructing representations in KidPad. The study also examines whether these benefits can be maintained once the reciprocal questioning support is withdrawn.

Finally, Chapter 6 brings together the findings from the three studies presented in Chapters 3-5 by discussing their findings, strengths and limitations, as well as the implications for research and practice. The chapter is concluded with an indication of potential avenues for future research arising from these studies.

Chapter 2: Literature Review

The work presented in this thesis is aimed at investigating how children's collaborative storytelling can be supported through constructive and interactive story-making. Specifically, this thesis examines how providing children with a set of resources, encouraging them to construct their own representations and to interact with each other while they make their story benefits their subsequent storytelling.

The first part of this chapter argues for the importance of storytelling by presenting a review of research which has been carried out to date on the value of storytelling for children. Subsequently, the literature defining the requisites of a good story is reviewed, followed by a review of the findings on how children progressively develop an ability to tell good stories as they grow older.

The second part of this chapter addresses the literature that has been carried out to date on scaffolding children's storytelling, i.e., through resources and through peer collaboration. This part also introduces a framework to help organise this literature and situate it within a broader literature on learning, to identify areas where further research is needed, as well as to formulate the research questions and predictions addressed in this thesis.

The third part of this chapter examines how technology can scaffold children's collaborative storytelling by providing a variety of resources to help constrain the task as well as providing opportunities for children to organise their ideas, and to manipulate and construct representations. This section reviews research that has attempted to do so, and the relative findings. This provides a space within which the technologies used for the work presented in this thesis are situated, with respect to their features and potential benefits.

1. Children's storytelling

1.1 Introduction

Stories are tools for reflection through which people shape their understanding of what they experience in the world. Bruner (1986, 1990) once argued that we comprehend the world in a narrative way, and that stories are a way for us to select what is extraordinary about life and form new meanings. Moreover, stories are not only a reflection of our need to shape and handle experience (Britton, 1972; Shank, 1995), but also a manifestation of our need to communicate our experience to others (Jones & Buttrey, 1970). The way we choose to express ourselves through stories, our 'narrative voice', constitutes our unique way of communicating; however, the ability to do so is only gradually acquired through sustained production and exposure to narrative (Engel, 1999).

From our early childhood, our culture exposes us to narratives through a variety of informal channels such as parental shared storybook reading, theatre, performance, television, cinema, and so on. This has made it one of the privileged genres through which children are introduced to learning in formal education as well (Aiex, 1988; Ellis & Brewster, 1991; McCabe, 1997; Tannen, 1980; Wright, 1995). Due to the pervasiveness of narrative ways of shaping and communicating experience, a large body of research in the last century has investigated the learning benefits of telling stories. Storytelling has been argued to contribute to academic success through the development of several areas of the curriculum (Ellis & Brewster, 1991; Feagans, 1982; Grugeon & Gardner, 2000; Wright, 1995).

1.2 The benefits of storytelling

Formal education also places strong emphasis on enculturing children into narratives by exposure as well as direct practice. Because the ability to tell stories allows people to make sense of their experience and to communicate it to others in their own terms, the development of this ability plays an important role in the curriculum from primary education onwards. The ability to understand others' stories as well as to communicate one's experience of the world through stories has been found to develop generic skills such as the ability to express oneself creatively, imaginatively and artistically (Ellis & Brewster, 1991), to communicate in a social setting (Engel, 1999; Labov, 1972; McCabe, 1991, 1996; Polanyi, 1981), to think critically about events (Aiex, 1988) and to abstract through the development of symbolic, language driven thinking (Nicolopoulou, 1996).

Storytelling has also been found to benefit the development of more specific skills related to academic success, such as listening and concentration skills (Ellis & Brewster, 1991), comprehension skills (Aiex, 1988), and content recall (Colby & Cole, 1973; Kintsch & van Dijk, 1975; Mandler & Johnson, 1977; Meyer, 1975; Rubin, 1995; Rumelhart, 1975; Schank, 1995). This has been demonstrated to be particularly valuable in the development of primary school children's ability to recall facts and events: due to their early exposure to the narrative genre, children have been found to be more at ease with recalling facts when they are in the form of a story than in a written expository text even later on in their early years of formal education (Freedle & Hale, 1979).

Furthermore, due to its pervasiveness in children's lives from a very young age, storytelling has been argued to facilitate the transition from oral to written literacy (Ellis & Brewster, 1991; Grugeon & Gardner, 2000; McCabe, 1997; Sulzby, 1996; Tannen, 1980; Wright, 1995). Storytelling has been demonstrated to foster a variety of literacy related skills and abilities, such as a positive attitude towards reading (Aiex, 1988) and an appreciation of literature (Grugeon & Gardner, 2000), vocabulary development (Ellis & Brewster, 1991) and most importantly, the ability to communicate effectively to an audience (Nicolopoulou, 1996): when children tell a story to an audience, they learn how to shape their message in such a way that it can be understood and appreciated by others. Because much of the process of schooling is about the acquisition of discourse forms that enable learners to communicate effectively by presenting information in ways that are understood by others (Cook-Gumperz, 1986), storytelling plays a key role in the curriculum.

The ability to communicate effectively to a listener is, in turn, closely related to the ability to communicate to an absent reader: the former facilitates the latter through the child's acquisition of an internal model of readers' understanding processes and how a message needs to be shaped in order for it to be communicated effectively (Schriver, 1992). McCabe and Peterson (1991) also argue that the development of an internal sense of audience (as expressed by increasingly de-contextualised language in writing) is accomplished first by responding to a real audience. Therefore, storytelling constitutes a privileged channel for children's transition from oral to written literacy, where the reader is not physically co-present with the writer or does not have access to the same context as the writer.

As it enables people to communicate effectively in the absence of a listener, the ability to use 'de-contextualised language' has been a major educational challenge in the development of written language (Britton, 1972; Cassell, 2004; Michaels, 1986; Nicolopoulou, 1996; Snow, 1983; Westby, 1984), and much of the National Curriculum for literacy has been designed around teaching children to acquire this ability (DCSF[2]; QCDA[3]). As storytelling is an effective way of supporting the development of this ability, it is important to examine what difficulties children encounter when telling stories and how to address them with appropriate scaffolding.

1.3 The features of a good story

As the ability to tell good stories is an important skill for children to have, an understanding of what constitutes a good story is necessary in order to assess how good children are at telling stories and, crucially, to support them in doing so.

A large amount of literature has tried to address and define the concept of a story, ranging from anthropological, cultural and literary perspectives to linguistic and

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[2] http://nationalstrategies.standards.dcsf.gov.uk/node/88619 [Accessed 10 May 2010]

[3] http://curriculum.qcda.gov.uk/key-stages-1-and-2/subjects/english/keystage1/index.aspx [Accessed 10 May 2010]

psychological ones. The structuralist approaches are represented by studies in story grammars, which in the second half of the last century advocated that stories have an underlying structure and tried to the define its fundamental constituents as well as how these are assembled into a consistent structure (Kintsch & Van Dijk, 1978; Mandler, 1978; Mandler & Johnson, 1977; Rumelhart, 1975, 1977; Stein & Policastro, 1984; Thorndyke, 1977). Their findings were based on empirical research on what elements in a story people spend most time reading or recall most (Kintsch & Van Dijk, 1978; Rumelhart, 1975, 1977), which story structure people find it easier to comprehend and retell (Mandler & Johnson, 1977; Thorndyke, 1977), as well as people's direct judgement of whether different types of text are considered to be stories (Stein & Policastro, 1984). Perhaps due to the rich and elusive nature of stories, however, the research produced by advocates of story grammars reached no agreement on what exactly constitutes a good, comprehensible story, with virtually every story grammatician proposing a different grammar.

Criticisms of this approach have focussed on how story grammars fail to provide a consistent and comprehensive account of what stories are, or how they are produced and understood (Black & Wilensky, 1979; Brewer & Lichtenstein, 1981; Wilensky, 1983). This may have been due to the story grammars' preoccupation with abstraction from content, which may have made the task impossible in itself, considering the extreme richness and variability of storytelling forms (de Beaugrande, 1982). Crucially, story grammars have been criticised for ignoring the importance of those linguistic features which give a story its 'flavour', thus making a sequence of events salient, important and ultimately enjoyable for a reader. As Labov and Waletzky (1967) have argued, skilful narrators not only include those elements which story grammars identify as important for moving the plot forward, but also express these elements in such a way that a desired effect in the listener (of interest, enjoyment, appreciation, etc.) is attained. This is achieved, for example, through lexical choice, representation of character's internal states, repetition, climax building, formulaic expressions, and other expressive devices which ultimately make a story worth attending to.

In Labov and Waletzky's approach to narrative (1967), the story aspects which drive the plot forward is defined as referential, because they report about facts and events in a story. On the other hand, while the expressive elements which give 'colour' to a story are defined as evaluative, because they convey a sense of the narrator's approach and perspective on the events being reported.

After formulating the concept of a story as product which is composed not only of referential aspects, but also of expressive ones, Labov went on to articulate the concept of expressiveness and 'colour' in a story. Labov (1972) argued that a story can be expressive by providing introductory and conclusive statements aimed at indicating to a listener that a story is being told; these can be formulaic expressions (e.g., Once upon a time; The end; They lived happily ever after), and summaries of what the story is about or its main theme (e.g., This story is about a boy who has lost his frog; The monkey was asking lots of animals if they had seen his mum; The monkey learnt not to run away from his mummy ever again). Other expressive devices are statements aimed at setting the scene of the story, including information about time, place of events and characters involved. Finally, narrators can express richness and 'colour' by giving emphasis to some elements over others in the story, for example by using expressions, repetitions, and stating characters' internal states such as their thoughts and feelings.

Labov and Waletzky's argument for the importance of a story's referential elements to be complemented by evaluative aspects reflects Bruner's considerations (1986) on the importance of stories as vehicles to express meaning. In Bruner's perspective, not only does a good story report a number of events driving a plot, but it also weaves these events into a fabric of expressive devices (such as characters' subjective states, feelings, intentions, and motives) aimed at conveying meaning to a story. Together, these two aspects (events reporting and expressive meaning making) form what Bruner defines a 'dual story landscape'.

Finally, Stein and Glenn (1979) took an approach to defining stories which combines story grammar's preoccupation with rigour and formalism and Labov and Waletzky's appreciation that stories go beyond the mere reporting of certain types of events driving a plot, which they define 'referential aspects' (from Labov and Waletzky, 1967). They claim that stories also need to include expressive elements aimed at conveying meaning, which they define 'evaluative elements'. Crucially, Stein and Glenn (1979) based their definition of a story on their analysis of large corpora of stories produced by primary school age children, thus making their story definition particularly relevant for the research presented in this thesis.

Moreover, the definition proposed by Stein and Glenn gained face validity in a study conducted by Stein and Policastro (1984) where a group of middle school children and their teachers were presented with a set of texts which fulfilled all the requirements in Stein and Glenn's definition (1979) and others which did not, and were asked to judge whether they considered these to be stories as well as to rate their quality. The study showed that although some of the texts which did not fulfil all requirements were considered to be stories by the children and the teachers, these were consistently rated to be poor stories. The texts which fulfilled all the requirements in the story definition, however, were considered to be good stories throughout. Therefore, it can be concluded that the definition proposed here is more than an abstract construct, as it appears to reflect children as well as teachers' expectations of what a good story is.

The definition of a story proposed by Stein and Glenn (1979) includes referential elements such as the presence of a setting, an initiating event (i.e. a problem to be addressed), one or more characters' reaction (i.e., their intention to address the problem), their attempt(s) at solving the problem, and a final (positive or negative) resolution of the problem. This definition of a story, however, also includes evaluative elements such as statement of a setting through characters' descriptions, their internal responses to the story events, and their reaction to the final problem resolution. Although less articulate than Labov's definition, Stein and Glenn's (1979) definition of a story's evaluative layer based on analysis of children's stories reflect Labov's emphasis on elements such as characterization, for example through the description of settings and characters' internal responses to the story events as well as their reaction to the final problem resolution.

Due to its inclusion of both referential and evaluative layers as well the fact that it is grounded in the analysis of real stories produced by children, the Stein and Glenn (1979) definition of a story has been widely used in research on children's storytelling. Therefore, the definition can now be considered as a standard in related research, this will be used in this thesis as a measure for children's story quality.

1.4 The development of children's storytelling abilities

In order to be understood and appreciated by an audience, a story needs to be both referentially complex and evaluatively rich (Berman, 1995; Labov & Waletzky, 1967; Stein & Glenn, 1979). However, as much psycholinguistic research has shown, children's storytelling skills evolve with age, exposure to stories and production practice. This means that children in their early years of formal education are only beginning to shape their stories in such a way that it enables a listener to understand and appreciate them.

Moreover, it has been found that the type of story which is elicited also affects the quality of the stories produced: as Berman (1995) and Hudson and Shapiro (1991) show, children find it easier to respond to elicitations of generic scripts ("Tell me what happens when a person goes to the doctor", or "Tell me what happens when a person eats at McDonald's") than accounts of personal experience (e.g., "Tell me about when you had a fight" or "Tell me about when you went to a party"), and make believe stories are the hardest for children to tell. Developmentally, this sensitivity to the way in which a task is framed and elicited is not unique to storytelling, and it has been reported in a variety of different cognitive domains (Donaldson, 1978; Gelman, 1978)

The work presented in this thesis focuses on how to scaffold children's telling of make believe stories, as these are the ones which children find harder to tell. Overall, research has suggested the age between six and seven as a crucial time window for children's development of their narrative skills. Findings from the psycholinguistic literature suggest that six to seven year old children's storytelling skills begin to enable them to tell referentially complex and evaluatively rich stories, but they also stress that these skills still need further developing and refining (Berman, 1995; Hudson & Nelson, 1983; Hudson & Shapiro, 1991; Nicolopoulou, 1996; Peterson & McCabe, 1983, 1991, 1997; Trabasso, Nickels, & Munger, 1989; Umiker-Sebeok, 1979).

Although the impetus of research on children's development of storytelling abilities seems to have come to a halt since the Nineties, this research has been used more recently as a basis for investigating a variety of storytelling related skills, such as learners' ability to read and comprehend text (Cragg & Nation, 2006; Westerveld & Gillon, 2010; Wilkinson, Elkins, & Bain, 1995), the ability of individuals affected by a variety of disabilities to communicate (Liles, Duffy, Merritt, & Purcell, 1995; McCabe, Bliss, Barra, & Bennett, 2008; Seung & Chapman, 2003); the ability of speakers of different languages to tell stories (Berman & Slobin, 1994) and in a variety of other contexts. These studies confirm the importance of previous research in providing a basis for further productive research in a variety of areas. This indicates that the landmarks charted by research on children's development of storytelling abilities have not been fundamentally questioned since their formulation and refinement between the late Seventies and early Nineties. Therefore, in this thesis, findings from this original literature are used as a basis for mainly focussing on storytelling produced by children between the age of six and seven, as this is recognised to be a privileged window to address when designing ways to scaffold children's storytelling.

1.4.1 The development of children's referential storytelling abilities

Labov (1972) argues that a story's referential layer needs to include enough information about plot advancing events to enable listeners to understand them even when they are naïve to those events. Stein and Glenn (1979) identified these referential elements in: the statement of a setting, the presence of an initiating event (i.e. a problem to be addressed), one or more characters' reaction (i.e., their intention to address the problem), their attempt(s) at solving the problem, and a final (positive or negative) resolution of the problem.

Research has shown a clear pattern of development in children's referential storytelling skills, going from the basic ability to give simple descriptions of temporally related events at the early age of three (Nelson, 1989), through to the age of eight and nine, when children start to become accustomed to telling stories which are composed of complex episodes featuring multiple, causally linked attempts at resolving an initial situation or problem (Botvin & Sutton-Smith, 1977; McKeough, 1992). Between these two developmental landmarks, children gradually refine their ability to tell more and more referentially complex stories.

Nicolopoulou's review of the literature (1996) attests that at the age of four and five, children begin to occasionally go beyond simple event accounts. Specifically, their stories begin to include narrative features such as orientations (i.e. the settings and characters involved in the story), initiating events, conflicts and their resolutions (Berman, 1995). Kemper (1984) and Peterson and McCabe (1983, 1991, 1997) argue six years to be a break-through age for children's narrative skills development, as this is when they begin to be able to tell well formed narratives that include all the referential aspects in Stein and Glenn's (1979) story grammar: a setting, an initiating event (a problem to be addressed), one or more characters' reaction (i.e., their intention to address the problem), their attempt(s) at solving the problem, and a final (positive or negative) resolution of the problem.

Applebee's analysis (1978) also shows that it is not until the age of six that children begin to occasionally tell well structured stories where each episode is causally related not only to its contiguous ones, but also to the central problem that the story revolves around. He argues that with age, narrative structure evolves from a collection of events related to each other only by proximity in time or space, to stories that have a physical or psychological centre (a central character or theme), to stories where events are chained into temporally related sequences, through to highly structured narratives in which the events are linked both to a common centre or theme and to the events which immediately precede and follow it in a cause-effect relationship. Although this level of referential complexity appears around the age of six, it is not until a few years later that the ability to produce complex stories becomes a consolidated routine. Trabasso, Nickels and Munger (1989) and Hudson and Shapiro (1991) also found that it is not until the age of nine that children are able to manage multiple episodes that are causally related to a central motif (such as multiple attempts to solve a central problem).

All these findings suggest that children begin to tell referentially complete episodes around the age of six and seven, but it is not until a few years later that they are able to build complex stories made of several episodes such as a set of repeated attempts to pursue a global goal.

1.4.2 The development of children's evaluative storytelling abilities

A large body of research has drawn from Labov and Waletzky's (1967) and Labov's (1972) description of stories' evaluative aspects, in order to assess children's abilities to include these elements in their stories (Stein & Glenn, 1979). As with referential skills, research also shows a developmental pattern in children's ability to include evaluative elements in their stories. Although children as young as five have been found to be able to appreciate the superior quality of stories rich in evaluative elements (Stein & Policastro, 1984), as well as to recall and reproduce some of these elements when asked to re-tell a presented story (Hudson & Nelson, 1983), the literature shows that when asked to encode evaluative elements into the stories they themselves had produced, young children often struggle to do so (Beck & Clarke-Stewart, 1998).

Hudson and Shapiro (1991) reported that even as late as third grade (eight to nine years old), children are still unable to include explicit reference to characters' internal states, goals and reactions in their stories. However, others claim that children as young as three employ a reasonably wide range of evaluative devices in their stories to attract others' attention to their own story (Umiker-Sebeok, 1979). Berman (1995) found that from the early age of four, children are able to include formulaic endings to their stories (such as 'the end' or 'they lived happily ever after'). However, it is not until the age of six that children start to use evaluative elements consistently (Botvin & Sutton-Smith, 1977).

Ukrainetz, Justice, Kaderavek, Eisenberg and Gillam (2005) also found that 87 per cent of five and six year old children's stories included some evaluative elements, and that by the age of nine, virtually all of the children in their study were able to include some form of evaluative elements in their stories. She also found that with age, children included more and more of these evaluative devices. Kernan (1977) also found a correlation between the frequency of evaluative devices and children's age. Finally, Bamberg and Damrad-Frye (1991) found that the frequency of evaluative devices did increase significantly with age, even when story length was controlled.

In general, comparing findings from different studies on evaluative richness is harder than in the area of referential complexity because of the difference in the way stories were elicited in each study. For example, the stories analysed by Umiker-Sebeok (1979) were collected in conversational settings, where the children may have used evaluative devices as part of their conversation or to obtain the turn to speak, and would not have otherwise included those if asked to tell a story in a more formal setting. The Umiker-Sebeok (1979) study, on the other hand, elicted personal narratives, which, according to Hudson and Shapiro (1991), would have been easier for the children to produce, compared to the fictional ones elicited by Botvin and Sutton-Smith (1977). Also, the Bamberg and Damrad-Frye (1991), Berman (1995), Hudson and Shapiro (1991) and the Ukrainetz et al. (2005) studies involved the use of pictures to elicit stories, and this could have facilitated children int heir task, resulting in the production of evaluatively richer stories. Moreover, as evaluative richness is a slightly more subtle and fuzzy concept than referential complexity, a variety of slightly different approaches and coding schemes have been used to analyse evaluative richness in children's stories. For example, Bamberg and Damrad-Frye (1991) created a basic coding scheme, which was later adopted by many researchers, although in an elaborated form including more categories to better capture the multi-faceted nature of evaluative richness (Peterson & McCabe, 1983; Ukrainetz et al., 2005). However, despite the differences between individual studies, the literature converges to show that children develop and refine their ability to include evaluative elements in their stories with age.

Overall, however, the findings suggest that children's ability to include evaluative elements in their stories evolves with age, and that the age of six to seven is an important landmark for children's consolidation and refinement of their evaluative repertoire.

Together with findings on children's development of referential abilities, the findings on children's acquisition of the ability to tell evaluative rich stories indicate that children start to become good storytellers around the ages of six and seven. As children acquire the necessary skills to tell good stories around this age, but still need to consolidate their abilities, it is particularly useful to investigate how children's storytelling can be supported around this age.

1.5 Children's storytelling: conclusions

Overall, it has been argued that the practice of storytelling benefits the development of children's ability to make meaning for others. When they tell a story, children learn how to shape a message for others and therefore develop the fundamental skill of communicating effectively to a listener and, ultimately, to an imaginary reader. This is important, because the ability to write for an absent reader is greatly valued in formal schooling and constitutes the basis for academic success.

Storytelling has also been demonstrated to benefit other academic skills such as creative, critical and abstract thinking, listening and concentration, comprehension and recall skills. More specifically to literacy, storytelling encourages positive attitudes towards reading, vocabulary development and the ability to articulate a message for others.

As storytelling is a key skill for children to learn, it is important to understand how skilled children are as narrators, and how their development can be supported. In order to do this, one needs to define what a good story is. Good stories can be understood and appreciated by others; in order for this to happen, a story needs to be referentially complex (i.e., to include plot driving elements such as settings, initiating events or problems, reactions, attempt(s) to solve the problem, and a final resolution of the problem) and it needs to be evaluatively rich (i.e., to include elements which give 'flavour' to the story, such as characters' descriptions, their internal responses to the story events, such as the characters' feelings, intentions, and motives).

As the developmental psycholinguistic literature demonstrates, children in their early years of primary education are beginning to consolidate their ability to tell stories which are referentially complex and evaluatively rich: although children of this age have an intrinsic awareness of what constitutes a good story, they are not yet able to translate this awareness into the production of referentially complex and evaluatively rich stories. In other words, children of this age find it difficult to articulate a message for others in such a way that it is complex and rich enough to enable its understanding and appreciation by a naive audience or readership. Therefore, this age window might represent a particularly interesting one for interventions aimed at supporting children's storytelling, as children are not entirely incapable of telling stories or appreciating what a good story is, but they are not yet able to produce good ones without support.

2. Scaffolding children's storytelling

As children only gradually become proficient at producing good stories, research has attempted to identify ways in which children's storytelling can be supported. Two areas can be identified in which this literature can be organised for the purpose of this thesis: one is concerned with the benefits of providing children with opportunities to engage with story resources, and the other is concerned with the benefits of peer collaboration.

These two ways of supporting children's storytelling can be explored by looking at how technology can resource children's collaborative storytelling by providing opportunities for them to engage with story material and to construct their own materials. As technology mediation is an important part of this thesis, a dedicated section of this review is provided in the third and final section of this literature review.

In order to organise the existing literature on supporting children's storytelling through engagement with story material and own constructed material, as well as to collaborate with peers, a framework is introduced which shows how these two areas have been addressed in the broader literature on learning, and how predictions can be made about the value of certain types of activities over others.

2.1 The "Active-Constructive-Interactive" framework

The framework presented here was originally proposed by Chi (2009) to describe the kinds of activities learners can engage in and their value in supporting learning. Although the framework was not originally designed to study children's collaborative storytelling, its broad and general approach to describing the kinds of activities learners might perform to interact with resources and with each other makes it suitable to be applied to a variety of domains, including children's collaborative storytelling. Specifically, the framework discusses the psychological processes and their related benefits with respect to learners using presented resources, constructing their own representations, and interacting with others. Therefore, the framework provides a helpful way to situate and summarise the research carried out for this thesis within a broader learning literature, as well as to organise this literature into a set of predictions on the psychological processes and their benefits in relation to using existing resources, constructing one's own representations, and interacting with others.

In her framework, Chi (2009) argues that learners benefit more from being 'active' than 'passive', that they benefit more from being 'constructive' than 'active', and that they benefit most from being 'interactive'. She argues that this is the case because the cognitive processes presumably involved in one activity subsume those presumably involved in another. Thus, being active subsumes being passive because being active presumably involves learners attending to the presented material more than being passive; being constructive subsumes being active (and being passive) because being constructive presumably involves learners not only attending to the presented material, but also creating new knowledge; finally, being interactive subsumes being constructive (and being active and passive) because it presumably involves learners incorporating their partners' feedback into the knowledge they have constructed themselves.

Chi (2009) defines as 'passive' those activities where learners are presented with some learning resources and are asked to view these without manipulating them in any way. For example, learners are passive when they simply read a text (Chi, de Leeuw, Chiu, & LaVancher, 1994; Kiewra & DuBois, 1991), or watch a video (Schwan & Riempp, 2004). When they are passive, learners are minimally engaged with the material they are viewing, as they are not doing anything.

Learners are 'active' when they actively engage with the presented resources, for example by looking and searching through a presented model (Azmitia, 1988), navigating some video content by pausing or selecting which sections to watch and in what sequence (Chi, Roy, & Hausmann, 2008), or underlining and copying and pasting parts of a text (Igo, Bruning, & McCrudden, 2005). Chi (2009) argues that when they are active, learners encode the presented resources and attend to them more than if they were not performing these activities, i.e., if they were passive (Schwan & Riempp, 2004).

Learners can also be 'constructive'; this happens when they generate some sort of new output which goes beyond the presented resources, for example by self explaining (Chi, Bassok, Lewis, Reimann, & Glaser, 1989; Chi et al., 1994), asking questions (Graesser & Person, 1994), and constructing a concept map (Biswas, Leelawong, Schwartz, & Vye, 2005; Roth & Roychoudhury, 1994) or a diagram (Bodemer et al., 2004; Suthers & Hundhausen, 2003). Based on the reviewed research, Chi (2009) argues that being constructive is more beneficial to learning than being active (Kastens & Liben, 2007; Klahr & Nigam, 2004), or passive (Hausmann & VanLehn, 2007). She argues that this is because when they are constructive, learners make their understanding explicit through the construction of new output. This leads to learners organizing and restructuring their understanding and, ultimately, to greater encoding and elaboration.

Finally, the framework advocates a fourth way in which learning takes place, namely through interaction among learners. Learners are 'interactive' when they attend to what their collaborating partner is doing and build on it productively. Chi (2009) argues that one of the most effective (and overtly observable) ways in which learners can be interactive is by engaging in dialogic discussion where ideas are not only articulated, but also attended to and expanded on by collaborators. In other words, in order for a collaborative activity to be interactive, learners must pay attention to the others' ideas and build on them productively through their own ideas, and a privileged way in which this can be done is by means of dialogue. This can be achieved, for example, through interacting with an expert (Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001; Graesser, Person, & Magliano, 1995) or with a peer (Barron, 2003; King, 1999; Soller, Lesgold, Linton, & Goodman, 1999; Webb, 1989). Also, regardless of whether learners engage in discussion whilst they are active or constructive together or simply discuss without doing, the discriminating factor that makes the activity interactive is the fact that learners attend to what the others say (and, possibly, do), and build on that through productive discussion. Chi (2009) argues that being interactive is more beneficial to learning than being constructive (Roscoe & Chi, 2007), active (Mastropieri, Scruggs, Spencer, & Fontana, 2003) or passive (Ebert-May, Brewer, & Allred, 1997). This is argued to be because being interactive is more beneficial to learning than being constructive (and therefore also more beneficial than being active or passive) because it involves not only the creation of new output, but also the articulation of one's ideas and the incorporation of feedback and new perspectives into the new output.

One of the values of the framework proposed by Chi (2009) resides in its ability to encompass and organise ideas that had already presented in other models, such as the one in Marshall, Price & Rogers (2003). Marshall and colleagues base their model on the distinction proposed by Mellar and Bliss (1994) between two ways in which students can engage with technology to support science understanding, namely by being exploratory and by being expressive. In the former case, learners explore a model that is presented by a system; in the latter case, learners create their own representations by using a system.

Marshall and colleagues apply this distinction to the study of tangible technologies and they argue that both exploratory and expressive are valuable ways for children to learn through tangibles: being expressive allows learners to make their understanding explicit, thus making it easier for them to identify misconceptions or gaps in knowledge, while being exploratory allows learners to gain an understanding of a correct model in a knowledge domain.

The definition of expressive and exploratory interaction resembles the definition of being active and constructive expressed in Chi (2009): being exploratory is similar to being active in that the learner manipulated a set of pre-existing material; being expressive is similar to being constructive in that the learner constructs some form of novel output. However, it is worth noting that, unlike Chi, Marshall, Price & Rogers (2003) do not argue for the value of one mode over the other, as they simply suggest that supporting a combination of the two modes might be the best way to support children's learning. Moreover, the Marshall et al. model is limited to descriptions of activities which are performed with the support of tangible technology, while Chi's definitions can be applied to both activities which are meditated by any type of technology as well as unmediated activities.

Finally, Chi's framework (2009) includes another way in which students can engage with learning, namely being interactive. The important dimension of being interactive is that learners construct a shared understanding of, most notably through dialogic activity. Like Chi, others have stressed the importance of discussion for learning, where learners build on each others' contributions meaningfully with the aim of achieving a shared understanding (Azmitia & Montgomery, 1993; Barron, 2003; Brown & Palincsar, 1989; King, 1999; Roschelle & Teasley, 1995; Schwartz, 1995; Soller et al., 1999; Webb, 1989). It has been demonstrated that sustained idea articulation through interactive dialogue effectively promotes learning because it makes ideas explicit and shared (Scaife & Rogers, 1996), thus providing a platform for these ideas to be understood by collaborators. This shared understanding is richer and deeper than the original ideas that were articulated by the different individuals participating in the discussion through articulation (Schwartz, 1995).

As this brief review shows, the framework proposed by Chi (2009) presents concepts which have been largely discussed and validated in the learning literature over the past couple of decades under various names and definitions. Therefore, while the value of this framework does not necessarily reside in its originality, it can be said to be particularly useful in bringing together a spate of findings from a variety of domains under a unified construct. This makes it a broad and encompassing framework which describes activities occurring both within and outside technology. For example, learners can be active with technology by pausing or rewinding a video, but they can also be active with the mediation of 'traditional technologies' by underlining some paper based text, or browsing and bookmarking a book; they can be constructive by creating an interactive diagram using a specifically designed system, or they can do so with pen and paper; finally, they can be interactive by co-constructing a text or a drawing with or without technological support, and their discussions can be mediated by a technology environment or simply take place in a face to face modality.

Finally, besides being applicable to a broad range of (technology and non-technology based) contexts, the framework also allows the formulation of specific predictions on the value of different types of overt activities based on the type of cognitive processes they entail. Specifically, the framework advocates the superiority of being interactive over being constructive (as well as over being active and passive), of being constructive over being active (as well as over passive), and of being active over being passive.

2.2 The benefits of resourcing children's collaborative storytelling

As the framework presented in Chi (2009) describes, providing learners with opportunities to manipulate presented resources (i.e., to be active) and to complement them with their own self constructed representations (i.e. to be constructive) encourages them, respectively, to attend to and to elaborate on the presented material. However, the question remains open as to how to resource children's storytelling in order to enable them to be active and constructive, and whether this does indeed benefit their storytelling in a collaborative context. The next two sections discuss these issues and conclude with a formulation of the first two research questions addressed by the work conducted for this thesis.

2.2.1 Supporting children's storytelling with presented resources

Although research has investigated how learning can be promoted by providing different types of external representations in a variety of learning domains (Ainsworth, 2006), resourcing children's storytelling when they are encouraged to actively manipulate these resources still remains a relatively unexplored domain.

Most research on resourcing children's storytelling has focused on activities where children passively (in the sense defined by Chi, 2009) look at story resources such as picture sequences or picture scenes, and are asked to tell a story based on these resources. It has been claimed that providing young children with a sequence of story pictures is a more effective way of eliciting better storytelling than simply providing a picture story scene. Pearce (2003) found that children using sequences of pictures representing a story produced longer, referentially more complex and evaluatively richer stories than children provided with a story scene only. Interestingly, similar results were found with a population of elderly participants (Duong & Ska, 2001). Finally, Berman (1995) found that six and seven year olds benefit more than pre-schoolers from being provided with sequences of story pictures, as it is not until this age that children are capable of moving beyond the tendency to describe pictures rather than producing plot driven stories.

Children have also been found to tell better stories when the picture sequences they are presented with are problem based, i.e. they represent a story where a problem drives the entire plot, than when they are event based, i.e., they represent a variety of episodes which are not unified by a plot driving problem (Hudson & Shapiro, 1991). Moreover, it has been found that allowing children to preview the picture sequence before they tell their story, as allowing them to see the pictures sequence while they tell their story leads to better understanding of the overarching theme of a story, and therefore to the production of more referentially complex stories (Hudson & Shapiro, 1991).

Hudson and Shapiro (1991) argue that children may be aware of the referential requirements of a good story, i.e., that a story needs to include the statement of a setting, an initiating event, a reaction, attempt to solve the problematic event, and a resolution (Stein and Glenn, 1979), but they find it hard to do so if they are also required to invent or remember a story. However, making a story based on given story pictures, and being able to access these pictures while they tell their story facilitates the storytelling task, thus leading to more referentially complex storytelling.

These findings indicate that providing children with structured resources benefits their storytelling. However, research is still needed in order to investigate how to resource children's storytelling by providing them with opportunities to be active and constructive. Moreover, the potential for children to be active and constructive with resources has not been explored in a collaborative context. Therefore, question emerging from this literature is:

> Research Question 1: *What are the features of good resources for children's collaborative storytelling?*

2.2.2 Supporting children's collaborative storytelling with self constructed representations over presented resources

The value of encouraging learners to construct their own representations over presented resources has been illustrated in Chi (2009), who defines this activity as being constructive, and argues that doing so is beneficial for learners because it presumably involves attending and elaborating to the presented resources more than if they were passively receiving these resources.

Although research has investigated how learning can be promoted by encouraging learners to construct their own representations in a variety of domains, such as learning about statistics (Bodemer et al., 2004), structural and functional systems (Ainsworth &

Iacovides, 2005; Ainsworth, Musgrove, & Galpin, 2007), or learning how to construct an argument (Suthers & Hundhausen, 2003), the question remains open about the value of encouraging children to construct their own representations to benefit their storytelling.

Practice based research offers qualitative evidence to suggest that asking children in their early years of primary education to complement a presented set of story pictures with their own, self constructed drawings leads to richer and better structured story writing (Caldwell & Moore, 1991; Dietz, 1976; Ernst, 1997; Karnowski, 1986; Steele, 1991). These studies provide valuable evidence based on teachers' practice in schools and therefore suggest that this type of task is not only beneficial to children's storytelling, but is also a familiar one for teachers and children. However, the anecdotal nature of the evidence requires that further systematic work is carried out in order to complement and support this evidence, as well as to further understand how to encourage children to produce their own content in order to scaffold their storytelling.

Literature on story comprehension also provides some additional evidence, although tangential to the story production task examined here, of the value of encouraging children to integrate a presented set of story pictures with self constructed representations. Studies by Lesgold, DeGood and Levin (1977), Constantino (1986) and Fisher (1976) demonstrate that when children are asked to integrate a presented picture based story with their own representations (e.g., by creating drawings, or painting cut-out figurines and arranging them onto an existing story scene), their story comprehension is significantly improved.

These findings suggest that encouraging children to complement provided resources with their own, self constructed representations benefits their storytelling. However, systematic research is still needed in order to investigate how doing so is beneficial to children's oral storytelling, especially in relation to their stories' referential complexity, evaluative richness, and coherence. Therefore, question emerging from this literature is:

> Research Question 2: *Does encouraging children to construct their own representations over provided resources lead to better collaborative storytelling than just manipulating these resources?*

2.3 *The benefits of collaborative storytelling*

Chi (2009) argues that one of the most effective (and overtly observable) ways in which learners can be interactive is by engaging in dialogic discussion where ideas are not only articulated, but also attended to and expanded on by collaborators. Being interactive is beneficial to learning because it involves the articulation of one's ideas and the incorporation of feedback and new perspectives into the new output.

Specifically to the domain of storytelling, children's ability to produce good stories has been shown to be improved by interaction with others. This has been argued to be true for both the case of children interacting with adults and with their peers.

2.3.1 *The benefits of adult-child collaboration for storytelling*

Research investigating the role of parental guidance shows that parents are often found to scaffold children's storytelling in a variety of contexts, such as shared book reading and family conversations, for example by prompting them to articulate their ideas more clearly.

Heath (1983), Fivush and Fromhoff (1988) and Stein and Levine (1989) found child-adult collaboration to benefit children's production of richer stories. Specifically, when mothers used specific linguistic and narrative devices such as orientations, temporal and causal language, and direct speech in their co-narations with their children, this was greatly beneficial for the children's later development of language and literacy skills (Fivush, Haden, & Reese, 2006). McCabe and Peterson (1991) also found that when parents scaffolded children's storytelling through open ended question prompting (for example with causal and temporal questions, such as "What happened when we went to the zoo?"), their children's stories were more complex and rich than when parents used close questions (such as "Did you like going to the zoo?"). Moreover, maternal praising and further enrichment of their children's contributions through details and further prompting has been found to encourage children's engagement in storytelling (Fivush, Hade, & Reese, 2006). Finally, scaffolding through open ended questioning by an adult has been found to promote the development of children's memory (McCabe & Peterson, 1991) and perspective taking abilities (Fivush & Fromhoff, 1988).

More recently, research has focused on how to achieve the benefits of adult guidance through the use of external resources which are designed to act as a more able other, i.e., as a scaffold to help students achieve a level of reflection and elaboration which is within their own 'zone of proximal development' (Vygotsky, 1978). Popular research methods which involve using external resources to prompt learners to engage in interactive discussion include the Reciprocal Teaching (Brown & Palincsar, 1989; Palincsar & Brown, 1984), and the Paired Reading (Christie et al., 2009; Topping, 1995; Yarrow & Topping, 2001) methods. The former involves the use of paper based prompts to encourage learners to engage in interactive discussion through questioning, clarifying and summarizing the presented learning material, while the latter involves prompting learners to take turns at articulating their understanding of the learning material to each other.

The Guided Reciprocal Peer Questioning method (King, 1990, 1994, 1999) has also been demonstrated to be an effective way of scaffolding peer interaction. The method involves pairs of students alternating between playing the role of the 'questioner' and that of the 'explainer' in learning about presented learning material. The method has been used in a variety of content areas to promote knowledge articulation and elaboration (i.e., interactive discussion), and its effectiveness has been demonstrated in numerous studies with students from fourth grade (nine to ten years old) through to higher education learners (King, 1990, 1994, 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998).

2.3.2 The benefits of peer collaboration for storytelling

It has also been argued that children not only benefit from interacting with adults, but with their peers as well. In peer learning, children feel more comfortable expressing their ideas than with an authoritative figure, such as an adult teacher: when working with a peer, children are more likely to question each others' contributions, propose alternative ones, request help as well as provide help through explanations that are understandable by their peers (Webb, 1989). These benefits have been ascribed to the fact that peers share a common perspective, understanding and language (Webb, 1989). In the domain of storytelling, Huard & Hayes-Roth (1996) found that although children are able to use puppets to construct stories both with peers and parents, they engage in more open-ended make believe play with their peers than with adult partners. Neuman and Roskos (1998) also found that when children play together in a literacy rich environment, they naturally scaffold each other by negotiating the meaning of literacy-related objects and routines, and this has been argued to benefit the children's literacy skills.

As Gelman, Massey and McManus (1991) put it, peer interaction provides a bridge between how children are expected to think and perform in formal learning contexts and how they operate in an informal setting such as during peer interaction. Daiute and Dalton (1993) also argued that because peers share a common perspective, understanding and language, their discussions are more productive. Peer learning presents many benefits for the development of children's academic abilities because it enables them to perform in a context where they are free to negotiate and integrate perspectives in an informal, exploratory way (Cook-Gumperz, 1986; Gelman, Massey, & McManus, 1991). This has been found to be particularly true for tasks designed to encourage increasing awareness of inert knowledge over tasks involving exposure to new knowledge (Daiute & Dalton, 1993).

The notion that peer collaboration especially benefits learners with tasks where they already have some inert knowledge but need support using it, is particularly relevant for the storytelling domain examined in this thesis, as children in the early years of primary education have a fairly mature appreciation of what constitutes a good story (Stein and Policastro, 1984), but their ability to produce well formed stories is still developing (Applebee, 1978; Bamberg & Damrad-Frye, 1991; Hudson & Shapiro, 1991; Kemper, 1984; Kernan, 1977; Peterson & McCabe, 1983, 1991, 1997; Trabasso, Nickels, & Munger, 1989). Therefore, because storytelling does not involve exposure to an unfamiliar task or new knowledge, where adult guidance would be most suitable, it seems reasonable to assume that peer collaboration is a highly beneficial way of supporting children's storytelling.

Another reason to study children's peer collaborative storytelling is the pervasiveness of this activity to children's culture. As anyone observing children telling stories together can attest, children find it enjoyable and motivating to tell stories together with their peers. This has been reported both in informal contexts, such as make-believe play (Galda & Pellegrini, 1985) and trips to school (Preece, 1992) as well as more formal contexts such as during school hours are also reported in the literature (Cook-Gumperz, 1986; Daiute & Dalton, 1993; Devescovi & Baumgartner, 1993).

Preece (1992) observed that when children have known each other for a while and have been exposed to opportunities to tell stories together, they find it natural to interact with each other in order to tell good stories. Her case study explored children's collaborative storytelling in an informal context (i.e., car sharing trips to school), and noted that children spontaneously offered each other criticisms and suggestions for story improvement. Therefore, the case study provides exploratory evidence that children's storytelling benefits from peer collaboration.

A study by Hayes and Casey (2002) complements Preece's work (1992) by measuring the quality of the stories produced by three and five year old children in dyads and individually. They found that stories of five year old dyads were longer and contained more characters than those produced individually. The authors explain this by arguing that in groups, individuals correct and extend each others' discourse, and this leads to the production of better stories.

However, Hayes and Casey (2002) also point out that the stories told by the children individually were more coherent, as the individual story ideas were better connected with one another. Hayes and Casey argue that it was easier for the children telling stories individually to maintain coherence because the individually produced stories were shorter and less complex. This is an important finding because it suggests that, although collaboration might promote richer storytelling, this might be to the expense of the stories' coherence. Therefore, some additional scaffolding might be needed in order to encourage children to build on each others' ideas coherently. Since articulating and discussing each others' ideas has been found to benefit collaboration (Barron, 2003; Chi, 2009; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996; Wegerif, 1996), encouraging learners to engage in interactive discussion might promote the production of more coherent stories, as well as richer ones.

Daiute and Dalton (1993) compared children's individual story writing after dyadic story writing and after individual story writing, and found that children told significantly better individual stories after writing a story together with a peer. Daiute and Dalton claim that this was due to children being exposed to their peers' story writing abilities, which often complemented their own, thus enabling them to expand their skills repertoire. They argue that the improvement in children's abilities to tell a story was due to the productive interaction that took place during paired story writing: because the children were able to externalize their ideas through discussion, these were iteratively extended and refined, thus providing a model for subsequent individual productions, where the newly internalised expertise was drawn upon in order to produce better stories.

Finally, Devescovi and Baumgartner (1993) explored the benefits of peer collaboration for children's storytelling: they analysed how dyads and triads of three to five year old children interacted with each other during story-making and found that when they engaged with each other during story making, the children eventually told stories which included more descriptions of characters and their actions.

Overall, these studies indicate that peer collaboration effectively supports children's storytelling. However, this is conditional to children engaging in interactive discussion. When they are asked to make a story together, children who engage in interactive discussion tell better stories than children who do not (Devescovi & Baumgartner, 1993) and also longer and richer stories than children who work individually (Hayes & Casey, 2002); moreover, when children write stories together, they subsequently write better stories individually (Daiute & Dalton, 1993). Preece (1992) also notes that, although the children in her case study were observed to provide suggestions for each other on how to improve their story, they were not always prepared to discuss or include each others' suggestions in their stories, even when these would have led to an improvement to the story.

This emphasis on the importance of interactive discussion in promoting effective collaboration has been stressed by many outside the storytelling domain as well. Many researchers have argued that the quality of interaction peers engage in affects the outcome of the collaboration, with the benefits of collaboration being conditional to learners articulating and engaging with each others' ideas (Chi, 2009; Dillenbourg & Traum, 2006; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996; Wegerif, 1996; Yarrow & Topping, 2001). Moreover, it has been argued that although children may articulate ideas for each other, they may still engage in unproductive collaboration, where ideas are suggested, but not subsequently negotiated, and ultimately disregarded (Barron, 2003).

2.3.3 Scaffolding children's collaborative storytelling: Research Questions

Therefore, it is important to note that effective peer collaboration might need scaffolding. As the literature on adult-child storytelling shows, children's reflection and encoding of information into well structured and rich stories needs to be prompted by open ended, elaborative style questioning. In the context of peer collaborative storytelling, this might be achieved through external scaffolding by an adult (Fivush & Fromhoff, 1988; Fivush, Hade, & Reese, 2006; McCabe & Peterson, 1991).

However, this can also be achieved through the use of external resources designed to act as a more able other (Brown & Palincsar, 1989; Palincsar & Brown, 1984; Christie et al., 2009; Topping, 1995; Yarrow & Topping, 2001). Most notably, King and colleagues found that the use of question prompts facilitates reflection and elaboration (King, 1990, 1994, 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998).

To conclude, it can be argued that although peer collaboration is an effective way to improve children's storytelling, asking children to make a story together does not necessarily mean that they will engage in interactive discussion, and therefore produce good stories. As children do not always engage in interactive discussion when making stories together, the question emerging from this literature is:

> Research Question 3: *Does encouraging children to engage in interactive discussion whilst making stories lead to better collaborative storytelling?*

This question is addressed by investigating how a "more able other", both through an adult mediation and through external resources replacing the adult's role, can promote children's collaborative storytelling by encouraging their engagement in interactive discussion.

Finally, having investigated the potential benefits of scaffolding children's collaborative storytelling by encouraging them to engage in interactive discussion, this thesis investigates whether good collaborative storytelling will be maintained even after direct support has been withdrawn. Children's ongoing engagement in interactive discussion once they are no longer encouraged to do so through scaffolding would suggest that they have internalised the means through which to engage in interactive discussion (Wood, Bruner, & Ross, 1976). Therefore, this thesis asks the final question:

> Research Question 4: *Do children continue to engage in and benefit from interactive discussion once they are no longer encouraged to engage in it?*

3. Children's storytelling and technology

3.1 Introduction

This section reviews how technology can provide a range of resources for children and it examines how these opportunities may benefit their collaborative storytelling. Many have argued for the value of using technology as a scaffolding tool (Quintana et al., 2004; Sherin et al., 2004), and the idea that technology can be used to support learners by transforming a task in order to make it more accessible and productive for learners has become increasingly important in the design and evaluation of pedagogical scenarios. Specifically, Quintana et al. (2004) stressed how technology can help simplify a task, for example by providing constrained resources which learners can focus on. Technology can also provide rich tools for transforming a task in order to allow learners to manipulate and modify representations to include new ideas or to make connections explicit. By allowing learners to make ideas explicit through the establishment of connections and the manipulation of representations, these tools can facilitate interactive discussion in collaborative learning situations, where ideas are not always spontaneously articulated and discussed (Cohen, 1994; Webb, 1989).

The focus of the review is on whether the different storytelling systems are effective at promoting children's collaborative storytelling by providing resources for them to be active and constructive. Specifically, the review considers whether being active and constructive through storytelling technology encourages children to tell referentially complex and evaluatively rich stories, as well as stories where children build on each others' contributions coherently. The storytelling technologies are also reviewed with respect to whether children engage in interactive discussion with each other when using them to make stories together.

By defining the space of existing technologies for children's storytelling and discussing how their different features benefit children's storytelling, this review is aimed at motivating the choice of two technologies, i.e., StoryTable and KidPad, which have been used throughout my thesis work. Apart from the obvious constraint of the technologies being available to me at the time of the work carried out for this thesis, the choice of these technologies was motivated by the fact that they included the key design features evaluated in the technologies reviewed here.

Specifically, StoryTable provided the opportunity to explore how encouraging children to engage in the active selection and positioning of story characters and settings would facilitate their collaborative storytelling. StoryTable also allowed for the active arrangement of recorded story material into different sequences, which was expected to promote reflection on the story structure. Finally, StoryTable's recording tool provided an opportunity to explore how children's active construction of content would promote discussion and reflection.

KidPad also provided intereting opportunities to investigate the potential benefits of encouraging children to construct their own representations. In the case of KidPad, the content constructed was in the form of permanent drawings which were expected to promote interactive discussion and collaborative storytelling.

Moreover, the analysis of children's use of StoryTable and KidPad allowed for the investigation of children's ability to benefit from these technologies with and without additional support around the technology.

Therefore, although other storytelling systems have been reported to be used to support children's storytelling, such as Kidsroom (Bobick, Intille, Davis, Baird, Pinhanez, Campbell, Ivanov, Schutte, & Wilson, 1999), Triangles (Gorbet, Orth, & Ishii, 1998), Pogo (Decortis, Rizzo, & Saudelli, 2003), Ghostwriter (Robertson & Good, 2003), Renga (Cassell & Ryokai, 2001), Rosebud (Glos & Cassell, 1997), SAGE (Bers & Cassell, 1998), Sam (Ryokai, Vaucelle, & Cassell, 2003), AR-Jam (Dünser & Hornecker, 2007), in the interests of brevity and focus these systems are not included in this review. This is because these systems do not provide much additional insight into the choice of the storytelling systems selected for this thesis, either because they present similar features (thus making their review redundant), or they do not include the features of interest here (thus making their review irrelevant).

3.2 Review of existing storytelling technologies for children

This section reviews storytelling technologies which allow children to actively manipulate story settings and characters, and to create their own representations, through audio and drawings. Each technology is described, and existing literature is briefly reviewed to show how these systems might benefit children's collaborative storytelling. This section is concluded by examining the relevance of the evaluations with respect to the research questions addressed in this thesis.

3.2.1 Graphic StoryWriter

Graphic StoryWriter is a desktop based application for children's storytelling, where children can select from a number of characters and props by dragging and dropping these elements into a work area. In order to make the storytelling activity more engaging, visual and audio effects are also triggered as a result of children's selection (for example, when a character eats a pear, the sound "yum yum" is triggered'). Additionally, children can specify a character's attribute (e.g., nice, mean, timid, greedy, helpful, silly, etc.) from a pre-defined list of possible options (see Figure 1).

As a result of children's selection, story text is automatically generated by the system based on the attributes of the character or prop as well as on previous events in the story. The system is designed to generate stories which contain a goal: for example, if the child selects 'shy' as an attribute for his main character, the system generates a story where the character's goal is to make friends; if the child selects the attribute 'hungry', the character's goal is to find some food, etc. Graphic StoryWriter also generates 'reminders' for children to make their subsequent selections according to the story goal in the form of sentences such as "The boy is still looking for some food". Finally, the system includes an Authoring Tool for teachers and parents, where new stories can be created by associating characters, props and attributes to newly generated story segments.

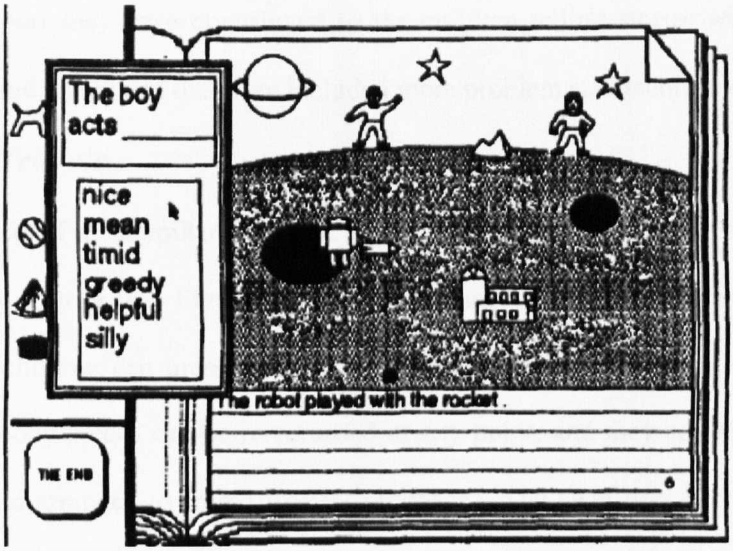

Figure 1. Character attribute selection in Graphic StoryWriter.

An evaluation study (Steiner & Moher, 1992) compared the stories produced by six year old children using Graphic StoryWriter and those produced by children using a pen and paper set of equivalent characters and props, and found that the children who used the system produced referentially more complex stories (i.e., the stories contained more events which included the statement of a problem and its resolution). Steiner and Moher argue that this was because the system provided opportunities for children to choose their characters' attributes, therefore encouraging them to engage more in the process of deciding the content of the story.

This evaluation study suggests that providing resources for children to actively manipulate (for example by selecting and arranging story settings, characters and props) may benefit their storytelling. However, it is important to note that this was not the only added support the children had when they played with Graphic StoryWriter. Unlike in the pen and paper mock-up, when the children played with Graphic StoryWriter they also benefited from the pre-established association between the choice of a character attribute and the character's goals, as well as from the automatic goal reminders generated by the system. Also, the system provided reminders for the children to base their subsequent selections on the characters' goals, therefore ensuring that a resolution is included in the story. These forms of additional support may have contributed to the children telling stories which were better structured around a goal and therefore included more problem statements and resolutions.

3.2.2 TellTale

TellTale consists of a caterpillar toy made of six parts, namely five body parts and a head, which embody a story (see Figure 2). Each body piece is coloured differently, and has a button which children can press in order to record a part of their story lasting up to 20 seconds. The body pieces can be re-recorded at any point, and they can be detached from one another and arranged to form different sequences. The head part of the caterpillar toy can be attached to the rest of the body and this action results in the story to be played back in its entirety according to the sequence in which the different story parts are assembled.

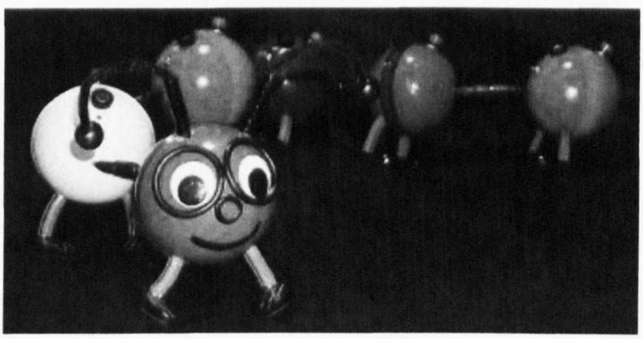

Figure 2. TellTale.

Research shows that the system is a valuable help in encouraging children's storytelling (Ananny, 2002; Ananny & Cassell, 2001) in their early years of primary education. Playing with TellTale was found to be engaging for children: they were observed to take advantage of the opportunity to play back the individual story parts they had recorded in order to ensure they were satisfied with their recording. The children were also observed to re-record their story parts if they were not satisfied with the quality of the sound or the content of the recording.

Ananny (2002) also observed that children playing with TellTale built coherently on each others' contributions by extending each others' ideas and using syntactic features to bind the different recordings together. Ananny argues that this was facilitated by the opportunities provided by the system to play back individual story parts and re-record them if the children felt their initial recording could be improved upon. It is also argued that the children's storytelling was supported by the fact that the system allowed them to construct different sequences in order to explore how to improve their stories.

This evaluation study suggests that providing resources for children to create their recordings with and to review then and assemble them into different story sequences benefits their collaborative storytelling. However, it is worth noting that the children using TellTale had access to additional guidance in the form of a facilitator suggesting themes on which their story could be based (e.g., TellTale was lost in the forest and met a new friend) and prompting the children to develop and discuss their story around the given theme through open ended questions (e.g., What kind of creature did he meet? What's the forest creature's name? Where did he meet his friend?). This may have contributed to help the children organise their contributions around a central theme, thus appearing to be building on each others' contributions.

3.2.3 Jabberstamp

Jabberstamp allows children to make stories by constructing drawings and integrated sound recordings. It consists of a Wacom tablet, two modified Wacom pens, speakers and a microphone connected to a PC (see Figure 3). A piece of paper is placed on the tablet, where children can draw their story, and recordings are made through pressing a 'rubber stamp' with an integrated microphone onto their drawing. This results in the rubber stamp leaving a star shaped sign on the drawing, to remind the child that a recording has been made relating to that part of the drawing. Children can play the sound back as many times as they like by placing a technology enhanced 'trumpet' on the star sign; if multiple sounds are triggered, their audio playback is mixed together, and echo effects can be created by triggering the same sound file repeatedly.

If a child wants to create another drawing to continue the story, they can press a button on the side of the tablet indicating where the present drawing is situated with respect to the rest of the story, thus determining how the drawings are sequenced as if they were paged in a story book.

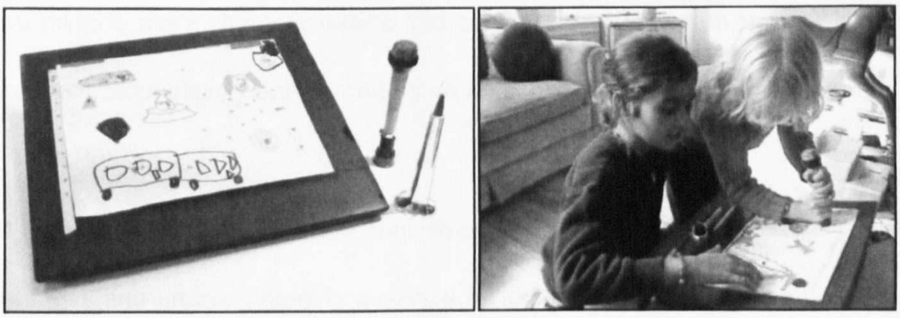

Figure 3. Jabberstamp interface and children playing with the system.

In their evaluation of the system, Raffle, Vaucelle, Wang and Ishii (2007) note that children enjoy making stories together with Jabberstamp, and that the system is a valuable way to encourage children to reflect on their stories and to improve them. They also conducted a case study where a pair of children (an eight year old and a four year old) made a story together using Jabberstamp and found that they engaged with the system and the storytelling task for an extended period of time, and that they created large quantities of drawings and recordings. Raffle and colleagues note how the drawings created in Jabberstamp provided opportunities for children to verbalise their ideas and how the recordings were often reviewed and edited if the children felt that these could be improved.

Raffle, Vaucelle, Wang and Ishii (2007) argue that the value of the system in supporting storytelling lies in the fact that it provides opportunities for children to construct their own representations through drawings and to enhance them through audio, and in the fact that it allows children to review their recordings at any point of their storytelling process. However, the evaluation does not report on the quality of the stories produced, thus leaving the question open as to the specific benefit of providing opportunities for children to create drawings and recordings together in terms of collaborative storytelling. Moreover, the authors suggest that the stories produced relied on the assumption that the audience would be able to access the drawings along with the sound, thus suggesting that the story recordings would not have been sufficiently articulate as a standalone product to allow an audience to understand them. Finally, the authors recognise the need to investigate how additional support in the form of embedded guidance within the system might encourage children to include more characterisation and contextual information in their recordings so as to make them more clearly understood by an audience (Raffle et al., 2007).

3.2.4 Puppet

Puppet is a desktop based application consisting of a work area called 'stage', where three characters move and interact, namely a cow, a farmer and a sheep. The cow and the farmer are autonomous agents, while the sheep is an avatar which the children can control when making their story. The cow and farmer agents are endowed with a set of different states (e.g., high status, low status) and attitudes (e.g., positive, negative), which can be selected and combined to form different configurations associated with specific facial expressions, gait and sounds (see Figure 4); the sheep avatar can be in a positive, negative or neutral state and is used by the children as an avatar to explore the story world.

Children can interact with the system in four modes: in the Audience mode, children simply watch the unfolding of a system generated story where the two agents interact with each other; in the Actor mode, children move the sheep avatar on the stage, and determine its interaction with the two agents; in the Scriptwriter mode, children stop the story at different points and record pieces of dialogue among the characters; in the Editor mode, children review the dialogue they have previously created in the Scriptwriter mode and edit it if they wish to.

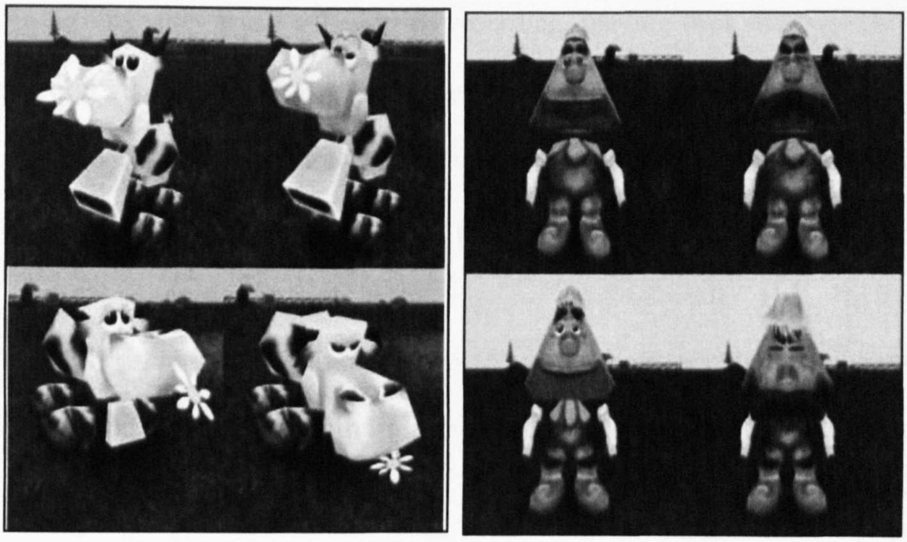

Figure 4. Different characters' states in Puppet.

Puppet was evaluated in a study where seven and eight year old children's collaborative storytelling was compared in the four available modes (Marshall et al., 2004). In all four modes, an adult facilitator was present to provide additional support. He is reported to have regularly asked the children questions about the salient features in the story, such as characters' goals and internal states and attitudes.

In the Audience mode, where children are 'passive' recipients of the system generated story, Marshall et al. (2004) found that, although the children were able to reflect on the characters' states and attitudes, they were not very engaged with the storytelling process and they did not discuss the story as much as they did in the other three contexts.

In the Actor mode, where children can 'actively' select the characters' states and attitudes and position their sheep avatar, the authors found that children often discussed the story with respect to how the characters' appearance related to their goals and behaviours (e.g., "I like it when it's angry because it looks like it's going faster…"). However, the authors note how children's interactions were rarely prolonged enough to allow for sophisticated reflection on the characters' goals and strategies to achieve these goals.

Finally, in the Scriptwriter and Editor mode, children can 'construct', review and edit the dialogue between the characters and they can also play back their recordings. In the Scriptwriter and Editor modes, children were observed to be particularly engaged in the storytelling activity: they spent a long time recording, playing back and re-recording the characters' dialogues, as well as discussing their recordings. However, Marshall and colleagues also note how the children's discussions revolved mostly around how to improve surface aspects of their recordings, such as prosody and sound quality (Marshall et al., 2004).

This evaluation study suggests that providing resources for children to be active and constructive with may benefit their reflection on the story they are making, for example through engagement in interactive discussion. However, as the evaluation did not include a phase where children tell their story together, and extra guidance was provided through the facilitator's questioning, it is hard to conclude the extent to which providing opportunities for children to actively manipulate resources and to construct and review their recordings benefited children's collaborative storytelling.

3.2.5 Teatrix

Teatrix is a desktop based application which allows children to make stories throughout three different stages. In the Backstage phase, children prepare the 'scene' by selecting from a determined set of story settings, characters and props, and assigning a role to each of the selected characters. In the On Stage phase, children select a character each and use them as an avatar to explore the 3D scenes they had previously prepared (see Figure 5). During this phase, the system takes snapshots of the children's exploration for later review during the Audience phase, where children can be audience to their own productions by reviewing their characters' actions; should they wish to, children can use these snapshots as a basis to write their story on paper.

The system also includes a component called Director, which monitors the action on the stage, e.g., what they do, what props they hold, what other characters they encounter, and compares it to a Story World Model, where characters' goals and emotional states are stored based on their associated role. As the children's exploration of the story world unfolds, the Director checks that the character's goals are being pursued; if children are observed not to take actions towards the fulfilment of the goal for a prolonged length of time, the Director may decide to introduce a new object or even a new character in order to drive the plot forward. The Director can also freeze the action, thus making it impossible for the children to continue their exploration, and trigger the Reflection Tool. This consists of a pop up window which contains a reminder of the character's role and current emotional state, and a reflection prompt as well as any history of previous reflection prompts. Reflection prompts are aimed at encouraging children to carry out actions which reflect their character's emotional state and goal, by giving suggestions, such as "Why don't you pick up a stick and use it?", or "You are a villain and you should harm Linda", etc. (see Figure 6).

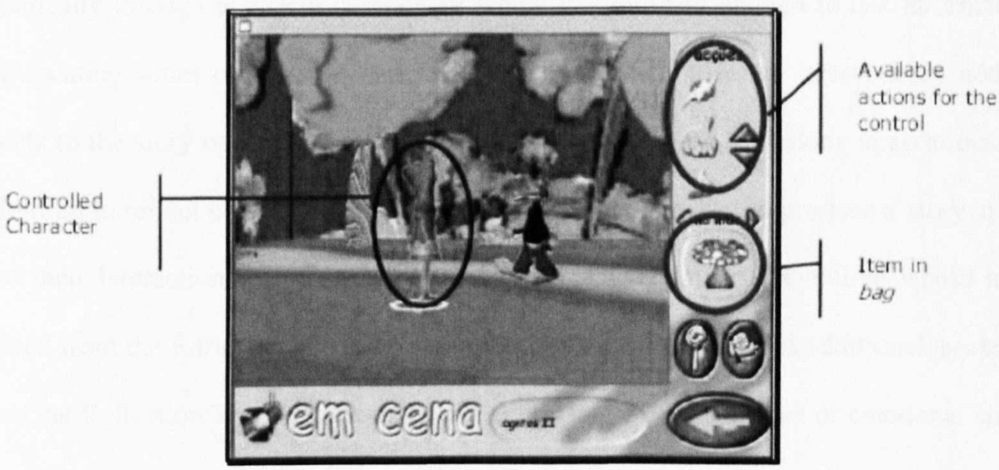

Figure 5. Character positioning in Teatrix

Figure 6. The Reflection Tool in Teatrix.

The system was evaluated with children ages between seven and nine, who played daily with the system in groups over an entire term. This group of children were compared to a group of children who carried out similar activities with their teacher prompting them to reflect but without using Teatrix. It was found that although in the first few weeks the children were observed to ignore the Reflection Tool, they gradually started to respond to it by producing elaborate justifications for their own character's actions and to take these into consideration when planning subsequent actions (Machado et al., 2001).

The evaluation of Teatrix shows that children can be encouraged to reflect on the character's goals and actions through prompting. It also shows that this can be done automatically through a system component which is intelligent enough to use information about updating states of the story world in order to decide when to intervene by adding elements to the story or freezing the action and asking questions or making suggestions for the children to reflect on. However, as the children were not asked to produce a story at the end of their interaction with Teatrix, it is not clear whether their storytelling would have benefited from the Reflection Tool. Moreover, the system also provides additional guidance beyond the Reflection Tool, by automatically generating a goal and a set of emotional states as a result of the children's attribution of a role to their character. Therefore, further work would be needed in order to establish the role of this additional support, why the Reflection Tool was initially ignored by the children, and its potential value in supporting children's collaborative storytelling.

3.3 Existing storytelling technologies for children: conclusions

The review of storytelling systems illustrated some examples of ways in which technology can resource children's collaborative storytelling, by providing opportunities for children to be active and constructive (Research Question 1). In relation to being active, children can actively manipulate and assemble characters and settings (Machado et al., 2001; Marshall et al., 2004; Steiner & Moher, 1992), and this type of engagement with existing story material has been found to be an enjoyable way for children to make and tell stories together.

Moreover, in Graphic StoryWriter, the opportunity to select and position characters and props appeared to be related to the production of better structured stories, and in Puppet this activity might encourage children's discussion about the characters' inner states and behaviours. Children were also observed to benefit from playing with Teatrix as they reflected more on their characters' motivations and actions. Therefore, it can be argued that providing similar types of resources for children to manipulate may be an appropriate way to support children's storytelling.

The review of storytelling systems has also provided a few illustrations of how technology can provide children with opportunities to construct their own representations, for example by creating audio recordings (Ananny, 2002; Marshall et al., 2004; Raffle et al., 2007) and drawings (Raffle et al., 2007), and also by arranging their recordings into different sequences (Ananny, 2002). These ways of being constructive have been found to be highly engaging possibilities for children to produce stories together. Therefore, it could be argued that providing similar types of resources for children to construct their stories (e.g., through audio, drawing, and sequencing) can be an effective way to support children's collaborative storytelling.

However, the children in the evaluation studies reported above also benefited from additional guidance: in Graphic StoryWriter, an automatic goal generation and prompting system was available to ensure that the children included a resolution to their stories; in TellTale, story suggestions and questions were provided in order to encourage children to shape their story coherently around a central theme; in Puppet, an adult facilitator prompted the children to reflect on salient aspects of the story; finally, in Teatrix, an automated Reflection tool was used to prompt children to reflect on their character's goals and emotional states.

Due to the presence of these additional forms of guidance, it is impossible to conclude that the active and constructive features of these technologies would have been sufficient to support children's collaborative storytelling. Therefore, further research is needed in order to explore the potential of this type of features alone, but also to investigate the potential value of providing additional scaffolding around technology in order to facilitate children's engagement in interactive discussion during story-making (Research Question 3). Finally, more research is needed in order to investigate whether the potential benefits of additional scaffolding to support interactive discussion can be maintained once this scaffolding is no longer provided (Research Question 4).

4. Choosing the storytelling technologies for this thesis

The choice of the storytelling technologies to be used throughout this thesis was informed by the lessons learnt from reviewing some of the existing storytelling technologies on the benefits of resourcing children's active manipulation of story material, their construction of own representations and their engagement in interactive discussion during story-making. The two technologies presented here – StoryTable and KidPad – were selected because they combined some of the elements featured in the systems described above, and therefore allowed for the exploration of the benefits of bringing these features together to support children's collaborative storytelling.

Similarly to Graphic StoryWriter (Steiner & Moher, 2002), Puppet (Marshall et al., 2004) and Teatrix (Machado et al., 2001), StoryTable provides children with a set of characters and settings which can be selected and arranged into story scenes for children to base their stories on. StoryTable also presents a commonality with TellTale (Ananny, 2002) and Jabberstamp (Raffle et al., 2007), as it allows children to create individual recording; like TellTale, StoryTable also allows children to arrange these into different sequences. The combination of these features in StoryTable allowed for the exploration of the potential benefits of providing resources for children to select and arrange and encouraging children to construct their own representations within the same technology. Given that these individual features were shown to be beneficial in combination with additional guidance, the StoryTable case study explores whether combining these features might be sufficient to support children's collaborative storytelling, without the need for additional guidance.

The choice of KidPad was partially informed by findings on Jabberstamp, showing that children are easily engaged with producing stories through drawings, and that they tend to articulate the ideas expressed in their drawings for each other as they draw. The choice of KidPad was also motivated by findings arising from the StoryTable case study, as well as unavailability of the StoryTable technology, which was still in its prototype stage, after relocation to Nottingham University.

4.1 StoryTable

StoryTable was developed at the Istituto per la Ricerca Scientifica e Tecnologica (IRST) in Trento, Italy, in 2003. The centre is now called Fondazione Bruno Kessler, and it is a research institute where new technologies are developed and evaluated in both a formal and informal learning contexts.

StoryTable was built on a large tabletop hardware called DiamondTouch (Dietz & Leigh, 2001), where a number of digital objects, also called 'widgets', are displayed. The interface is shown in Figure 7. Children can select from a number of available story settings and story characters and position the characters and move them around the selected setting. Children record their story into individual story segments (called 'Audio LadyBugs'), and they can play them back or re-record them at any time. Finally, children can arrange the story segments into different sequences (in an area called 'PlayList'), and play back the entire story sequence.

The widgets can be moved around with finger touch: children drag any widget anywhere on the horizontal display and drop it in its final position. These widgets represent story elements, such as characters and settings, and are 'contained' within larger widgets, called 'LadyBugs[4]'; one LadyBug contains several characters and the other LadyBug contains several story settings. When a child 'double taps' on one of the LadyBugs, this

[4] The name LadyBug is used to refer to the widgets, because their shape is similar to that of a ladybird. The American English word ladybug was used to express this similarity, as the British English expression was not known at the time of the system development process.

opens to display its content, i.e., a series of thumbnail pictures representing the different characters or story settings. When a story setting thumbnail is selected, the resulting image is displayed across the entire tabletop screen, and when a character thumbnail is selected, it can be dragged and dropped anywhere on the screen.

Additionally, another type of widget was designed, which allow children to record and store their story segments; these smaller widgets are called 'Audio LadyBugs' and represent different story parts. Children position one of the Audio LadyBugs onto a graphical representation of a microphone in the middle of the screen, and record their story part. A total of six Audio LadyBugs are available for children to record, and the maximum length of each Audio LadyBug is 30 seconds. When an Audio LadyBug is recorded, it takes a different colour according to which child has recorded it. Typically, two colours are available, blue and purple, and children decide which colour they want their own Audio LadyBug to take before they start playing with StoryTable. The content of the Audio LadyBugs can be played back at any time during the story-making process.

Finally, another type of representation was included into the system called 'PlayList', which consists of a representation showing a string of six empty slots, where the Audio LadyBugs can be positioned. Any Audio LadyBug can be positioned into a slot and moved onto any other slot at any time of the story-making process. The entire story can be played back by children touching the first Audio LadyBug on the PlayList; this results in the story being played back in the order in which the Audio LadyBugs are positioned in their slots on the PlayList.

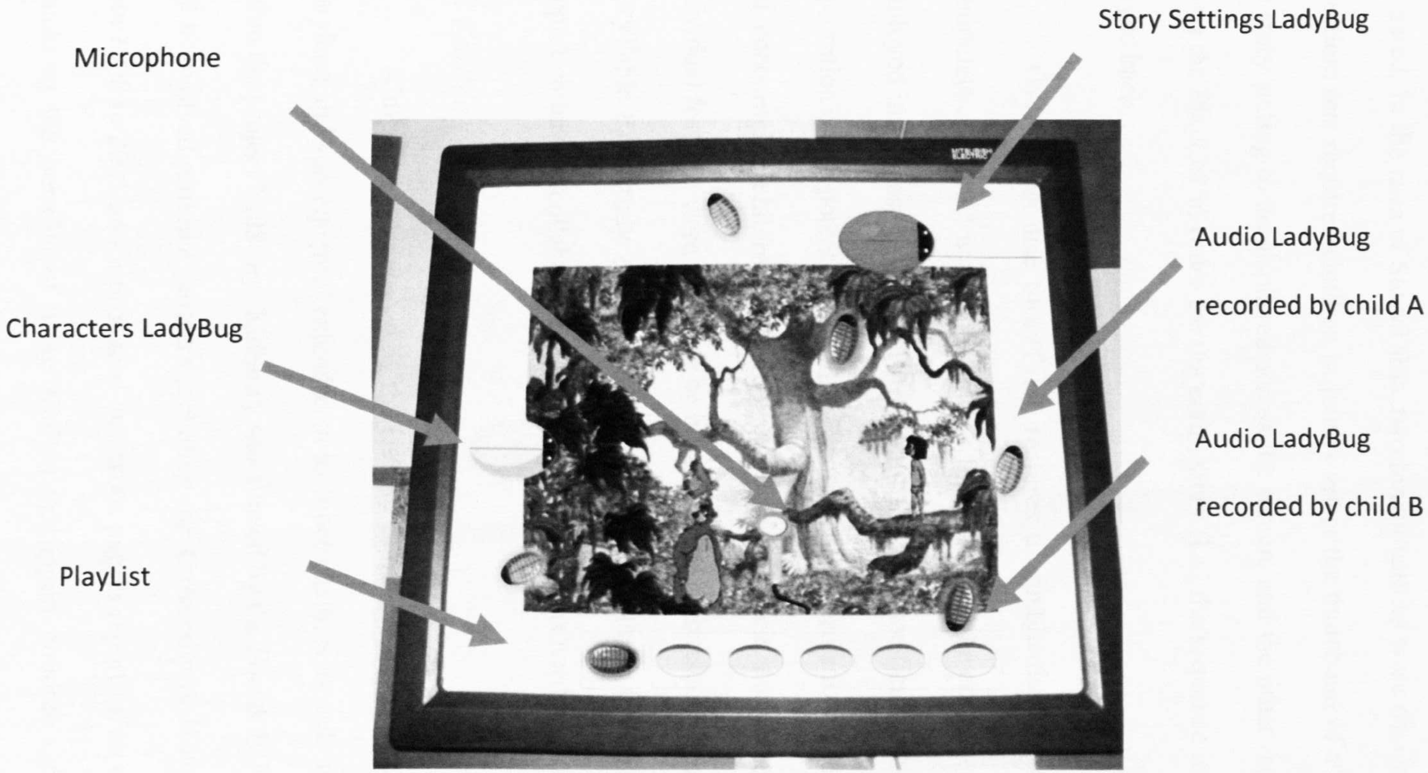

Figure 7. The StoryTable interface.

The Diamond Touch technology used for StoryTable was designed to support collaboration by providing simultaneous access to pairs of users (Dietz & Leigh, 2001). This enables two children to interact with the system at the same time. Moreover, specific functionalities can be designed which require joint selection from both users in order to be triggered. In the case of StoryTable, two functionalities were designed, which required joint selection: one required children to jointly select the thumbnail of a story setting in order for the story setting to be displayed across the screen, and the other required children to jointly select the PlayList in order for the entire story (i.e., the sequence of Audio LadyBugs) to be played back.

Overall, because StoryTable features a combination of resources for children to manipulate combined with opportunities for children to be constructive, this technology was employed in the case study presented in this thesis. Specifically, StoryTable allowed for the exploration of the potential benefits of providing resources for children to select and arrange and encouraging children to record and sequence their story segments. Given that these individual features were shown to be beneficial in combination with additional guidance, the StoryTable case study explores whether combining these features might be sufficient to support children's collaborative storytelling, without the need for additional guidance.

4.2 KidPad

KidPad was developed by the Human Computer Interaction Lab at the University of Maryland and subsequently extended in its functionalities as well as hardware compatibility within the project KidStory. KidStory was funded by the Fourth EU Framework Programme, and it involved multiple partners including the University of Nottingham. The project run from 1998 to 2001 and it produced numerous papers reporting on the findings from studies evaluating the benefits of using KidPad to support children's collaborative storytelling (Abnett, Stanton, Neale and O'Malley, 2001; Benford, Bederson, Akesson, Bayon, Druin, Hansson, Hourcade, Ingram, Neale, O'Malley, Simsarian, & Stanton, 2000; Stanton, Bayon, Neale, Ghali, Benford, Cobb, Ingram, O'Malley, Wilson, & Pridmore, 2001; Stanton, Neale & Bayon, 2002; Stanton & Neale, 2003).

KidPad is a drawing application which provides children with a number of tools that can be used to create drawings, enhance them with dynamic features and to navigate the drawing space (see Figure 8). Pictures can also be imported into KidPad and displayed across the screen, and children can browse through or draw over them. The basic tools for drawing consist in a set of different coloured 'Crayons', an 'Eraser' tool can be used to delete drawings, and an 'Arrow' tool for moving the drawings around the drawing space.

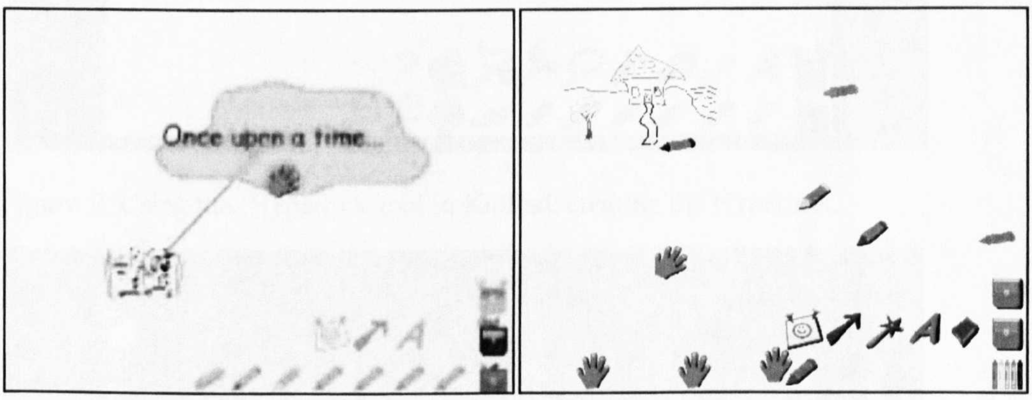

Figure 8. The KidPad interface.

The application provides an unlimited drawing space which can be navigated with the 'Hand' tool in the same way as a child's hand would move a piece of paper around. The 'Hand' tool is also used to trigger connections established with the 'Magic Wand' tool. The 'Magic Wand' is a hyperlinking tool which connects two elements (a source element and a target element) belonging to two different pictures. Once a hyperlink is created between a source element in one picture and a target element in another picture, clicking on it will show a transition from the first element to the second, ending in a full screen view of the latter. Figure 9 and Figure 10 illustrate the hyperlinking function being used to connect an element (a butterfly) in the picture of a monkey sitting in the forest to an element (a butterfly) in another picture of a monkey swinging on a tree in the forest. Clicking on the hyperlink takes the viewer from the first picture to a screen size view of the target element in the second picture.

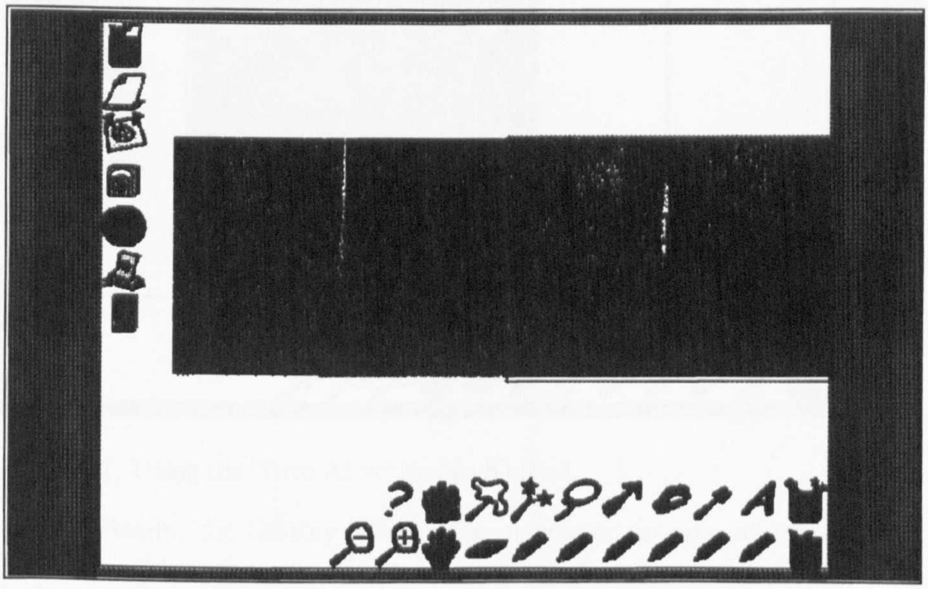

Figure 9. Using the 'Hyperlink'tool in KidPad: creating the Hyperlink.

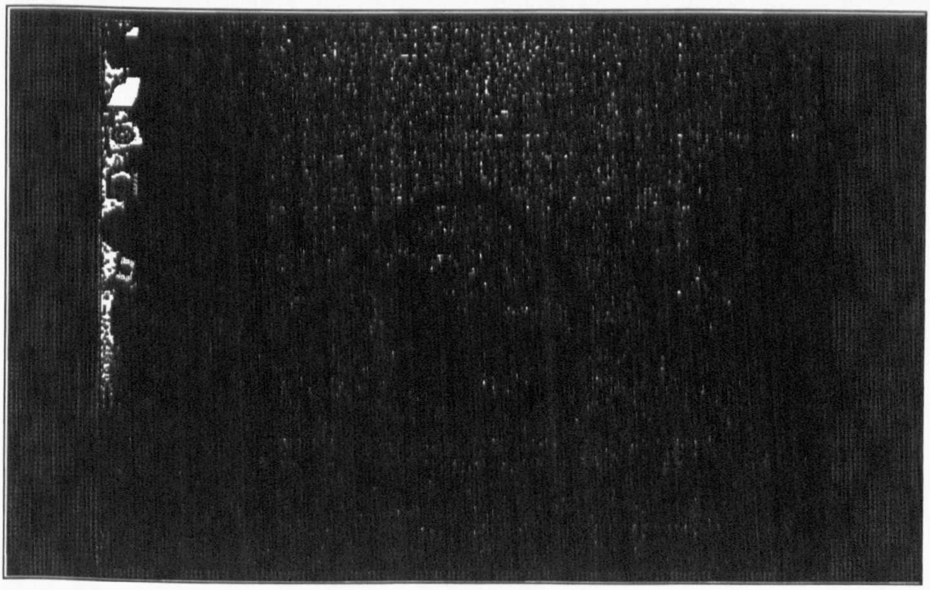

Figure 10. Making Hyperlinks in KidPad: the Hyperlink's target.

Two more tools called the 'Turn Alive' tool and the 'X-Ray Window' tool allow children to enhance their drawings. The 'Turn Alive' tool makes the parts of a drawing look as if they 'wiggled'. Figure 11 illustrates the use of the 'Turn Alive' function used to make a circle drawn around the monkey look 'wiggly'. The 'wiggly' line appears on the screen to move like a serpentine.

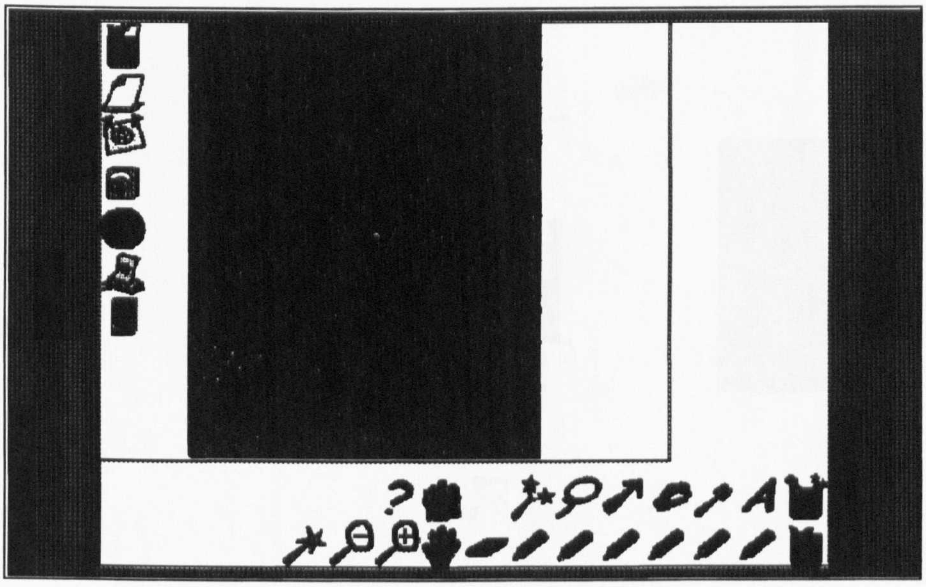

Figure 11. Using the 'Turn Alive' tool in KidPad.

Finally, the 'X-Ray Window' tool creates an area of the screen where anything falling into it can be made to look as if they were disappearing. Moving the window away from the element makes the element visible again. In Figure 12, the drawing of the frog is only visible when surrounded by the blue box; when the blue box is moved, the frog is no longer visible (see Figure 13).

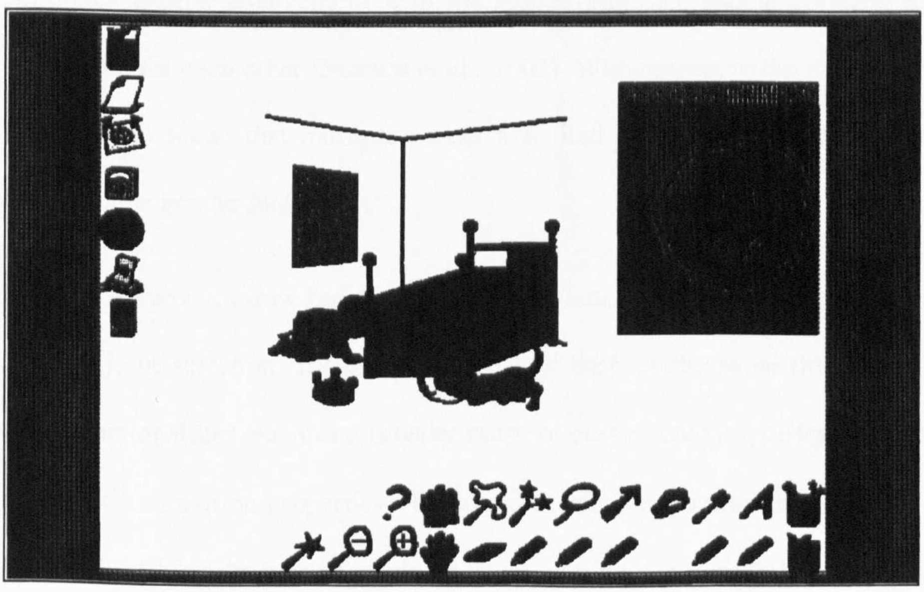

Figure 12. Using the 'X-Ray' tool in KidPad: showing its content.

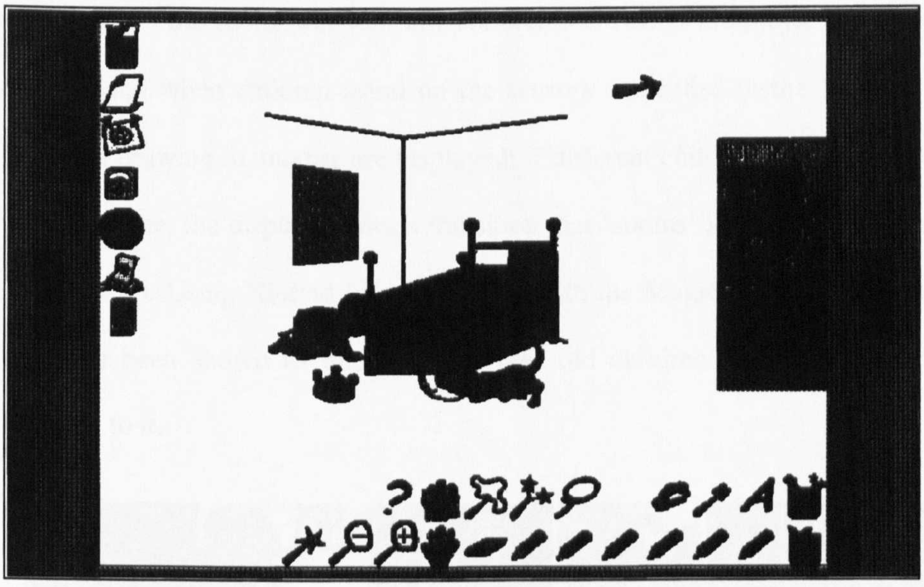

Figure 13. Using the 'X-Ray Window' in KidPad: hiding its content.

KidPad supports both individual and collaborative storytelling: while an individual child can operate the system without additional support, the system also supports simultaneous input from multiple users via multiple mice plugged into a single computer. Multiple children can independently select and use different tools or several instantiations of the same tool at the same time using their own mouse. This has been found to be related to children's greater engagement with the storytelling task and to children articulating their ideas more for each other (Stanton et al., 2002). With respect to the stories produced, Abnett, et al. (2001) found that multiple access benefited children's collaborative storytelling, but only in same gender male pairs.

Moreover, a few functionalities are included in KidPad which can only be accessed through joint selection. By selecting one tool each at the same time, children can access extra functionalities, such as a broader range of crayon colours, different shapes, and control an object's animation properties. However, informal evaluation reported that these specially designed collaboration functionalities were not very successful, as the children did not appear to make use of them when asked to make a story together (Benford et al., 2000).

KidPad can also be used in conjunction with a specially designed input device called Magic Carpet (see Figure 14), which allows children to pan across their KidPad drawings and to access the zoom function. The children's drawings are projected onto a large vertical display, and when children stand on the sensors embedded in the 'carpet', the transitions from one drawing to another are displayed; if different children stand on different sensors at the same time, the display shows a transition that 'zooms' in or out of the drawing (Stanton et al., 2001). Using KidPad in combination with the Magic Carpet for extended periods of time has been shown to improve five year old children's ability to retell a story after listening to it.

Figure 14. Children playing with KidPad on the Magic Carpet.

Overall, results from research evaluating the potential of KidPad to support children's storytelling have shown that children enjoy making stories with KidPad, and that they are more focused on their task when they are able to access the drawing space simultaneously.

KidPad was selected for the work carried out for this thesis because it allows for the investigation of the potential benefits of encouraging children to construct their own representations over provided resources. Specifically, KidPad supports importing of preselected pictures as well as creating dynamic drawings over these pictures.

Therefore, it allows for the investigation of Research Question 2, i.e., "Does encouraging children to construct their own representations over provided resources lead to better collaborative storytelling than just manipulating these resources?". Specifically, this thesis tests the prediction informed by the Chi (2009) framework that being constructive (in this case, creating dynamic drawings over presented pictures) is more beneficial to learners than simply being active (in this case, browsing presented pictures).

5. Conclusions

This thesis investigates how children's collaborative storytelling can be supported through active, constructive and interactive story-making. Specifically, it focuses on the potential benefits of providing children with resources and encouraging them to construct their own representations through technology, as well as encouraging them to interact with each other.

The first part of this chapter argued for the importance of storytelling for facilitating the development of academic skills such as the ability to communicate and make meaning for others. The concept of a good story has been defined as a coherent product which is referentially complex and evaluatively rich, and children's development of the ability to tell good stories has been charted through a review of developmental literature.

The second part of this chapter reviewed existing research on scaffolding children's storytelling, identifying two productive ways in which this has been achieved, namely through resources and through peer collaboration. A framework was also introduced, to help organize this literature and to identify further research questions and predictions. Specifically, the questions asked in this thesis are about what the features are of good resources for children's collaborative storytelling (Research Question 1), whether encouraging children to construct their own representations over provided resources benefits collaborative storytelling more than just manipulating these resources (Research Question 2), whether encouraging children to engage interactive discussions during story-making leads to better collaborative storytelling (Research Question 3), and whether children continue to engage in interactive discussion once they are no longer encouraged to engage in it (Research Question 4).

Given the potential that technology entails in transforming tasks in such as way that it becomes more accessible and productive for learners, the third part of this chapter reviewed existing storytelling technologies and points to some of the features which seem most promising in supporting children's collaborative storytelling. Specifically, the review focuses on how these technologies provide opportunities for children to manipulate and construct resources, and how the features allowing children to do so could help answer the above mentioned research questions (see **Table 1**). Consequently, two technologies are presented which include similar features, namely StoryTable and KidPad, which were employed in the work carried out for this thesis.

Table 1 *StoryTable and KidPad features and how they allowed for hypothesis testing.*

Type of engagement	Specific activity	StoryTable	KidPad	Hypothesis
Active story-making	Picture browsing	□	✔	Picture browsing will encourage children to attend to and elaborate on their story ideas
	Picture selection & positioning	✔		Picture selection & positioning, audio playback, and audio snippet positioning will encourage children to attend to and elaborate on their story ideas, and also to engage in interactive discussion
	Audio playback	✔		
	Audio snippet positioning	✔		
Constructive story-making	Dynamic drawing	□	✔	Dynamic drawing, audio recording, and audio sequence construction will encourage children to attend to attend to and elaborate on their story ideas more than picture browsing only
	Audio recording	✔		
	Audio sequence construction	✔		

Chapter 3: Supporting Children's Collaborative Storytelling through StoryTable: a Case Study

1. Introduction

1.1 Motivations for this case study

The case study presented in this chapter aimed to provide insights into the nature of the collaborative storytelling task, and how it can be productively designed for subsequent experimental manipulation. Different aspects of the collaborative storytelling task are considered here, and the children's responses to these aspects were considered in order to make subsequent experimental studies as ecologically valid as possible.

The case study approach was deemed to be suitable for this initial exploration, as it allowed for the collection of a rich set of data about the context in which the collaborative storytelling activity took place through extensive and detailed qualitative observations. The other advantage of the case study approach is in its flexible nature, which makes it open to the emergence of aspects of the task that might be worth further pursuit (Creswell & Plano Clark, 2007; Greene et al., 1989). This allowed me, as an observer, to progressively shift the focus of my observations in order to allow for the exploration of any issue that might emerge as the observations unfolded.

The case study approach was also deemed to be suitable because it provided the appropriate tools to investigate the first Research Question in this thesis, which is of a general and exploratory nature. This question asks what features of the story-making resources might benefit children's collaborative storytelling, by providing opportunities for children to act on them and construct with them. This broad interest in what might be the features of good resources arises from the necessity to explore the material context around which subsequent experimental manipulations are designed, in order to ensure that these manipulations are designed into a task which is ecologically valid and involves the use of optimal resources. Therefore, before the more specific Research Questions 2-4 could be addressed, it was thought important that a qualitative exploration be carried out in order to observe the potential impact of declining these questions through different types of resources.

Specifically, Research Question 1 was addressed in this case study by exploring a range of different ways in which resources can provide opportunities for children to be active and constructive (Chi, 2009). Like the evaluations of the systems reviewed in Chapter 2 and Section 3 (Graphic StoryWriter: Steiner & Moher, 1992; Teatrix: Machado et al., 2001), this case study evaluated the benefit of providing children with opportunities to actively manipulate a set of pre-defined story characters and settings. Also, like in the version of KidPad evaluated by Benford and colleagues (Benford et al., 2000), children could access extra functionalities by making joint active selections; unlike in Benford et al. (2000), however, joint selection was also required in order to access critical functionalities for proceeding with the story-making session. Moreover, similarly to the evaluations of the systems reviewed in Chapter 2, Section 3 (TellTale: Ananny, 2002; Jabberstamp: Raffle et al., 2007, Puppet: Marshall, Rogers, & Scaife), this case study explored the benefit of providing children with opportunities to be constructive by creating recordings, and to arrange their recordings into different sequences.

These resources were evaluated both with specifically designed technology (StoryTable) and with a paper based mock-up which reproduced most of their functionalities. These ways of resourcing children's active manipulation and constructive activity were observed in relation to their potential to support children's engagement in interactive discussion during story-making as well as the quality of their collaborative storytelling.

Finally, this case study began to explore Research Questions 3 and 4, by observing the effects of encouraging children's engagement in interactive discussion during story-making and whether the potential benefits related to this could be maintained once the children are no longer explicitly encouraged to discuss their ideas with each other. Specifically, this case study explored the potential benefits of providing children with adult guidance around the technology resources through adult support. Adult guidance has been shown to benefit children's collaboration around technology (Price, Rogers, Stanton, & Smith, 2003; Stanton-Fraser, Smith, Tallyn, Kirk, Benford, Rowland, Paxton, Price, & Fitzpatrick, 2005). Specifically, adult support has been shown to benefit children's literacy abilities both around technology (Sutherland, Eagle, O'Malley, & Manches, 2008) and without it (Fivush & Fromhoff, 1988; Fivush, Haden, & Reese, 2006; McCabe & Peterson, 1991; Stein & Levine, 1989). It was hoped that this might be an effective way of supporting children's collaborative storytelling as well. This was achieved through a set of observations, where adult guidance was introduced and gradually withdrawn, in order to observe whether this form of guidance would benefit their collaborative storytelling (Research Question 3) and whether these benefits could be maintained once this support is no longer present (Research Question 4).

1.2 Three sets of observations

This chapter presents the work that was carried out to explore the task of collaborative storytelling and to address Research Question 1 through an in-depth observation of a few pairs of children engaging with a variety of resources to encourage them to be active and constructive. Three sets of observations were conducted: the first two sets of observations were conducted with five pairs of children of different ages, while the third consisted in observing the same pair throughout several sessions. The aims and details of the three sets of observations are summarised in Table 2.

The first set of observations aimed to explore whether children would benefit from the opportunities provided by StoryTable to actively manipulate characters and settings and to construct their own recordings and story sequences. Specifically, these opportunities were expected to encourage the children to engage in interactive discussion during story-making and to produce better stories, i.e., stories which are referentially complex, evaluatively rich, and coherent. Moreover, this set of observations was aimed at exploring whether resourcing children's collaborative storytelling through the requirement for joint actions in order to trigger specific functionalities would promote their engagement in interactive discussion (Kerawalla, Pearce, Yuill, Luckin, & Harris, 2005). Finally, as StoryTable was a newly developed prototype, a secondary aim of this set of observations was to explore whether children of different ages could use the system fairly autonomously.

Subsequently, in order to validate and refine these observations, a second set of observations was conducted, where the same children were asked to make a story together using a paper based mock-up reproducing some of the StoryTable functionalities.

It was hoped that together, these two sets of observations would reveal whether children could benefit from actively manipulating resources (by making selections about story settings and characters, and by reviewing their own constructions) and constructive (by creating audio recordings and arranging them into different sequences).

Finally, the findings emerging from these first two sets of observations helped inform the design of a third set of observations. Although originally unplanned, this third set of observations provided valuable insight into the benefits of complementing technology use with additional adult guidance aimed at encouraging interactive discussion during story-making and better collaborative storytelling. Specifically, this set of observations represented an initial exploration of the value of directly encouraging interactive discussion, thus beginning to address Research Question 3, and of how this support might be withdrawn whilst maintaining its benefits for children's collaborative storytelling (Research Question 4).

Table 2 *The three sets of observations*

	Aim	Participants	Resources
Set observations 1 (planned)	RQ1: Do children benefit from the opportunities to actively manipulate resources and to construct with these?	Pairs of children 1-5	StoryTable: children can actively select settings and characters, position characters over settings, construct recordings and play them back, arrange the recordings into different sequences and play them back.
Set of observations 2 (planned)	To explore children's use of the same type of resources when implemented in a familiar and less complex environment	As above	Paper based version of StoryTable, reproducing most of StoryTable's functionalities
Set of observations 3 (emerged)	To begin to address RQ3, by exploring whether children benefit from a combination of technology based resources and additional guidance around technology directly aimed at encouraging children to engage in interactive discussion. RQ 4 is also addressed by exploring whether the potential benefits can be maintained once the additional guidance is withdrawn.	Pair 3 from above	StoryTable and additional guidance around the system, where adult facilitator asks questions, makes suggestions, and encourages story play back and sequencing.

2. First set of observations: Supporting children's collaborative storytelling with StoryTable

As described in Chapter 2, StoryTable allows children to actively manipulate resources by selecting story settings and characters from a set of existing options and by positioning their characters on the selected story setting. Additionally, the system encourages children to engage with each others' ideas by requiring that agreement is reached over the story setting selection: by requiring joint selection of the story setting, it was hoped that the children would attend to this joint decision by engaging in interactive discussion (e.g., articulating and discussing their reasons for choosing a setting) and describe the setting in their stories.

StoryTable also provides opportunities for children to be constructive together by making individual audio recordings called Audio LadyBugs and by arranging the Audio LadyBugs into different sequences. Moreover, StoryTable allows children to review their constructions by playing back their individual Audio LadyBugs as well as the entire sequence in which they have been arranged. In this case study, children's use of these functionalities was explored in order to see if they would engage with their collaborative story, for example by reviewing and discussing the content of the Audio LadyBugs and of the story sequences, and whether they would tell good stories as a result.

2.1 The participants

An email was sent to the employees of the research institute where StoryTable had been designed, to explain that children were needed in order to test the potential benefits of using StoryTable to support children's collaborative storytelling. The email received quite a lot of interest from the institute's employees who had children, saying that they were happy for them to participate in the study. These parents were contacted again and handed a consent form (Appendix I). All parents agreed to their children taking part in this case study, to be filmed whole doing so, and for the data originated from the study to be published in research dissertations, conferences and journals.

The children were grouped into five pairs; in order to ensure that the children shared similar skills, each pair was composed of children of a similar age. The participants' details are summarised in Table 3. Although ideally an additional set of criteria could have been used to match the children, such as friendship, memory and linguistic skills, the very limited nature of the sample size did not allow room for sophisticated matching.

Each pair was invited to the institute on an allocated time, and on the day of the study, their relative parents who worked for the research institute had an informal chat with the researcher about their child's familiarity with stories and technology. The conversation was guided by questions about whether their child knew any stories, whether they were used to being told stories and whether they were used to telling known as well as made up stories, as well as whether their child ever played videogames, whether they used a computer, whether they used a computer with others, whether they used CD players and VCRs, and whether they used mobile phones.

Table 3 *Participants' age and gender*

	Age	Gender
Pair 1	5 and 5	Both male
Pair 2	6 and 5	Both female
Pair 3	7 and 8	Male and female
Pair 4	4 and 4	Both female
Pair 5	6 and 6	Both female

Pair 1: Sergio and Matteo[5]

Pair 1 was composed of two boys, Sergio and Matteo (both aged five). From their parents' answers to our questions, we know that they were familiar with stories: Sergio was regularly told stories by his parents and siblings, and he was used to telling known and made up stories to them as well; Matteo was also used to being told stories by his parents and

[5] Pseudonyms are used throughout to protect children's identity.

grandparents, and to telling known as well and made up stories to his little sister and friends. Sergio's and Matteo's parents reported that they had both used a computer with their parents before, and knew how to play a CD or a tape in the VCR.

Pair 2: Maria and Clara

Pair 2 was composed of Maria (a six year old girl) and Clara (a five year old girl). Both children were familiar with stories: Maria was particularly experienced, as she often read her own story books and told her made up stories to her friends; Clara was used to being told stories by her dad and to telling both known and made up stories to others. Maria's parents reported that she was a very 'technological girl', as she played videogames, used the computer both on her own and with others, and knew how to play a CD and a videotape; Clara's parents, on the other hand, answered that she did not use technology on her own, and she was usually helped by others when she wanted to play a CD or a videotape.

Pair 3: Alessandro and Alina

Pair 3 was composed of Alessandro (a seven year old boy) and Alina (an eight year old girl). Both children were familiar with stories: Alessandro was used to being told stories by his mum and to telling both known and made up stories to himself and to his family; Alina was also used to being told stories by her school teacher and to writing her own stories up at school. Alessandro's parents answered that he was used to playing videogames and using the VCR to watch videotapes; Alina seemed more familiar with technology, as she used videogames, computers and CD players on her own as well as with others.

Pair 4: Anita and Carla

Pair 4 was composed of two girls, Anita and Carla (both aged four). Both children were familiar with stories: Anita was used to being told stories both at home and at school and to making her own stories up with her teddy bear collection; Carla was also used to being told stories by her parents and grandparents daily and to tell know and made up stories to her parents. The two girls did not appear to be very familiar with technology, as their parents told us that they never played videogames or used a computer, and only Carla had used a CD player and a VCR, and her parents operated these devices for her.

Pair 5: Amelia and Claudia

Pair 5 was composed of two girls, Amelia and Claudia (both aged six). Both children were familiar with stories: Amelia was used to being told stories by her parents, grandparents and sisters, and she was used to telling known as well as invented stories to her family and friends; Claudia was used to being told stories by her parents and grandparents and to telling known and made up stories to her parents. The girls were not very familiar with technology, as the only technology they were used to playing with on their own was the VCR for watching videotapes.

2.2 Training the children to use StoryTable

For each pair that visited the research institute (Istituto per la Ricerca Scientifica e Tecnologica), the author introduced herself in her role of facilitator and invited the children to follow her into a quiet room where StoryTable was set up together with two camcorders recording their interactions with each other as well as their interactions with the system. A number of toys had also been placed in the room for the children to play with before the start of the collaborative storytelling session with StoryTable. The toys were provided in order to ensure that the children felt at ease in the new environment and that they had opportunities to play together for a while if they so wished.

Subsequently, the facilitator introduced the children to StoryTable, and explained that they would be shown how to use it and then be asked to use it to make a story. She also explained that they would be able to play the story back for their parents at the end of the session if they wished to. The pair of children was shown how to use the system: for each of the StoryTable functionalities demonstrated by the facilitator, each child was asked to perform the demonstrated action. If the child failed to perform the action, s/he was shown how to perform the action again, and then asked to perform it again until s/he could successfully perform the said action.

The children were told that StoryTable is a game that was designed to help them make and tell stories together, and that it contains a set of story settings and characters for them to base their stories on. First, they were shown how to 'open' the LadyBug containing the story settings (i.e., the red widget in the shape of a LadyBug), and how to 'open' the LadyBug containing the story characters (i.e., the yellow widget in the shape of a LadyBug) by double tapping with their finger on them.

The children were shown how the red LadyBug contained thumbnail images of the two available story settings and the yellow LadyBug contained thumbnail images of the five available characters, and how these could be selected: in the case of the settings, they were told that they both needed to select the same picture thumbnail in order for an equivalent picture to appear across the entire display (see Figure 15); in the case of the characters, they were told that they could select one by touching the corresponding thumbnail individually, and dragging it out of the yellow ladybug (see Figure 16). The children were also shown how the selected characters could be placed anywhere over the story setting, and that any number of instances of the same character could be selected and positioned.

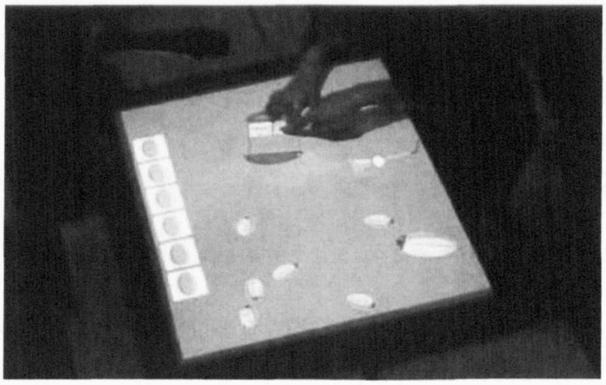

Figure 15. Joint setting selection.

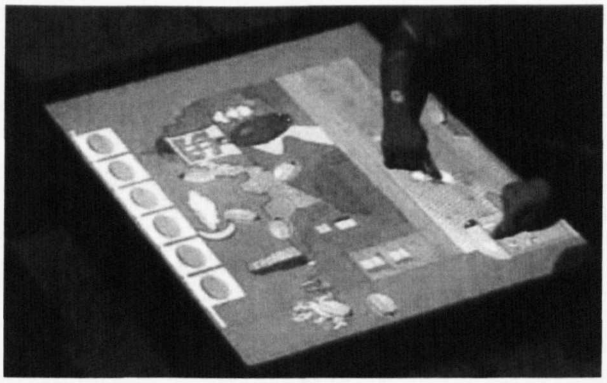

Figure 16. Character selection (child on the right) and positioning (child on the left).

Subsequently, the children were told that in order to record a story part in one of the Audio LadyBugs (i.e., the widgets representing a blue-ish ladybug which was smaller than those containing the story settings and characters), they would need to place the Audio LadyBug on the representation of a microphone on the display and touch it with their finger in order to begin recording (see Figure 17). The children were also shown how recording turned the Audio LadyBug's colour from blue-ish to purple or green according to which child had recorded it. The facilitator also explained that if a child wanted to re-record an Audio LadyBug that had been recorded by the other child, they would both need to drag the Audio LadyBug to the microphone together. After the recording, the children were shown how double tapping the Audio LadyBug results in its content to be played back.

Next, the children were told that the recorded Audio LadyBugs could be placed in any of the six available slots in on the PlayList, if this did not contain an Audio LadyBug already, as well as how to rearrange the Audio LadyBugs into different sequences on the PlayList (see Figure 18). Finally, the children were shown how to play the entire sequence of Audio LadyBugs on the PlayList by jointly placing their finger on the first Audio LadyBug on the PlayList (with the sequence playing from left to right), and how the story setting and characters disappear from the display while the story is played back. The entire set of instructions was aimed at ensuring that children were familiar with the StoryTable functionalities (see section 4.1)

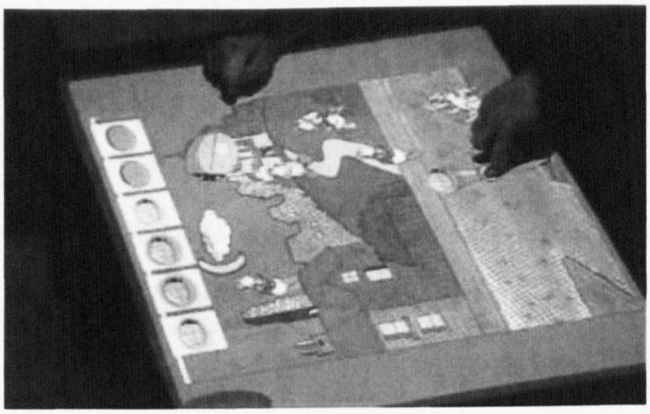

Figure 17. Audio Ladybug recording.

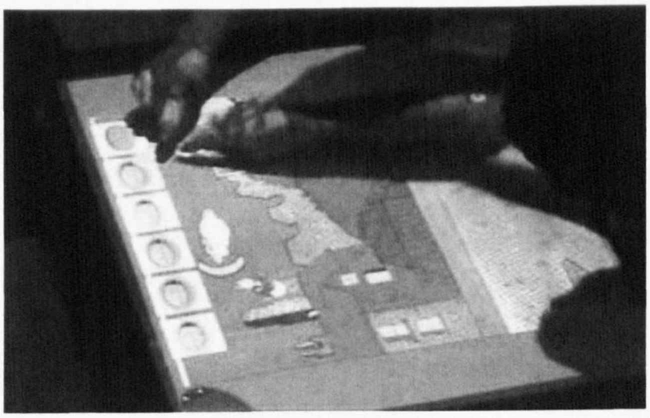

Figure 18. Positioning Audio Ladybug on the PlayList.

All five pairs of children were given two different sets of story settings and characters to use: in the training session, they were presented with a day and a night version of a forest as story settings and a set of five characters (e.g., a wolf, a bear, an owl, etc.); in the collaborative storytelling session, the children were presented with a day and a night version of Duckburg and a set of five characters (e.g., Donald Duck, Mickey Mouse, Goofy, etc.).

After the training, the facilitator invited the children to make a story together with StoryTable, while she remained in the room to assist the children in case they encountered technical difficulties.

2.3 The StoryTable sessions

The sessions were videotaped and the videos were examined with respect to the children's interactions with each other and with the system, as well as their resulting collaborative stories. Specifically, the analysis focused on the effects of providing resources for children to be active and constructive together, and how this encouraged them to engage in interactive discussion during story-making. The stories resulting from this collaborative story-making process were considered with respect to how referentially complex they were (e.g., if they included settings and plot driving events such as initiating events and resolutions), how evaluatively rich they were (e.g., if they included elements such as expressions, repetitions, characters' thoughts and feelings) and how coherently the different turns build on one another. The findings are summarised in Table 4 below; this is followed by more detailed accounts of the individual pairs' story-making and collaborative storytelling.

Table 4 *First set of observations: findings*

	Story-making				Storytelling			
	Time on task	Discussion	Entire story review	Story re-sequencing	Number of words	Referential complexity	Evaluative richness	Coherence
Pair 1	10'24"	No	No	No	11	Setting only	Very little	Low
Pair 2	8'17"	No	No	No	33	Setting only	Very little	Low
Pair 3	14'53"	Occasional suggestions and requests for explanations	Once	No	18	Setting and some plot driving events	Little	Low
Pair 4	11'02"	No	No	No	49	Setting, plot driving events, resolution	Little	Low
Pair 5	13'49"	Occasional idea verbalisation	No	No	39	Setting and some plot driving events		Low

Pair 1: Sergio and Matteo

Sergio and Matteo were two five year olds who were familiar with storytelling but only had limited familiarity with using technology autonomously. This, however, did not prevent them from engaging with StoryTable even on those occasions when they encountered difficulties using StoryTable. Although the children sometimes required the facilitator's help with dragging and dropping items from the Settings LadyBug and the Characters Ladybug and to play back the content of the Audio LadyBug, they did not allow these technical difficulties to distract them from the storytelling task. Another technical problem in this session meant that the Duckburg setting could not be loaded; therefore, the children used the forest setting they had been practicing with during the training.

As to the story-making process, Sergio and Matteo took about ten minutes to make their story together. Although they enjoyed playing with the story characters by positioning them in different places on the story setting, the children did not engage in interactive discussion about their story selections, even when they were required to make a joint selection in order to choose the story setting.

As to the final product, the story they recorded was composed of 11 words, with each child recording two Audio LadyBugs, and it was a description of the setting and the characters inhabiting it; the following is a translation of the story from the Italian original:

Sergio: *Hi*

Matteo: *We are in the woods*

Sergio: *I am a little wolf cub*

Matteo: *There are lots of animals.*

The story included a setting (i.e., the woods) and one character (out of the many that were selected and positioned by the children), but did not involve any plot driving events, or any description of detail. Besides not being referentially complex or evaluatively rich, the story is also not coherent, as the individual recordings do not build on each other and the general feel is that the story is a cumulative list of unrelated statements. For example, as it is unclear who utters the word "Hi" in the first recording, it is impossible to establish whether the next recording is a coherent development; another example is the third recording, where a single person pronoun is used and it is unclear how this builds on the previous turn, where a plural pronoun is used.

The children took turns at recording one Audio LadyBug each. The recording is the final stage of a sequence where a child would select a character, position it, and then record a related story part into an audio LadyBug, which he would subsequently play back to check that it was recorded, and finally position on the PlayList. This sequence was started by Sergio, with Matteo watching what he was doing without interfering, and then repeated by Matteo with his own characters and Audio LadyBug; this was then followed by another sequence where Sergio would select and position a character, then record an Audio LadyBug, play it back and position it on the first available slot on the PlayList, and Matteo subsequently doing the same. On three occasions, when Matteo tried to move a few characters while it was Sergio's turn to make his part of the story, Sergio moved Matteo's hand away saying "This is mine, it's my turn".

Apart from those occasions, however, the children did not talk to each other when they had to select a story setting together or at any other stage of the storytelling process. There were no instances where the children were observed to review their entire story by playing back the sequence of Audio LadyBugs, or where they arranged them into different sequences.

<u>Pair 2: Maria and Clara</u>

Maria and Clara were two young girls who were familiar with stories and with technology, although Clara was only used to using technology with adult guidance. Although Maria and Clara encountered no major difficulties with using StoryTable, they sometimes struggled to play the content of their Audio LadyBugs back; when this happened to Clara, Maria was happy to help her, while when this happened to her, Maria was able to play the audio back after a few autonomous attempts. Also, because the PlayList was situated at the opposite end of the StoryTable side the children were working on, Maria and Clara struggled to reach it in order to place the Audio LadyBugs in the holes in the PlayList; when this happened, the facilitator helped them do so.

Maria and Clara took about eight minutes to make their story. Although they enjoyed playing with the story characters by positioning them in different places on the story setting, the children did not discuss or even articulate what they were doing. The joint selections also did not lead to discussion. The story they recorded was composed of 33 words, and it was mainly a description of the setting and the characters inhabiting it mixed with a description of the storytelling session including the names of the two girls recording it; the following is a translation of the story from the Italian original:

> Maria: *I took Goofy, Mickey Mouse and Clarabelle Cow. Bye, Maria.*
>
> Clara: *Mickey Mouse.*
>
> Maria: *Hello Maria, I am here with Clara, Goofy, Clarabelle Cow and Mickey Mouse and lots of new things.*

The story evolved, and as the girls took turns at recording their Audio LadyBugs and playing them back, they noticed that they wanted to improve them. After Clara recorded and played back her Audio LadyBug, she realised she wanted to improve it by adding a second character, so she re-recorded her Audio LadyBug saying: "Mickey Mouse and Donald Duck". Maria did the same with her second Audio LadyBug, which she re-recorded saying "Hello Maria. Clara, Maria, Mickey Mouse, Goofy, Clarabelle Cow; the blue, yellow and red ladybirds and this beautiful town, with its yellow and brown house and lots of new things. A nice meadow and Scrooge McDuck's house".

The story included a rich description of the setting, which Maria was able to refine and improve after reviewing her recording, and several characters, but did not involve any plot driving events, or any character description. Therefore, the story is not referentially complex or evaluatively rich. Clara's recording builds on Maria's one by integrating it with additional information, as she lists an additional character (i.e., Donald Duck). This is made possible by the fact that StoryTable allows her to review her recording and improve on it.

Similarly to Pair 1, these children took turns at creating one recording each, and never discussed their selections and recordings with each other. There were no instances where the children were observed to review their entire story by playing back the sequence of Audio LadyBugs, or where they arranged them into different sequences.

Pair 3: Alessandro and Alina

Pair 3 was composed of seven year old Alessandro and eight year old Alina who were familiar with stories and technology. Apart from a few problems with opening and selecting items from the Settings and Characters LadyBugs, and with playing the Audio LadyBugs back, the children managed to use StoryTable autonomously.

Alessandro and Alina took about fifteen minutes to make their story. They appeared to be very engaged with the task and, unlike the other pairs, they talked to each other while they were making the story: when Alessandro was not engaged in making his story part, he talked to Alina to give her story suggestions (for example, suggesting that Alina should select and use Donald Duck in her story part), and more often to prevent her from accessing the story material he had previously used. For example, when Alina tried to move Clarabelle Cow away from the location Alessandro had originally placed her in, he told her that that was 'his' character; he blamed her for something she did that might have meant that he was not able to properly double tap on the Character LadyBug in order to open it ("You made a mess, look!"). However, Alessandro's most frequent comment was to stop Alina from making two consecutive story parts, as he felt it was important that they took turns at making one story part each ("Wait, it's my turn now"). On her part, Alina was less verbose, and only spoke to Alessandro once, to ask him why he was positioning Mickey Mouse in the sky (Alessandro answered that Mickey Mouse is flying in the sky). Finally, on a few occasions, Alessandro tried to prevent Alina from accessing the story material while it was his turn by physically taking her hand away from the characters and the Audio LadyBugs. The only time Alina took Alessandro's hand was because she needed him to jointly touch the first Audio LadyBug on the PlayList in order to play the story back.

However, this was the only instance where the children played the entire sequence of Audio LadyBugs on the PlayList, and it was upon the facilitator suggestion. Moreover, the children never took advantage of the opportunity to arrange the Audio LadyBugs into different sequences on the PlayList, and they never discussed the story as a whole. Also, no discussion occurred about the story setting, despite the requirement for the children to make a joint selection.

The story they recorded was composed of 18 words and, similarly to Pair 1's story, each child recorded an equal number of Audio LadyBugs:

Alessandro: *Here comes Mickey Mouse.*

Alina: *I am Mickey Mouse.*

Alina: *I have just got home.*

Alessandro: *I am Superman!*

Alina: *The sun shines in the sky and it's lovely.*

Alessandro: *Minnie says hello to Mickey Mouse.*

The story made by Alina and Alessandro was more complex than those made by Pair 1 and 2, as it involved mention of a few characters, a description of a setting, and some plot driving events (e.g., a character arriving home, and characters speaking to each other), although these did not include initiating events, characters' goals or resolutions. Despite the lack of characters' descriptions or other enriching details, some evaluation was present (e.g., "It's lovely"). However, the children did not build coherently on each others' recordings: for example, it is not clear if it is Mickey Mouse who has just got home or another character, and whether the character saying "I am Superman!" is the same as the character mentioned in the previous recordings. Moreover, it is not clear how Minnie greeting Mickey Mouse is related to the rest of the story.

After they finished their story, the children were so enthusiastic about their experience with StoryTable that they asked the facilitator if they were allowed to make another one, and went on to record another short story, where some referential elements are included (e.g., characters and setting) as well as some evaluative elements (e.g. such as internal states), but the recordings do not build coherently on one another, as the story feels like a cumulative list of events:

Alina: *Donald Duck is angry.*

Alina: *It's night time.*

Alina: *Minnie says hello to Mickey Mouse.*

Alessandro: *Scrooge McDuck is tired.*

<u>Pair 4: Anita and Carla</u>

Pair 4 was composed of two four year old girls, Anita and Carla, who were familiar with stories but were not used to using technology on their own. However, neither this nor their young age seemed to prevent them from being able to use StoryTable, as they managed to select and position their characters as well as to record a 49 word story. Similarly to Maria and Clara, Anita and Carla struggled to reach the PlayList in order to position the Audio LadyBugs in one of the slots; when this happened, the facilitator was there to help them do so. The children took about eleven minutes to make their story and each child recorded an equal number of Audio LadyBugs:

Anita: *My mum's name is Elena and my dad's name is Francesco.*

Carla: *My mum's name is Claudia and my dad's name is Francesco.*

Anita: *So there was a sick girl who lived in a town called Tavolissi and the doctor cured her. He gave her a very good medicine and it was all gone.*

Carla: *This is the last one.*

Overall, the story was not coherent: as it is unclear how the recordings about the children's parents are related to the events about the sick girl, the recordings cannot be said to build on each other. However, the individual recording made by Anita about the girl being sick tells a referentially complete story, which includes the introduction of a character, a setting, an initiating event and a resolution. The recording also includes some evaluative elements, such as the description of the medicine being "very good" and the emphasis on the fact that this made it "all gone".

Similarly to the other pairs, Anita and Carla took turns at making one story part each: first, Anita would select and position her characters, record her Audio LadyBug, play it back and finally position it on the PlayList while Carla simply watched her do so; then, Carla would do the same while Anita watched her, and so on. The children did not discuss their story while they were making it; however, they clearly paid attention in order to ensure that they would not miss their turn to make their story part: on one occasion when it was Anita's turn to record her story part, Carla reached to select a character, and Anita reacted by moving Carla's hand away and saying "Leave it, it's my turn to make it!".

Finally, the children did not engage in interactive discussion about their story selections, even when they were required to make a joint selection for the story setting. Moreover, they never played the entire story back from the PlayList or arranged the Audio LadyBugs into different sequences.

Pair 5: Amelia and Claudia

Pair 5 was composed of two six year old girls, Amelia and Claudia, who were familiar with stories, but were not used to playing with technology on their own. Like Pair 4, this did not seem to prevent them from being able to use StoryTable. The session proceeded smoothly except for a few technical problems where the facilitator had to intervene to select a character or play an Audio LadyBug for them.

The children managed to select and position their characters as well as to record a 39 word story in a session that lasted about fourteen minutes:

Claudia: *Donald Duck is sitting on a cloud.*

Amelia: *The thieves want to shoot with the cannon.*

Claudia: *Scrooge McDuck is running late.*

Amelia: *Donald Duck is flying.*

Claudia: *Scrooge McDuck is sad.*

Amelia: *A friend of Donald Duck's is going to see Scrooge McDuck.*

The story includes some referential elements, such as settings (i.e., a cloud), characters (i.e., Donald Duck, Scrooge McDuck and the thieves) and their goals (i.e., the thieves wanting to shoot with the cannon), thus providing some plot driving events. However, the story does not mention an initiating event and a resolution, so it cannot be said to be referentially complex or even complete. The story also includes some evaluative elements, such as characters' internal states (i.e., Scrooge McDuck is sad). The story is not a coherent set of events which build on each other, as it merely consists of a list of characters and their actions (for example, it is not clear how Scrooge McDuck's sadness is related to Donald Duck flying or to the thieves running late).

Similarly to the other pairs, Amelia and Claudia took turns at making one story part each, and they recorded an equal number of Audio LadyBugs. Amelia was quite vocal while she was making her own parts of the story. For example, before recording the Audio LadyBug about Donald Duck flying, she positioned her character in the sky and said "I'll put Donald Duck here: it's flying!"; Claudia however, did not follow up on these comments or produce any about her own story parts, and the only time she was asked a question by Amelia ("Which Audio LadyBug can I record, Claudia?"), Claudia's reply indicated that she was not going to interfere with Amelia's storytelling as long as she did not interfere with hers ("I don't mind, as long as it's not one of mine"). The children spontaneously took turns at making one story recording each.

Finally, Amelia and Claudia never engaged in interactive discussion about their story selections, and only Amelia articulated her ideas, for example by verbalising the fact that she was positioning a character in a certain place and explaining what that means in the story. Also, the children never played the entire story back from the PlayList, and they never arranged the Audio LadyBugs into different sequences.

2.4 Discussion of findings from the first StoryTable sessions

One of the aims of this first set of observations was to establish whether children of different ages would find StoryTable usable. A few technical difficulties were observed, with children struggling to open the Settings LadyBug and the Characters LadyBug, and to select and drag items out of the LadyBugs. This was due to problems with the sensitivity threshold settings on Diamond Touch, and improvements were made in order to facilitate accuracy of selection. Moreover, the younger children had problems reaching to position their recorded Audio LadyBugs into the PlayList, as this was positioned on the opposite side of the table the children were working on. Therefore, the PlayList was moved for subsequent observations to the nearest side of the table for the children to easily access it.

The other focus of this set of observations was to explore the potential of providing resources for children to be active and constructive with in order to support their collaborative storytelling. Specifically, the children could actively select and position the provided story resources, and they could construct their own recordings and story sequences. These resources were expected to encourage children to engage in interactive discussion during story-making and to produce better stories, i.e., stories which are referentially complex, evaluatively rich, and coherent.

The children were found to be motivated to use the technology, as they interacted with the story settings and characters provided, made several recordings, reviewed them, and sometimes re-recorded parts of their stories.

However, using the resources provided in StoryTable for active manipulation and for construction did not appear to encourage children's engagement in interactive discussion during story-making or to improve their collaborative storytelling. For example, the active selections were only discussed in Pair 3, where Alessandro gave a couple of suggestions to Alina as to what characters she should select, and Alina questioned Alessandro on where he had positioned his character, and what it meant in the story. Not all selected characters were included in the children's stories, and not all characters that were included in the stories were described: although some descriptions of the characters' internal states were included, these were not very elaborate; also, other characterising elements such as the characters' appearance and personality were never included in the stories.

Moreover, despite the requirement for children to make a joint setting selection, these selections were never discussed. However, children clearly paid attention to this element, as they mentioned the story setting in their recordings, with some descriptions being richer than others.

One possible explanation for the lack of engagement in interactive discussion could be that the children had no prior experience of working together. Although measures were taken as to ensure that the children felt at ease in the new environment, it is reasonable to assume that the children would have felt more comfortable to tell stories with friends, and that the quality of their collaboration would have benefited from friendship pairing (Azmitia & Montgomery, 1993).

StoryTable also provided resources for children to construct their own recordings into six Audio LadyBugs. Moreover, the children could review what they had constructed by playing back their individual recordings. The children engaged extensively with the opportunity to record: each pair recorded at least three Audio LadyBugs, and they always reviewed their recordings to check that they had successfully recorded their story part. On a couple of occasions with Pair 2, the opportunity to review their recordings led to the children improving their story part by re-recording it to include more information.

The other opportunity for children to be constructive was by arranging the Audio LadyBugs into different sequences on the PlayList. However, not a single instance was observed where children tried to arrange the Audio LadyBugs in sequences other than the very same sequence they had recorded the Audio LadyBugs in: the children would simply take turns at recording their own Audio LadyBug and positioning it in the next available slot (going from left to right) on the PlayList. This suggests that the children did not consider the PlayList as a tool that they could experiment with in order to improve their stories. The fact that the children did not take the opportunity to connect their own recordings to their partner's through sequencing suggests that the story was not considered as a collaborative product.

That the children did not approach the task as a collaborative one is also suggested by the fact that they never discussed their story recordings with each other (the only exception of Pair 3 and the occasional verbalisation in Pair 5). Related to lack of discussion is the fact that the children did not produce coherent stories, as their contributions did not follow and build on the previous ones. The fact that the children did not review their entire story and did not articulate their story ideas for each other (i.e., they were not interactive) meant that shared understanding on the story content was not possible, and this can be argued to have led to the production of incoherent stories which felt like a cumulative list of unrelated characters and events.

The fact that the children never played the entire story sequence on the PlayList (with the exception of a single story play back in Pair 3's session) might have contributed to the lack of story coherence. More generally, the lack of story sequence play back suggests that the children were not viewing the story as a collaborative product, where a shared understanding of each others' contributions needs to be achieved and negotiated in order for the story to be a coherent product. The requirement to jointly select their story in order for the play back to be triggered might have also deterred the children from playing their story back. As others have shown, children do not always tend to take advantage of extra functionalities when joint selection is required (Benford et al., 2000).

Finally, the conclusion that children did not approach the story as a collaborative product is also supported by the fact that they seemed to attend to their own story recordings as if they were special objects which they were particularly attached to, while this was not the case with their partner's recordings. For example, Alessandro in Pair 3 would often refer to the Audio LadyBugs he had recorded as 'his', and Sergio from Pair 1 made some similar comments as well; also Amelia in Pair 5 referred to her own LadyBugs as 'my little friend', 'the silly girl' and almost treated them like animated objects (for example, when she positioned one of her own Audio LadyBugs on the PlayList, she looked at Claudia and explained "It's there so it's safe, because it's afraid you'll cook it up!").

Overall, the stories consisted mostly of disconnected lists of descriptions of the story material (e.g., the stories made by Sergio and Matteo, and by Maria and Clara). Even when some plot driving events were included in the stories, these did not build coherently on each other (e.g., the stories made by Alessandro and Alina, by Anita and Carla, and by Amelia and Claudia). Besides being disconnected from each other, some recordings resemble descriptions of the context in which the children were asked to make a story rather than an actual story, or even a description of the story material (e.g., "I took Goofy, Mickey Mouse and Clarabelle Cow. Bye, Maria", or "Hello Maria, I am here with Clara, Goofy, Clarabelle Cow and Mickey Mouse and lots of new thing."). Paradoxically, the children's recordings were stories about the fact that they were making a story together, rather than being stories about the material provided in StoryTable.

A similar impression can be gained from recordings which describe the children's family and have nothing to do with the story material (e.g., "My mum's name is Claudia and my dad's name is Francesco"). Interestingly, this happened with the younger children (e.g., Anita and Carla describing their family), but not with the older children (e.g., Alessandro and Alina). This might be because the younger children still struggled to provide referentially complex stories, as demonstrated in the developmental literature (Berman, 1995; Hudson & Shapiro, 1991; Nicolopoulou, 1996; Peterson & McCabe, 1983, 1991, 1997; Trabasso et al., 1989). However, the fact that the recordings do not include the story material they had played with in StoryTable suggests that it may not have been immediately clear to them that they were required to create recordings to tell a story.

Moreover, the children's performance on storytelling is likely to have been influenced by their individual abilities in a number of areas, such as theory of mind, short term and working memory. Their perspective taking abilities will have influenced their appreciation of the need to articulate and elaborate on their own story ideas for the benefit of their storytelling partner, as well as their ability to provide good enough explanations for their partner to understand and build upon these ideas. Moreover, the ability to store information in their short term memory as well as to organise it through working memory processes would have greatly benefited the children's collaborative storytelling when they were using transient support such as the Audio Ladybugs. Memory would have also played an important part in the children's ability to hold the information stored in the Audio LadyBugs in their mind, in order to experiment with different sequencing in the PlayList. Therefore, baseline measures for theory of mind, short term and working memory would have helped interpret the findings on the quality of the children's collaborative story-making and story-telling.Finally, individual measures of the children's ability to tell stories individually with and without technology would have provided a useful insight into the impact of children's collaborative storytelling with StoryTable. However, given that the technology was designed specifically to support collaboration, individual use of StoryTable would have been impossible; for example, selecting the story setting and playing the story back form the PlayList would have required joint action from two children. Moreover, the fundamental assumption of this and the subsequent studies in this thesis was that collaboration, when suitably designed and supported, is conductive of better outcomes than individual storytelling in terms of story quality (see Section 2.3, The benefits of collaborative storytelling, in Literature Review chapter). Therefore, the pairs and their collaborative products were considered to be the fundamental unit of analysis (Barron, 2003) in this study.

To conclude, this initial set of observations with StoryTable suggested that the children actively engaged with the resources provided by StoryTable as well as constructively producing plenty of recordings. However, the stories they produced resembled a cumulative list of descriptions more than a story, and some recordings could not even be considered to be part of a story. Moreover, the children did not seem to engage with each others' work: they rarely discussed their selections and recording with each other, only checked on the quality of their own recordings, and their stories lacked coherence (indicating that they were not building on each others' ideas).

It was speculated that this may have been due to the fact that the children were neither used to telling stories together, or to using StoryTable to do so. However, it could also have been due to the specific ways in which StoryTable encouraged children to be active and constructive together, and that these were not effective ways to support children's collaborative storytelling.

These findings were compared with those from the subsequent set of observations, which explored the potential benefits of providing resources for children to be active and constructive through a more familiar technology (i.e., paper and tape recorder) as well as with a storytelling partner they had already worked with. If this second set of observations was to show that the children were still not telling referentially complex, evaluatively rich stories together and were not building coherently on each others' contributions, this would suggest that the specific resources through which children were encouraged to be active and constructive are not sufficient to benefit children's collaborative storytelling. On the other hand, if this next set of observations was to show that children's collaborative storytelling does, in fact, benefit from these resources, then it could be argued that the initial StoryTable session failed to benefit children's collaborative storytelling due to the complexity of the technology and the novelty of the task.

3. Second set of observations: Supporting children's collaborative storytelling with the paper mock-up

Given that the opportunities provided by StoryTable for children to actively manipulate resources and to construct recordings and story sequences did not seem to substantially benefit their collaborative storytelling, a second set of observations was conducted, where children were encouraged to actively manipulate material and to be constructive in a low-tech environment. The aim was to encourage children to attend to their story and elaborate on it more than they had in the StoryTable set of observations, and to encourage them to be interactive, i.e. to engage with each others' ideas through articulation and discussion.

This mock-up reproduced the StoryTable features in a low-tech context, where the children were familiar with the technology employed (i.e., paper cut outs, tape recorder) and had worked together on this task before. Although this is not the same level of familiarity that a friendship pairing would have ensured (Atmitia & Montgomery, 1993), it was hoped that this arrangement would prove to be a less distracting and more effective way for children to engage with the existing features, to see if they would encourage good collaborative storytelling.

One difference distinguished the mock-up from StoryTable: because the mock-up employed a traditional tape recorder, the children were not required to jointly select their story in order to play it back, but could do so individually by rewinding the tape and pressing 'play'. As it was reasoned that the complexity of the StoryTable system might have discouraged children from using this feature, it was hoped that the mock-up would represent a more intuitive and straightforward way to encourage them to do so.

Overall, this part of the case study provided an opportunity to explore whether the children's collaborative storytelling would be supported more effectively by the StoryTable features when these are presented in a more familiar context. Specifically, these observations focused on whether the features which the children had used in StoryTable, such as the story setting and character selection and the audio recording, would lead to better collaborative storytelling than in StoryTable. Moreover, these observations also focused on whether the features which the children had not used in StoryTable, such as the whole story play back, would be used when presented in a more familiar context, and if so, whether they would benefit collaborative storytelling.

3.1 Training the children to use the paper mock-up

The same five pairs of children who had used StoryTable were asked to make a story together using the paper based mock-up. On the same day as the StoryTable sessions, and straight ater the StoryTable sessions, the facilitator showed the children how to make a story together with the mock-up (see Figure 19), by explaining that they would have to open a red box containing two cards representing a story setting each (a day and a night version of a medieval scene with a castle), and that they would both have to select the same card in order to be handed a poster sized version of the story setting. The facilitator also showed a yellow box to the children, which contained a selection of five figurines representing a character each (e.g., a princess, a knight, etc.) that the children could position on the poster sized story setting.

Figure 19. Selecting settings and characters with the mock-up.

The facilitator also showed the children how to record their story on a cassette recorder, and how to play the whole story back (see Figure 20). After she had ensured that the children were able to operate the cassette recorder using the basic 'record', 'rewind' and 'play back' functions, she invited them to make a story together that they could play back for their parents if they wished to. The facilitator remained in the room to assist the children in case they encountered technical problems with the tape recorder.

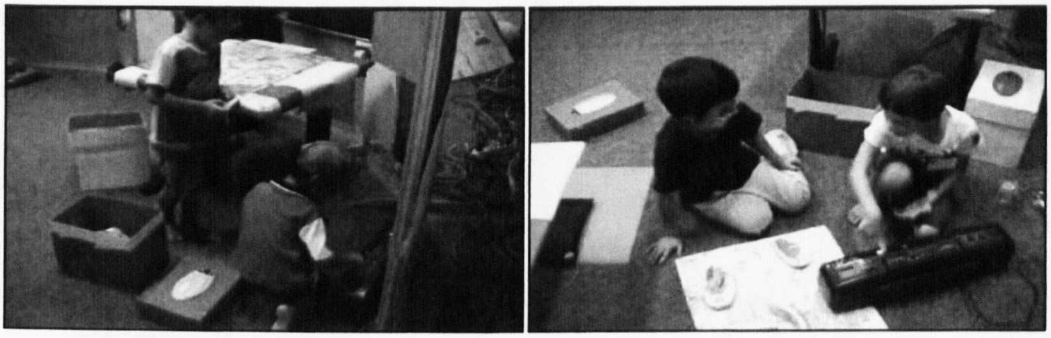

Figure 20. Recording and reviewing the story with the mock-up.

3.2 The paper mock-up sessions

Similarly to the previous set of observations, the paper based sessions were videotaped and the videos were examined with respect to the children's interactions with each other and with the system, as well as their final collaborative storytelling. The analysis focused on the effects of providing opportunities for children to actively engage with the provided resources and to be constructive together, and whether the children engaged with each others' selections and constructions, for example by discussing them and by including them into their collaborative storytelling.

In Pair 1, only Sergio made a recording, and this is what the translation from the Italian original is: "*The dragon is burning the houses*". After he made his recording, Sergio played it back to check that he was happy with it and then both children declared the story to be over. There was no discussion of the selected settings or characters, and no suggestions were made by Matteo about what Sergio could include in his story recording.

Pair 2 also recorded a very short story, which only Maria contributed to: "*Clara wants to say something. There is a castle and a woman*". Again, after she had made her recording, Maria played it back to check that she was happy with it and then both children declared the story to be over. Like Pair 1, the children did not engage in interactive discussion about what they had selected and constructed.

Pair 3, however, seemed more engaged with the task, and their session appeared to be similar to the one they had with StoryTable. Both Alessandro and Alina recorded an equal number of story parts, and they took turns at recording these story parts and playing them back to ensure they were happy with the recording:

Alina: *God is praying.*

Alessandro: *The apostles are walking.*

Alina: *There is a dragon in the castle.*

Alessandro: *Jesus is carrying his cross.*

Similarly to the story Alessandro and Alina made with StoryTable, this story included some referential elements such as characters and places, but did not contain plot driving events such as attempts to resolve a problem, or evaluating elements such as descriptions of characters' appearance and internal states. Moreover, like the one made with StoryTable, this story was not coherent: the different story contributions did not build on each other, and it was not clear how the different actions were related to each other (for example, it is unclear how God praying is related to the apostles walking or the dragon in the castle).

Like in their StoryTable session, Alina tried to record a story part after she had just recorded one, and Alessandro stopped because it was his turn to record. Like in StoryTable, when Alessandro volunteered a suggestion for Alina, Alessandro showed interest in what Alina had recorded and made comments about how to improve it: after Alina had recorded "God is praying", Alessandro commented that it was "too easy" to say that the character was God, and that it must have been an apostle instead (in fact, the characters were not meant to represent a religious scene, but the simple medieval costumes they were represented wearing might have led the children to believe this was a religious scene). Interestingly, there was one instance where children spontaneously played the entire story back to review it; however, no discussion ensued from this episode.

The story made by Pair 4 was recorded by Anita alone, and it was a nursery rhyme, which they did not play back. Like with Pairs 1 and 2, Anita and Carla did not discuss what they had selected or recorded.

Finally, Pair 5 recorded quite a lengthy, articulate story, which both Amelia and Claudia contributed to:

Amelia: *The dragon was near the castle and was scaring people out, but the sultan was not scared.*

Claudia: *A few men were walking and they see a dragon and they say "Oh mamma mia, we'd better tell the king".*

Claudia: *The dragon was making fire with his mouth and the people wanted to chase him away, so the sultan could be safe.*

Like the story Amelia and Claudia had made with StoryTable, this story included some referential elements, such as characters, settings and initiating events to drive the plot forward. However, like in StoryTable, the children did not include a resolution to their story, so this cannot be considered to be a referentially complete product. The story also included some evaluative elements, such as characters' internal states, and its contributions built coherently on one another (for example, the contribution "The dragon was near the castle and was scaring people out" was elaborated into the next contribution "A few men were walking and they see a dragon and they say 'Oh mamma mia, we'd better tell the king'").

The children always played back the story parts they had recorded, and on one occasion, Claudia re-recorded her own story part to spell out more clearly the word 'dragon'. After they had recorded their story, the children played it back once without being prompted to by the facilitator, but like with Pair 3, no discussion ensued from this.

Amelia and Claudia expressed the desire to record another story, and this is what they recorded:

Amelia: *Jesus and Mary were having a stroll in the sky.*

Claudia: *Jesus is very good.*

3.3 Discussion of findings from the paper mock-up sessions

This set of observations was aimed at exploring whether providing resources for children to be active and constructive within a more familiar context would lead to better collaborative storytelling than was observed in StoryTable. In these sessions, the children were familiar with the technology and they had told a story with their partner before. Moreover, in these sessions, the children were not required to perform a joint action in order to play the entire story back.

As three out of five stories consisted of one recording, it was not possible to establish whether facilitating the replay of the entire story through the tape recorder was more effective than through StoryTable. Even when a story consisted of more than one contribution and it did get played back, this did not lead to discussion (only Alessandro from Pair 3 volunteered a suggestion on how his partner could improve her recording) or any improvement on the story compared to the one they had produced with StoryTable.

Unexpectedly, these collaborative storytelling sessions were shorter than the StoryTable ones: these stories took between five to eight minutes to make, while the StoryTable ones took between eight and fifteen minutes. The stories they recorded were also shorter than those they had recorded with StoryTable. Moreover, the children were less engaged with the task, as they recorded fewer story parts which only rarely played back. Similarly to the StoryTable sessions in the previous set of observations, the children almost never engaged in a discussion about the story.

These findings suggest that, despite the attempts to create a more familiar context, the children's collaborative storytelling did not benefit from the resources provided by the mock-up. Similarly to the StoryTable sessions, the children seemed to be mainly concerned with their own contributions to the story, and did not reflect on how these built coherently on their partner's contributions, or how to make their story referentially more complex and evaluatively richer. Moreover, the children's recordings can barely be considered to be stories, as one was a nursery rhyme, and the others mostly consisted of simple lists of descriptions.

A tangential observation concerned the sequential approach taken by children when using StoryTable and the paper based mock-up: despite the fact that both systems enabled simultaneous interaction with the provided resources, children tended to take turns at interacting with these. Similar findings are reported in (Rogers, Hazlewood, Blevis, & Lim, 2004), who note that this might be a positive indication of collaborators' ability to orchestrate and coordinate their actions with each other. However, this study showed how turn taking did not necessarily mean that children were more aware of each others' story ideas and they did not take advantage of this sequential pattern to discuss each others' story ideas.

Overall, the observations of children's collaborative storytelling with StoryTable and with the paper based mock-up suggest that, although children can engage with the task by being active and constructive, additional support is needed in order to encourage them to make the most of these resources.

Therefore, it can be concluded from these initial two sets of observations that the opportunities provided by StoryTable and the mock-up were not sufficient to support children's collaborative storytelling. These observations provided input for the design of subsequent experimental manipulation, where the lesson about this type of resources was capitalised upon in the choice of resources for children to be active and constructive with.

4. Third set of observations: Facilitating children's collaborative storytelling with StoryTable and adult guidance

In the light of the observations on children's collaborative storytelling with StoryTable and with the paper based mock-up, a third and final set of collaborative storytelling sessions was arranged. This set of observations explored whether it was possible to support children's collaborative storytelling through a combination of StoryTable resources and external guidance aimed at encouraging children to engage in interactive discussion during story-making. As it focused on complementing technology with support outside technology which was specifically aimed at encouraging interactive discussion, this set of observations began to address Research Question 3.

The observations also focused on whether, once the children had been exposed to the facilitator's guidance over a few storytelling sessions, this support would no longer be necessary: as the children became familiar with the idea of articulating their ideas for each other and attending to the story as a collaborative product, it was hoped that the facilitator's guidance could be gradually faded and the children could be left to productively using StoryTable autonomously. Because the focus here was on withdrawing the scaffolding aimed at encouraging children's engagement in interactive discussion, this set of observations also began to address Research Question 4.

Based on research on how parents and teachers support their children's storytelling through questioning and suggesting story ideas (Carnine & Kinder, 1985; Fivush & Fromhoff, 1988; Fivush et al., 2006; McCabe & Peterson, 1991; Stein & Levine, 1989), this set of observations explored whether children's collaborative storytelling could benefit from an adult encouraging children to reflect on their story by asking questions and suggesting that they review their collaborative story once this has been made.

The questions asked by the facilitator were aimed at encouraging children to reflect on their own and their partner's story ideas. They focused on how the children's stories could be made referentially complex, evaluatively rich, and coherent. For the purpose of making the story referentially complex, the facilitator used questions to encourage the children to articulate the story setting, its characters (e.g., their goals and reactions, their attempts, whether they were helped by other characters, etc.) and their ideas on a possible resolution. For the purpose of making the story evaluatively rich, the facilitator questioned the children on the characters' appearance and internal states.

The guidance also involved encouraging children to reflect on how each story recording might (or might not) build coherently on the previous ones; in order to do this, the facilitator occasionally suggested reviewing the story by playing it back on the PlayList, and discussed how the sequence in which the individual recordings had been arranged might be changed in order to make the story more easily understood by a naive audience.

Finally, in order to explore whether this support could be withdrawn, a longitudinal approach was taken, whereby the same pair of children was invited to participate in four storytelling sessions with StoryTable. As it was important that the children were fairly familiar with each other and with the StoryTable technology and that they were old enough to be able to benefit from the support provided, a pair of children from the previous set of observations was invited to particulate in this set of observations. These were the children in Pair 3, as they were seven and eight years old and they had demonstrated a slightly better potential to engage in interactive discussion during story-making as well as to create good stories together.

4.1 Introducing children to the StoryTable and adult guidance sessions

As observations 1 and 2 suggest that seven and eight year old children might benefit more than younger children from the opportunities to be active and constructive described here, Pair 3 was selected to participate in this third and final set of observations.

Alessandro and Alina were invited to visit the research institute for four more sessions with StoryTable. These children were selected because of the slightly more interactive approach they took to storytelling: the children were occasionally observed to offer suggestions and request explanations from each other, and they generally made stories which were reasonably articulate to provide a basis from which the facilitator could work.

When she met Alessandro and Alina again, the facilitator explained to the children that they would be asked to make a few more stories together in the next four sessions using StoryTable. She explained that she would help them make a good story by giving them a few suggestions and asking them questions, but that the story was ultimately their own story, and they would have to make it together.

So as to ensure that the children made different stories in each of the four sessions, different story material was employed each time. In the first session, the day and night version of Duckburg with its related characters was used; in the second session, the day and night version of the forest and its related characters (e.g., a wolf, a bear etc.) were used; in the third session, the day and night version of a town with a castle and the characters from the cartoon Asterix were used, finally, in the fourth session, a day and a night version of a forest from the Jungle Book was used with its related characters (Mowgli, Baloo, etc.).

In the first three sessions, the facilitator sat with the children throughout the storytelling process with StoryTable, asking them questions about their story and encouraging them to play the story back and reflect on it (see Figure 21). As the idea was to see whether the children could internalise the facilitator's questions and suggestions and gradually become more autonomous, the facilitator gradually decreased the amount of input she provided from session to session until, in the fourth session, the children were left alone to make their story with StoryTable with no external support.

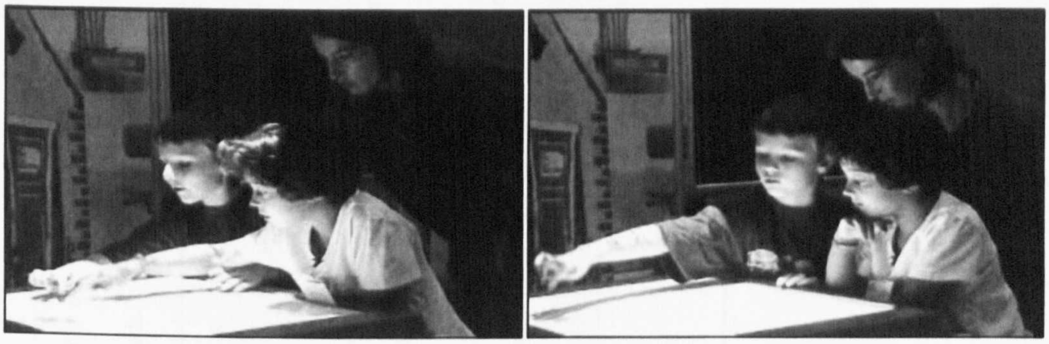

Figure 21. Facilitating children's collaborative storytelling with StoryTable.

4.2 The StoryTable and adult guidance sessions

The observations were conducted observing the same method described in the first two sets of observations: the sessions were videotaped and analysed with a focus on the children's interactions. The findings are summarised in Table 5 below; this is followed by more detailed accounts of the four individual story-making and collaborative storytelling sessions.

Table 5 *Third set of observations: findings*

	Story-making				Storytelling			
	Time on task	Discussion	Entire story review	Story re-sequencing	Number of words	Referential complexity	Evaluative richness	Coherence
Session 1	29'51''	Question asking and suggestion giving	Yes, upon facilitator's request	Yes, upon facilitator's request	64	Setting, initiating event, main character's and helper's attempt, resolution	Yes	Yes
Session 2	18'49''	Suggestion giving	Yes, upon facilitator's request	Yes, upon facilitator's request	53	Setting, initiating event, attempt, resolution	No	Yes
Session 3	38'56''	Idea verbalisation and suggestion giving	Yes, spontaneously	Yes, upon facilitator's request	45	Setting, initiating event, helper's attempt, attempt, resolution	Yes	Yes
Session 4	21'30''	Suggestion giving	Yes, spontaneously	No	54	Setting, initiating event, attempt, resolution	Yes	Yes

Collaborative storytelling session 1

Alessandro and Alina were invited back to the quiet room where StoryTable had been set up and they were shown the available story settings and characters from Duckburg. They were told by the facilitator that she would be helping them make their story, but that, ultimately, it was them who had control over their story and that they would have to make it together.

The session lasted about half an hour, during which the facilitator asked questions to help the children create a referentially complex story. For example, she encouraged the children to articulate what the story setting looked like, if it was day or night time, what the characters they had selected were doing. She also asked what could happen to the characters and, when the children did not seem to be able to provide an answer, she suggested an idea for a problem that a character might be presented with (e.g., Scrooge McDuck having had his money stolen from his depot). She also suggested that Scrooge McDuck could ask some other character to help him find his money back in order to make the story more complex, and she finally encouraged the children to draw their story to a close with a resolution.

The facilitator also asked questions to help the children enrich their story with evaluative elements, such as descriptions of the characters' physical appearance, personality and internal states; for example, she suggested that Scrooge McDuck could be angry at discovering that his money has been stolen, and she asked the children to articulate what his reaction might be when his money was found again; she also drew the children's attention to the pictures of the characters, and how their props might be used in the story (e.g., Mickey Mouse's magnifying glass could be a tool he uses to help Scrooge McDuck find his money).

Finally, the facilitator asked the children to play their whole story back in the sequence they had arranged it in the PlayList, to encourage them to attend to each others' ideas and to see if these were sequenced into a coherent story. As the story included a recording saying that Donald Duck is investigating on the lost money case, followed by a recording saying that Scrooge McDuck invited Donald Duck to investigate on the case, the facilitator pointed out that, in order for the story to make sense, the order of these two recordings should be reversed. Once this had been pointed out to them, the children agreed to the suggestion and proceeded to invert the order of the recordings.

As far as the children are concerned, Alessandro and Alina were quite talkative in this session as they articulated what they were going to record, and gave each other suggestions on what to include in the story; for example, Alina suggested to Alessandro that he could say that Scrooge McDuck is patrolling his depot, and that Donald Duck calls lots of friends to help him with the investigation so they all look in different places. Also, as the facilitator asked questions, the children were observed to build their ideas about the story together; in the following excerpt, Alessandro builds on Alina's answer in response to the facilitator's questioning

Facilitator: Who might help him?

Alina: Donald Duck!

Facilitator: Why?

Alessandro: Because Donald Duck is smart.

After playing their Audio LadyBugs back, the children sometimes re-recorded them in order to include some content that had been discussed with the facilitator; for example, Alina re-recorded her Audio LadyBug saying "*Scrooge McDuck is counting his money in the depot*" to include more content "*It's night time, Scrooge McDuck is counting his money in the depot*", and Alessandro re-recorded his "*Donald Duck is investigating*" into "*Donald Duck calls Mickey Mouse and asks him for help with the investigations*".

The resulting story was a fairly sophisticated product, with the different story parts building coherently on one another. Beside containing some evaluative elements (internal states), the story was referentially complete, with an initial setting (It is night time and Scrooge McDuck is counting his money in the depot), an initiating event (Scrooge McDuck's money has been stolen), an attempt to solve this (Donald Duck's investigation), a helper for the main character (Mickey Mouse), and a resolution (the Beagle Boys are caught and the money is returned) with some evaluation (Scrooge McDuck is happy):

Alina: *"It's night time, Scrooge McDuck is counting his money in the depot"*

Alina: *"Scrooge McDuck realises that some of his money is missing"*

Alina: *"Scrooge McDuck is patrolling the depot and he calls Donald Duck"*

Alessandro: *"Donald Duck calls Mickey Mouse and asks him for help with the investigations"*

Alessandro: *"Mickey Mouse finds the Beagle Boy's fingerprints"*

Alessandro: *"The Beagle boys are caught and Scrooge McDuck is happy"*

Collaborative storytelling session 2

The second session took place on a different day, and it lasted about twenty minutes. The facilitator asked questions to the children in order to encourage them to create a referentially complex story: as this story was about animals in the woods and Alina had recorded an Audio LadyBug about a cheetah teasing the other animals, the facilitator asked the children to articulate how the animals are teased by the cheetah (i.e., initiating event). She also asked what the animals' reaction could have been to the initiating event, and encouraged the children to conclude their story with a resolution (e.g., "Do the animals make peace?", "How does it all end?"). Finally, the facilitator asked the children to play their whole story back in the sequence they had arranged it in the PlayList, to encourage them to attend to each others' ideas and to how these built (or did not build) on one another. As the contributions did not build coherently on one another, the facilitator suggested that the Audio LadyBugs are arranged in a different order so that the initiating event is followed by an attempt to solve it.

Like in Session 1, Alessandro and Alina gave each other suggestions about what could be recorded, and these suggestions were included in the story. For example, as Alessandro seemed unsure about how to record in an Audio LadyBug, Alina suggested he could say that the cheetah is stealing prey from the bobcat, and Alessandro proceeded to do so. On another occasion, when Alina seemed unsure about what to record, Alessandro suggested the idea that an eagle might be catching a sparrow while the cheetah and the bobcat are having a fight over their prey, and Alina records this.

Being able to review their recordings and to discuss them with the facilitator provided opportunities for children to improve the story. For example, as Alessandro recorded an Audio LadyBug saying "*The cheetah is catching prey*" and played it back, the facilitator was able to point out that the story lacked an initiating event, and asked how the cheetah might be teasing the animals; Alessandro replied that the cheetah might be stealing animals that had been caught by other animals, and proceeds to change his recording into "*The cheetah is stealing prey from the bobcat*". Alina also changes her recording from "*While the bobcat and the cheetah are having a fight, the eagle catches a sparrow*" into "*The cheetah and the bobcat make peace and they split the prey*" after reviewing her initial recording and discussing how the story might end with Alessandro and the facilitator.

Although the story was not evaluatively rich, it was a coherent and referentially complete product, which included an initial setting introducing the different animals and what they are doing (the eagle is flying in the sky, the bobcat is hunting for prey, the cheetah is teasing the animals), an initiating event (the cheetah stealing the bobcat's prey), an attempt (the fight between the cheetah and the bobcat), and a resolution (the cheetah and the bobcat making peace and splitting their prey between them):

Alessandro: "*The eagle is flying in the sky*"

Alina: "*The bobcat is hunting for prey*"

Alina: "*The cheetah is teasing the animals*"

Alessandro: "*The cheetah is stealing the prey from the bobcat*"

Alessandro: "*The bobcat is having a fight with the cheetah and it bites it*"

Alina: *The cheetah and the bobcat make peace and they split the prey*".

Collaborative storytelling session 3

The third session took place on a different day, and it lasted about forty minutes. As Alessandro and Alina appeared to be confident about how to create a referentially complex story independently, the facilitator's intervention was limited to encouraging children to include articulate ideas about the evaluative elements in their story, such as characters' internal states (e.g., "Is he good or bad?", "Is he a clever dog or a silly dog?"). She also encouraged the children to play their whole story back in order to reflect on the sequence of the recordings, and pointed out that the recordings should be sequenced more coherently, so as to have an initiating event (i.e., the woman in the castle needs saving) followed by the characters attempts (i.e., Obelix keeps the guards occupied so Asterix can save the woman), and not the reverse.

Like in the previous sessions, Alessandro and Alina gave each other suggestions about what could be recorded, and these suggestions were included in the story. For example, Alessandro suggested that Alina should record that Obelix is squashing the guards outside the castle, and Alina proceeded to record this. On another occasion, Alessandro suggested an idea for how the story could continue, and moved on to record it himself: as he verbalised his story ideas to provide suggestions for Alina (i.e., Asterix is going into the castle and Asterix attacks the guards), Alessandro reflected on his ideas and proceeded to record something related to his suggestion ("*Obelix is keeping the guards occupied*").

Story ideas were articulated, and this allowed children to build on each others' ideas: for example, Alessandro explained that he was positioning Obelix on top of the castle because in the story, he is falling down. Interestingly, this provided the idea for Alina to introduce an initiating event, where a woman falls off the castle window.

The children also took advantage of the opportunity to review their recordings in order to improve them: for example, after Alessandro played back his Audio LadyBug saying "There is a nice castle", he went on to re-record it to include a formal opening "Once upon a time there was a castle". Moreover, the play back function provided children with the opportunity to make suggestions on how each others' recordings could be improved (for example, Alessandro pointed out a disfluency in Alina's recording and suggested she re-records).

Finally, in this session, the children decided to play the entire story back; this was the first time this functionality was used by the children without encouragement from the facilitator, and it shows how children were beginning to appreciate the importance of reflecting on the story as a collaborative product, as opposed to seeing it as a cumulative list of individual recordings. Later on, the facilitator encouraged the children to change the order of the recordings in order to introduce an initiating event before the characters' attempts are mentioned, and Alina showed an appreciation of the importance of doing so as she suggested to Alessandro that they should change the order of their recordings to create a better story.

The final product was a coherent and evaluatively rich story (opening story markers, internal states). The story was also referentially complete, as it included an initial setting (a nice castle), a reaction to an implied complication (Asterix goes into the castle to save a woman), a helper's attempts to support the main character's attempt to solve the problem (Obelix keeping the guards occupied), and a resolution (Asterix saves the woman). Moreover, some evaluative elements are present in the story, such as the fact that the castle is "nice", and that "everybody in the castle is happy":

Alessandro: "*Once upon a time there was a nice castle*"

Alina: "*Asterix goes into the castle to save the woman*"

Alessandro: "*Obelix is keeping the guards occupied*"

Alessandro: "*The guards are falling asleep*"

Alina: "*The woman falls off the castle and Asterix saves her*"

Alina: "*In the castle everybody is happy*"

Collaborative storytelling session 4

The fourth session lasted about twenty minutes; at the beginning of the session, the facilitator explained to the children that she would leave them alone so they could make their story together without her help (see Figure 22 and Figure 23). The facilitator remained in the room in case the children needed help using StoryTable.

Like in the previous sessions, Alessandro and Alina gave each other suggestions about what could be recorded. For example, after Alessandro had recorded his Audio LadyBug about Mowgli going into the jungle to watch the sky, Alina suggested that Mowgli could be watching the sky to check if it is sunny, and later on she also suggested that Mowgli could be playing with his friends and Baloo. Alessandro also gave suggestions to

Alina: when he noticed that Alina had selected Mowgli and positioned it, Alessandro suggested it would be better if Mowgli was on the tree.

Moreover, Alessandro and Alina showed they are attending to each others' contributions by integrating their partner's ideas with their own, in order to enrich them: for example, when Alina was articulating her idea by saying that Mowgli "[...] notices that an elephant is coming out of the bush", Alessandro adds that "the elephant is called Hathi".

The children also gave each other feedback on how to improve their story recordings: for example, when Alina articulated her story idea, explaining that she wanted to record "[...] that one day Mowgli went into the woods", Alessandro suggested she uses the word 'jungle' instead of 'woods'. Interestingly, in another episode, Alessandro expressed his concern about Alina's recording not fitting in coherently with the rest of the story: after Alina had recorded "Mowgli asks the elephant is they could all play hide and seek with him, and everybody had a great time together", Alessandro points out to Alina that her recording would not work with the rest of the story: "[...] If the monkey had attacked Mowgli, how can he be free to play now?"; therefore, Alina changed her recording to "Baloo saw that Mowgli was trapped and he went to rescue him", thus building coherently on the existing story recordings. This episode showed how the children were finally attending to the story as an overall product, where each part needs to build coherently on the others, in order for the story to make sense, and how they had were able to discuss their story as a collaborative product.

The final product was a coherent and evaluatively rich story (internal states). The story was also referentially complex, as it included an initial setting (Mowgli is in the jungle, watching the sky), two complications (King Louie is spying on Mowgli, the monkeys attack Mowgli), an attempt to solve the problem and a resolution (Baloo rescues Mowgli). However, given the popularity of the theme, it must be noted that the story produced by the children contained events which could have been familiar to them from prior exposure to story books or movies, thus providing a joint frame of reference for the children to base their collaborative storytelling upon Unfortunately, the children's prior knowledge about this story was not investigated, thus making it impossible to tease out the media influence from the StoryTable benefits.

Finally, some evaluative elements are present in the story, such as the fact that the Baloo gets angry when he realises that Mowgli is being spied on:

> Alessandro: "*One day Mowgli went into the jungle, and he climbed on a tree so he could watch the sky.*"
>
> Alessandro: "*King Louie is spying on Mowgli.*"
>
> Alina: "*Baloo realises that King Louie is spying on Mowgli and he gets angry.*"
>
> Alessandro: "*The monkeys attack Mowgli.*"
>
> Alina: "*Baloo saw that Mowgli was trapped and he went to rescue him.*"

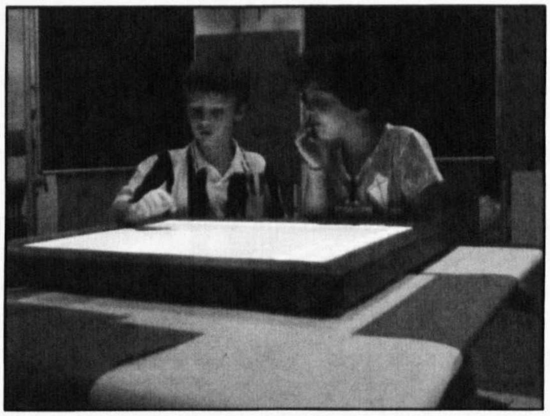

Figure 22. Alessandro and Alina selecting the story setting.

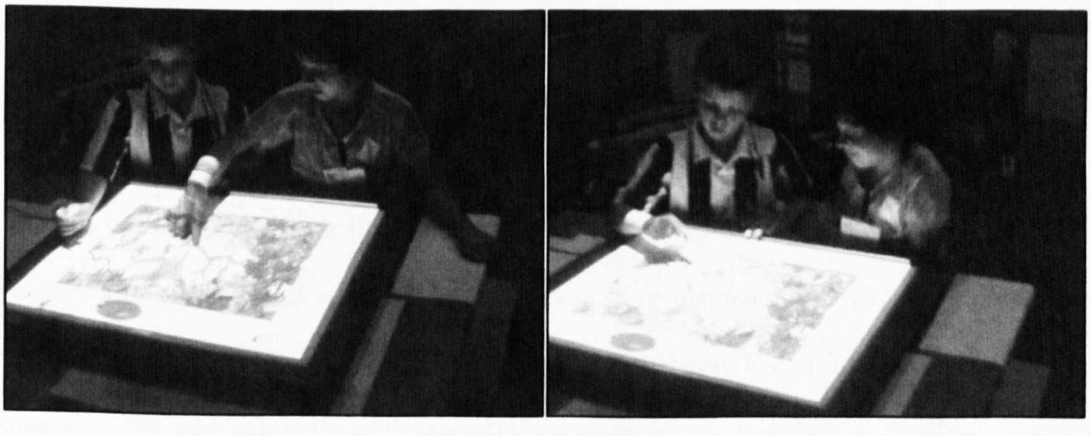

Figure 23. Alina and Alessandro making their story with StoryTable.

4.3 Discussion of findings from the StoryTable and adult guidance sessions

The aim of this set of observations was to explore how combining StoryTable with adult guidance could encourage children to engage with each other's ideas, and whether this could lead to better collaborative storytelling. This set of observations was also aimed at assessing whether good collaborative storytelling can be maintained when the adult guidance is gradually withdrawn. These two foci of observation helped provide insight into the type of additional guidance that might be designed into a subsequent experimental manipulation, where the idea of scaffolding children's collaborative storytelling outside technology in order to encourage them to engage in interactive discussion during story-making would be tested through quantitative tools (Research Questions 3 and 4).

The children were able to engage with the facilitator's questions and suggestions: they articulated their own story ideas in relation to their setting and characters selections, and were able to interactively discuss what to select and record. Combined with the opportunity to be active by reviewing their individual recordings, the guidance for children to be interactive proved successful at encouraging children to improve their story contributions by re-recording an Audio Ladybug, when they felt unsatisfied with the content they had reviewed. Moreover, encouragement from the facilitator to actively review the entire story sequence made it possible for children to reflect on the story as a collaborative product, and to improve it if they felt that a contribution did not build coherently on the others.

As a result, the children produced more sophisticated stories than in the first sessions (with StoryTable or the mock-up) without adult guidance: their stories were longer, referentially more complex, included more evaluative elements and were more coherent. This was made possible by the fact that, as a result of being encouraged to articulate their own ideas for each other, the children reflected on their own and their storytelling partner's contributions, and on how these were assembled into a more or less clear and coherent product.

These findings may have been partially due to the fact that the children were already familiar with making stories together using StoryTable (and a similar paper based mock up). Although this constitutes a limitation to these findings, it also created a more familiar context for children to tell their stories in. This makes the task more ecologically valid, as telling stories with a familiar peer and resources is a more common practice than doing so with a stranger using novel technology.

Finally, as the facilitator's intervention gradually faded, the children were able to pursue their collaborative storytelling task more and more autonomously. The amount of facilitator's suggestions and questions took 16 turns out of 20 in Session 1 (just over half the total number of turns), 8 out of 20 in Session 2 (less than half the total number of turns), 13 out of 37 in Session 3 (about a third of the total number of turns), and finally no turns in Session 4. At the same time, the quality of children's storytelling did not decrease, as the children kept engaging in interactive discussions during story-making and producing good stories together. Although this may have partly been due to the children's increasing familiarity with the task, their storytelling partner and the StoryTable, the fact that the stories maintained a good quality suggests that the children were able to internalise the guidance provided by the facilitator, until they were finally able to use StoryTable to make a good story together.

5. General Conclusions

One of the aims of this case study was to explore what the features might be of good resources to support children's collaborative storytelling (Research Question 1). Specifically, the case study explored the potential benefits of providing children with different opportunities to act on different resources and to construct with these.

As the first two sets of observations with StoryTable and the paper based mock-up show, children engaged with the opportunity to actively select settings and characters and to position their characters in the settings. They also engaged with the opportunity to construct their own recordings and to review them. However, this did not appear to provide enough support for children to engage in interactive discussion during story-making, as they rarely articulated their story ideas for each other, gave each other suggestions or feedback. Their collaborative stories were quite poor in their referential and evaluative aspects, the recordings they were made of did not build coherently on one another, and sometimes could not even be considered stories

The poor quality of children's collaborative storytelling in these two sets of observations might have been due to a number of aspects in the resources provided for children to be active and constructive with. The children did not discuss the settings and characters they were selecting and assembling, or the quality of their collaborative stories, despite the requirement for them to make joint selections in order to trigger some of these functions. Moreover, the children sometimes used the recording resources to record non-story content, such as nursery rhymes or descriptions of their families, and they ignored the opportunity to assemble their recordings into different sequences. Based on these observations, a number of considerations could be drawn.

Firstly, providing a set of characters and settings for children to assemble into a story might not have been a structured enough provision of resources for children. As the literature on scaffolding children's individual storytelling shows, providing children with more structured material to base their story upon, such as a picture story, leads to better quality storytelling (Hudson & Shapiro, 1991; Pearce, 2003). This recommendation might have been relevant for this case study, and even more so for the younger children participating, as the four to six year olds produced particularly poor stories.

Therefore, the subsequent experimental studies presented in this thesis employ more structured resources, such as sequences of pictures with an overarching goal based structure for the children to base their storytelling on. The subsequent studies also involved six and seven year old children, it was expected that they would be able to benefit from the provided resources more than younger children.

Secondly, joint selections are not necessarily an effective way of encouraging discussion, and the related functionalities can even be ignored if they are not part of the necessary set of actions required in order to perform the task. This reflects findings from (Benford et al., 2000), where children's collaboration was supported through a set of augmented functionalities in KidPad, which could only be accessed through joint selection. Similarly to the findings in this case study, Benford and colleagues report that children did not make use of these extra functionalities during story-making.

Thirdly, the recording function meant that the stories' content only became available progressively as it was played back. Also, playback is ephemeral, as its content becomes no longer available once it has been played back. Drawings, on the other hand, are persistent and their content can be accessed in its entirety at any time; for this reason, drawings might represent a more effective way of encouraging children to actively review their constructions. As others have argued, persistent representations provide effective 'anchoring points' for learners to engage in discussion about their meaning (Anderson, Hoyer, Wolfman, & Anderson, 2004; Crook, 1995; Crook & Webster, 1997; Roschelle, 1992; Tang, 1991). Therefore, because drawings are persistent, children might be more prone to attend to and discuss what they represent and how this relates to their collaborative story.

In the light of these considerations, the subsequent studies presented in this thesis examine drawing as a more promising modality for children to construct their collaborative stories through. As noted above, these studies also investigate storytelling with children who were slightly older than the majority of the children participating in this case study, in the hope that they could articulate the story ideas represented in their drawings and engage in interactive discussion for the benefit of their collaborative storytelling.

The findings emerging from the first two sets of observations also informed the design of a third set of observations within this case study, which explored how children's use of these resources could be complemented by additional guidance around the technology, to see if this would benefit their collaborative storytelling. These observations showed that complementing these resources with adult guidance benefits children's engagement in interactive discussion during story-making, as well as their production of referentially complex, evaluatively rich and coherent stories. It was also observed that these benefits could be maintained while the adult guidance is gradually withdrawn.

The first consideration to be drawn from this third and last set of observations was that the production of good collaborative stories can be facilitated by adult guidance in the form of questions, story suggestions, and encouragement to review the collaborative stories. The children were observed to articulate their own ideas for each other, to request explanations from each other and to provide feedback and suggestions for each other. The children were also observed to tell better stories together, and this reflects the literature on scaffolding for individual children's storytelling, showing that children can be encouraged to tell better stories through adult guidance (Fivush & Fromhoff, 1988; Fivush et al., 2006; McCabe & Peterson, 1991; Stein & Levine, 1989). The observation than children can benefit from this additional support also reflects the broader literature on scaffolding, which argues for the benefits of mediating children's interaction in order to promote their learning (Barron, 2003; Chi, 2009; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996; Wegerif, 1996).

The other consideration is that the children continue to engage in interactive discussion once the adult guidance is no longer available to them. This suggests that some children appear to be able to internalise the need to articulate and discuss ideas between each other, as they continue to engage even in the absence of adult guidance. These findings reflect the literature on the importance of designing scaffolding tools (Quintana et al., 2004; Wood et al., 1976) which are not only capable of transforming a task to facilitate learning while the tools are provided (effects with scaffolding), but also once the tools are no longer available to the learners (effects of scaffolding) (Salomon et al., 1991).

Finally, additional considerations emerged from this case study, which yielded a greater understanding of how children's collaborative storytelling is influenced by the context in which this takes place. This was made possible by the nature of the case study methodology employed in these observations, which involved openness to the emergence of valuable insights for the design of subsequent experimental manipulation. In this case, a number of observations were made on the nature of the collaborative storytelling task and how this can be designed more appropriately in order to facilitate children's understanding of what is required of them.

Firstly, it became apparent that children need time and practice to become familiar with telling stories together. Although not much improvement in the children's collaborative storytelling was observed from the first session they had together (first set of observations) to the second session (second set of observations), it became clear from observing Pair 3 in the third set of observations that by then, the children had become more used to working together and with StoryTable, and this might have facilitated their collaborative storytelling (beside the additional guidance discussed below). This is not entirely surprising, as others have made similar considerations about the benefits of children being used to working with each other on their collaborative storytelling (Pellegrini, Galda, Bartini, & Charak, 1998; Preece, 1992).

Secondly, a lack of a real audience might detract from the task validity, as children are used to telling stories to someone. Therefore, if the task does not involve an audience, children might understand the task: as some of the recording in his case study show, some of the children produced recording which cannot be considered as stories at all. Some children produced songs and descriptions of their families, and perhaps the presence of an audience would have created a stronger indication of the sort of 'stories' the children were asked to produce, i.e., stories which contain referential and evaluative elements and are coherent enough for an audience to be able to understand it.

However, it must be noted that the qualitative nature of this initial exploration would have been better suited to an exploration in context, where children were more familiar with the environment they were in and with their storytelling partner. Unfortunately, this was not possible due to the circumstances: as StoryTable was still at a prototype stage, it was impossible for the technology to be installed in schools or other informal contexts such as museums and summer camps. Although this limited the ecological validity of the findings, every effort was made in order to ensure that the children were comfortable in the laboratory environment, where toys and props were set up for the children to play together with their partner before the running of the study.To conclude, in relation to Research Question 1 (i.e., what might be the features of good resources to support children's collaborative storytelling), the qualitative exploration presented in this chapter suggested that encouraging children to actively manipulate characters and settings as well as to construct their own, reviewable recordings and story sequences might not be the most effective way to support children's collaborative storytelling. Some resources might be ignored (such as story sequencing and playback), while others might not be effective enough (such enforced joint selection of story settings). However, the children appeared to engage with the provided resources and to enjoy using them (some of them even made more stories than requested), and the older ones showed some potential to benefit from these resources. Moreover, when resources which provide children with opportunities to be active and constructive together are complemented by additional guidance outside technology, children have been observed to engage in interactive discussion during story-making and to produce good stories together. Moreover, these benefits appear to persist even when this additional guidance outside technology is withdrawn.

Answering Research Question 1 enabled the design of subsequent experimental manipulation aimed at testing more specific questions about the value of being constructive over being active (Research Question 2, Experimental Study 1), the value of encouraging children to engage in interactive discussion during story-making through promoting outside technology (Research Question 3, Experimental Study 2), and the ability of children to maintain their engagement in interactive discussion once this additional support is no longer available to them (Research Question 4, Experimental Study 2).

Chapter 4: Constructive Story-Making to support Children's Collaborative Storytelling

1. Introduction

This study addressed Research Question 2, "Does encouraging children to construct their own representations over provided resources lead to better collaborative storytelling than just manipulating these resources?", by investigating whether children constructing their own drawings produce stories which contain more referential and evaluative elements and which are more coherent. As the literature review (Part 2) has shown, encouraging learners to construct their own representations can increase encoding of and attending to the presented material more than simply encouraging them to actively manipulate the presented material without producing representations (Chi, 2009). The literature review (Part 3) has also shown how children's collaborative storytelling can benefit from the support of technology enabling constructive activity (TellTale: Ananny, 2002; Jabberstamp: Raffle, Vaucelle, Wang, & Ishii; KidPad: Benford et al., 2000; Puppet: Marshall, Rogers, & Scaife, 2004)

The StoryTable Case Study also showed how children can easily engage with constructive activities such as recording story segments and assembling them. However, the Case Study also revealed how even older children (e.g., seven and eight year old) might neglect the opportunity to be constructive by assembling their story segments into different sequences in order to improve its coherence. Moreover, children were sometimes observed to interpret the constructive task of recording as a non storytelling task. They sometimes made recordings which were not stories, such as nursery rhymes, descriptions of their families, or even descriptions of the context in which they were supposed to tell stories (i.e., the testing room, their peers, etc.). Together with the poor quality of the stories produced by the children, these instances suggested that recording audio might not be the most suitable modality for children to construct their stories in. This might be due to the transient nature of audio: as audio needs to be played back in order to be accessed, reviewed and possibly discussed, this might have deterred children from reflecting on the quality of their stories and even engaging in interactive discussion. Drawings, on the other hand, are persistent and can be accessed in their entirety at any time. Therefore, this study investigated drawing as a specific modality for children to be constructive in, and its potential benefits for children's collaborative storytelling.

In this experimental study, the children were presented with a set of pictures forming a story, and were asked to complement these pictures with their own drawings to make their story (story-making). The resulting combination of presented pictures and self constructed drawings was used to help them tell their story to an audience (story-telling).

It was predicted that when the children created these drawings, the elements in the presented pictures would become more salient and therefore more attention would be paid to them by the children. Consequently, it was predicted that the stories resulting from this process would be more referentially complex and evaluatively rich. Also, it was expected that the construction of drawings would provide an 'anchoring point' for children to articulate and discuss the story. This, in turn, was expected to encourage the production of referentially complex and evaluatively rich stories, but also to help children achieve a shared understanding, ultimately making the production of coherent stories possible.

1.1 The challenge of telling a good story

As argued in Chapter 2, telling a good story means including enough elements to allow an audiences, to understand it and enjoy it. Good stories include referential elements, i.e. elements that serve the function of driving the plot forward, such as an initial problem to be addressed, one or more character's attempt at solving the problem, and a final (positive or negative) resolution to the problem (Stein & Glenn, 1979). However, good stories also include evaluative elements, such as expression of characters' internal states and reaction to the story events, i.e. elements that make the story interesting for an audience, by suggesting a perspective through which the events are to be interpreted and therefore giving the story a unique flavour (Stein & Glenn, 1979).

Because the inclusion of referential and evaluative elements makes a story more easily understood and appreciated by the audience (Berman, 1995; Nicolopoulou, 1996; Stein & Glenn, 1979), encouraging children's development of the ability to tell referentially complex and evaluatively rich stories is an important aim of the primary literacy curriculum (DCSF)[6]. Including both aspects when making a story is a particularly challenging task for children in their early years of primary education: as developmental psycholinguistics research demonstrates, it is not until the ages of six and seven that children start to consistently include referential and evaluative elements in their stories (Bamberg & Damrad-Frye, 1991; Peterson & McCabe, 1983).

Finally, telling a good story together with other children requires that the elements in the story should be integrated coherently with one another. In order for children to be able to weave each others' contributions together into a coherent product, where each contribution builds on the previous ones, shared understanding needs to be achieved on the story being made. This is facilitated by articulation and discussion of the story ideas as they are conceived and elaborated on during story-making.

1.2 Learner constructed representations in individual settings

This study investigated whether encouraging children to create drawings over a set of presented pictures from a story book would lead to their attending to and elaborating on the presented material.

Extensive research has contributed to support claims about the benefits of learner constructed representations in learning presented material. Van Meter and Garner (2005) discuss techniques where learners are presented with content and asked to complement it with their self constructed drawings, and report studies where these techniques are shown to

[6] http://nationalstrategies.standards.dcsf.gov.uk/node/104310 [Accessed 10 May 2010]

improve learners' encoding and elaboration of the presented material. Independently of the individual research findings relating to specific types of representations (e.g., concept maps, diagrams or drawings) constructed by the learners, these studies converge towards the argument that when learners complement presented information with self constructed representations, their encoding and elaboration of the presented material is greater than when they are simply presented with the material (i.e., when they are 'passive') or even when they manipulate the presented material without constructing new representations (i.e., when they are 'active').

This may be due to a number of cognitive processes involved in the creation of representations. It has been argued that when learners create their own representations, they attend to these more than if they were simply presented with representations (Alesandrini, 1981; Dempsey & Betz, 2001; Van Meter & Garner, 2005). Specifically, the literature on self constructed drawings has argued that these lead to increased encoding of information associated with the representations, for example by encouraging learners to link presented information and prior knowledge, and by organising knowledge through establishment of connections and prioritising relevance (Paris, Lipson, & Wixson, 1983).

Moreover, extensive encoding involved in these cognitive processes has been found to promote increased recall of the constructed representations and of the processed information related to these representations (Lesgold, Levin, Shimron, & Guttmann, 1975; Schmalhofer, 1998; Van Meter, 2001). In turn, increased recall constitutes an important benefit for any task that requires the learner not only to encode the presented information, but also to elaborate on it and to present it to others (as in the case of storytelling). Therefore, although testing increased recall is not the specific aim of this study and it was not tested, it is reasonable to assume that one added benefit of increased encoding for storytelling might be increased recall.

In conclusion, the arguments in the literature suggest that encouraging learners to complement the presented learning material with self constructed representations leads to increased processing, i.e. encoding and elaboration of the learning material. Based on these arguments, this study explores how encouraging learners to complement presented story pictures with their own drawings might lead to increased encoding of the ideas expressed both in the presented story material and in the self constructed representations. In turn, this is expected to result in referentially more complex and evaluatively richer stories.

Moreover, presenting the children with a fixed set of story pictures for them to construct their story on offers an important methodological benefit: as all stories are based on the same story pictures, this makes it easier to compare between them in terms of their quality. Indeed, this methodological point has been made in many studies where pictures were given to elicit children's storytelling (Bamberg & Damrad-Frye, 1991; Berman, 1995; Reilly, Losh, Bellugi, & Wulfeck, 2004).

Although no known empirical studies have tested the above predictions or examined the cognitive processes described above in the specific domain of story-making, applied research with primary school children in the area of listening comprehension provide encouraging evidence of the benefit of self constructed representations. Fisher (1976) reports an activity where a teacher reads a story to the class, stops at certain points, and begins an outline of an illustration, while encouraging the children to take turns at completing the illustration with their self constructed representations. The children were observed to draw facial expressions showing the characters' emotions in the story, and to discuss the story with their peers. This argued to benefit children's comprehension of the story and their general engagement with the activity. Others have also reported picture making to help children develop ideas for writing (Caldwell & Moore, 1991; Dietz, 1976; Ernst, 1997; Karnowski, 1986; Steele, 1991). Similar findings have also been reported in with remedial readers (Constantino, 1986).

These qualitative observations provide an encouraging base for further, systematic investigation of the value of combining presented material with self constructed representations. Moreover, these observations provide evidence of practice based activities resembling the one investigated in this study, thus adding ecological validity to the storytelling task employed in this study.

1.3 Learner constructed representations in collaborative settings

Given the literature stressing the value of producing self constructed representations to learn about presented material in individual learning contexts, it is not surprising that recent research on collaborative learning has been investigating the benefits of encouraging learners to construct representations together.

As Crook has argued, learners working together around a computer benefit from a shared representation which provides an anchoring point for catalysing learners' informal discussions and grounding them more firmly through a stronger sense of having a common agenda (Crook 1995, 1997). A few studies have recently emerged in the literature on computer supported collaborative learning, which investigate the benefits of learners co-constructing shared representations such as text (Hoadley et al., 1995), diagrams (Suthers & Hundhausen, 2003), concept maps (Roth & Roychoudhury, 1994), and drawings (Prangsma et al., 2008). Independently of the individual findings related to specific representation modalities, the main argument is that collaborative co-construction forces learners to make their ideas explicit and visible (Scaife & Rogers, 1996), thus providing a platform for ideas to be encoded and elaborated on. Also, collaborative co-construction provides an anchoring point for ideas to be articulated and their meaning to be discussed. This, in turn, is also argued to lead to increased encoding and elaboration of the presented material (Van Bruggen, Boshuizen, & Kirschner, 2002; Van Bruggen & Kirschner, 2003).

Co-construction has also been argued to promote achievement of shared understanding, which in turn leads to the products of the collaborative activity being more coherent. For example, Dillenbourg (1999) argued for the value of learners being constructive together, as the representations they construct provide opportunities for learners to make their understanding explicit and therefore to achieve shared understanding. In turn, shared understanding is crucial to collaborative learning activities, as the amount of effort invested by the collaborators towards achieving a shared understanding has been claimed to be related to learning outcomes (Dillenbourg, 1999; Dillenbourg & Traum, 2006). Therefore, encouraging learners to create their own representations together should lead to increased engagement with the task and increased preoccupation with shared understanding (for example by engaging in interactive discussion about the self constructed representations), thus leading to better outcomes.

A good example where the co-construction of shared representations leads to increased effort towards achieving shared understanding and therefore better collaborative products is illustrated in Schwarz (1995). In this study, dyads of 10th grade (fifteen to sixteen year old) students were asked to create individual representations based on some presented learning material about food chains, and subsequently asked to co-construct a shared representation.

In one of the cases reported in the study, an interactive discussion takes place where the two students are investing considerable effort in trying to achieve a shared understanding of the self constructed representations. This is argued to be the fundamental mechanism fostering encoding and elaboration which is superior to the encoding and elaboration that would take place if the two students had worked individually. Schwartz (1995) illustrated this with a case where one student has drawn a picture of a monkey and a tree, and to the left of the picture is the letter H with an arrow pointing between the monkey and the tree. The other student has also drawn a picture representing two organisms, but without any indication of the relationship between the two (which eats which). Upon looking at the first student's representation, the second student enquires about the meaning of the arrow and the letter H, and the first student explains that the arrow is pointing to the monkey. This induces the second student to interpret the first student's representation in a way which is different from what the first student meant: the first student intended the arrow to indicate that the monkey represents the letter H (H stands for monkey), while the second student understands that H is transmitting to the monkey (the monkey eats H). Upon seeing the second student draw an arrow connecting the banana to the monkey, the first student realizes that the second student has not understood what his arrow device is intended to mean. He therefore engages the second student in a discussion which, eventually leads to clarification and the adoption of the arrow device to mean transmission (instead of representation as originally intended by the first student), and the elimination of pictorial devices in favour of the use of letters only.

As Schwartz (1995) argues, this example illustrates effective group negotiation, where interactive discussion leads to the development of a more abstract form of representation than those the individuals started with, thus enabling both learners to gain an understanding of the subject at hand which goes beyond the individual understanding of each collaborator alone.

Finally, research investigating the value of encouraging learners to construct representations together has emphasised the importance of constructing persistent representations, as they allow collaborators to review their own and others' contributions for reflection and discussion. In fact, the argument for the value of persistency in supporting collaboration has been widely recognised in the field of computer supported collaborative learning (Anderson et al., 2004; Roschelle, 1992; Tang, 1991). Roschelle (1992) includes persistency in his set of criteria for designing effective collaborative learning environments, and stresses the importance of persistent representations in providing better anchoring points for interactive discussion and therefore facilitating the achievement of a shared understanding.

Tang (1991) also discusses the importance of persistent representations in supporting shared understanding by providing a shared context for collaborators to coherently weave their ideas into. He notes how in his observations of small groups' shared drawing activities, collaborators use the persistent drawing space as a 'working sketchpad' to represent and interactively construct ideas with others, as well as to refine one's own thinking. He also notes how the drawing space is used to mediate group interaction, typically through its use as a support for directing the group's focus of attention. Therefore, Tang concludes, a shared drawing space is helpful because it functions as a persistent repository for ideas whilst also promoting interactive discussion, i.e., idea articulation and negotiation. Similarly, Anderson et al. (2004) stress the importance of persistency in supporting discussion and understanding of a representation's meaning. The authors studied how a system called Presenter is used to create notes, which they name 'attentional marks', to draw students' attention to the information presented on PowerPoint slides. These marks are defined as 'digital ink annotations which provide a linkage between spoken context and the shared display', and examples of these marks include boxes, over-bars, ticks, exclamation marks, check marks, brackets, dots, etc. Anderson et al.'s study yielded interesting considerations with respect to the need to provide context for the interpretation of attentional marks: when the marks are taken on their own, their meaning within the discourse is not transparent, and it is only by supplementing the marks with words (and gestures) that the marks become meaningful.

Similarly to the situation observed in Tang (1991) and Anderson et al. (2004), the study presented here is aimed at examining the potential benefits of co-constructing persistent representations for the purpose of helping children attend to and elaborate the presented story pictures. The persistency of the co-constructed representations is expected to aid collaboration both during the making of the story as well as the telling of the story to an audience. Because the drawings can be reviewed in their entirety at any point of the activity, these are expected to serve as 'anchoring points' for ideas to be articulated and discussed, therefore aiding the making of coherent story parts to follow as well as aiding the telling of the finished story to an audience. Moreover, because the constructed representations are persistent, they are expected to serve as 'anchoring points' not only for discussion and coherent story-making and story-telling, but also as 'reminders' of the ideas they encode and their relative elaborations, thus aiding subsequent story-making and story-telling.

1.4 Constructing drawings in KidPad in a collaborative setting

The study presented here builds on existing literature demonstrating the benefits of encouraging learners to construct representations together to improve their encoding and elaboration of presented material. Specifically, it investigates how presenting children with a set of story pictures and encouraging them to construct persistent drawings together might lead to increased encoding and elaboration of the story they are making together and therefore the production of better quality stories. Also, the construction of persistent drawings might provide an 'anchoring point' for children to interactively discuss their ideas, achieve shared understanding and therefore be able to tell more coherent stories. Finally, articulating and discussing their drawing is expected to encourage children to reflect on their productions and therefore produce referentially more complex and evaluatively richer stories.

KidPad provided a valuable tool to investigate these ideas, through its set of tools which allow children to construct dynamic, persistent representations for storytelling. In line with the notion of scaffolding (see Chapter 1, Scaffolding in and around technology) as formulated by Sherin et al. (2004), technology can support learning by transforming a task in such a way as to make it more easily accessible to the learner (Vygotsky, 1978). This is because technology can provide richer tools, for example to allow learners to manipulate and modify representations to include new ideas or to make connections explicit (Quintana et al., 2004).

This study embraces this approach by examining how KidPad can support children's collaborative storytelling by providing a set of rich tools for the construction of dynamic, persistent drawings. The Turn Alive tool allows children to turn their drawings into moving ones, the X-Ray Window tool allows them to make their drawings appear and disappear, and the Hyperlinking tool allows children to connect and zoom in and out of elements which have been previously drawn.

During story-making, children constructing these representations over the presented pictures might reflect more on how their story ideas relate to the presented story pictures, and include their ideas in the stories during story-telling. For example, creating a Hyperlink that zooms into a story element might encourage reflection on the importance of this story element within the story; making a Hyperlink to connect two elements might encourage children to reflect on the commonalities and relations between these two elements; making an element 'wiggly' with the Turn Alive tool might encourage children to reflect on the physical appearance of those elements in the story, or their emotional states (for example, a wiggly character might mean that he is excited, or jittery; and making story elements appear and disappear through the X-Ray Window tool might encourage children to reflect on their status in the story (for example, a character could only be seen under certain circumstances).

Moreover, creating representations in KidPad might encourage children to attend to the presented story pictures in more detail, and include these elements in their stories during story-telling. For example, creating a Hyperlink that zooms into a story element, or making the story element 'wiggly' with the Turn Alive tool, or making it 'appear and disappear' through the X-Ray Window tool might draw the children's attention to that element and its features (e.g., interacting with a picture of a monkey might draw the children's attention to the monkey's physical appearance).KidPad's dynamic representations have been found to benefit children's storytelling by encouraging them to attend to the elements presented in the story pictures they are presented with (Boltman, 2001).

Boltman (2001) carried out a study to test if children would tell better structured stories when presented with dynamic representations constructed in KidPad. In her study, pictures from the story *Frog, Where are You?* (Mayer, 1969) were presented to individual children who were asked to tell the story while browsing the pictures, and once again later, when the children no longer had access to the pictures. Three conditions were compared: in one, the children were asked to browse through a traditional book; in another, they were asked to browse through the pictures in KidPad; in the third condition, called Spatial

KidPad, the children were asked to browse through an augmented version of the pictures which included Hyperlinks, Panning and Fading effects previously created by the experimenter. After browsing the pictures in their assigned condition, all children were asked to tell a story based on what they had viewed, once while looking back through the pictures, and a second time without looking back through the pictures.

Boltman (2001) found that the children who were presented with the story pictures in Spatial KidPad included more subordinate and superordinate goals in their stories than the children in the other two conditions. This means that the children consistently mentioned a resolution in their stories, i.e., whether the boy finds his lost frog (subordinate goal) and takes it home with him (superordinate goal) when they were presented with interactive representations. Again, when asked to recall the story once the pictures were removed, the children in the Spatial KidPad condition recalled more subordinate goals than those in the other two conditions. Boltman (2001) argues that visually connecting ideas and concepts through Spatial KidPad's interactive representations resulted in specific content to be highlighted. She suggests that these dynamic features aid the building of a mental model in the learner's mind by organising visual information so as to make relationships among images and concepts salient.

These findings are relevant for the study reported here not only for the obvious commonalities in terms of task, software and material used, but especially because they suggest that being exposed to dynamic representations created in KidPad might encourage children to attend to and encode the presented information more than when they are not so supported. Therefore, it is reasonable to assume that the children using KidPad's dynamic representations would also be able to tell better structured stories, i.e. referentially complex stories.

Furthermore, the children in this study were encouraged to use KidPad's tools to create their own dynamic representations. In the framework proposed by Chi (2009), this means that children are 'constructive'; in the Boltman study (2001), however, children can be said to have been 'passive' recipients of KidPad's dynamic representations. Therefore, the framework would predict that children in this study would benefit more from using KidPad than those in the Boltman study, as being constructive is claimed to lead to greater encoding and elaboration than being passive. For this reason, it is expected that children constructing dynamic drawings in KidPad would not only tell referentially more complex stories, but also evaluatively richer ones.

Finally, because the representations created in KidPad are persistent, children can review their constructions while they tell their story, and are therefore expected to attend to these and include them in their stories.Therefore, it was expected that encouraging children to construct their own, persistent representations in KidPad would result in increased quality of storytelling. Specifically, it was expected that the construction of these representations would help children attend to the story pictures more, to reflect on the different elements, their role in their story and how they relate to each other, ultimately leading to the production of longer, referentially more complex, evaluatively richer, and more coherent stories.

1.5 Study hypotheses

Drawing from the literature on the value of self constructed representations in supporting encoding and elaboration of represented material, this study examined whether encouraging children to create persistent dynamic drawings in KidPad would lead to increased quality in their story-telling with respect to referential complexity, evaluative richness and coherence. Also, as the stories were expected to be more complex and richer, they were predicted to be longer.

As the task required children to work together to make a story which was new to them using a software which was also new to them, the children were asked to tell the same story twice: the first time (i.e., telling phase), they were asked to make the story using KidPad simply to browse through the presented pictures, while the second time (i.e., retelling phase) they were asked to either repeat the same procedure but to reflect on how to improve their story, or to use KidPad to construct drawings together (drawing retelling).

Therefore, an improvement in the quality of the children's stories was expected the second time they told a story. However, a significant interaction was also predicted which was specific to the intervention in this study, whereby the second time a story was told (retelling), its quality would be significantly better when the children were using the drawings than when they were not. Specifically, the following two predictions were made:

- Prediction 1 (main prediction). At the retelling stage, when the children used the drawing version of KidPad, they would tell significantly better stories. Specifically, it was predicted that the stories would be significantly

  1.1 longer (i.e., include significantly more words and propositions)

  1.2 referentially complex

  1.3 evaluatively richer

  1.4 more coherent

- Prediction 2 (secondary prediction). Secondly, at retelling, regardless of drawing condition (i.e. whether they were constructing drawings or not), the children would tell significantly better stories than at telling, with respect to story length (Hp 2.1), referential complexity (Hp 2.2), evaluative richness (Hp 2.3) and coherence (Hp 2.4).

1.6 The pedagogical scenario

These predictions were tested with children in their second year of primary education. The pedagogical scenario involved providing children with a set of picture sequences representing a story and subsequently telling their collaborative story to an audience. Designing this pedagogical scenario involved a number of choices which were informed by the literature review as well as the findings from the StoryTable Case Study. These choices mainly concerned (a) the children's age (b) the presence of an audience, and (c) the features of the resources available and (d) the children's access to these resources.

The decision to (a) focus on six to seven year old children was informed by the developmental literature, where there is agreement on the fact that children of this age are beginning to consolidate their ability to tell stories which are referentially complex and evaluatively rich. Although children of this age have an intrinsic awareness of what constitutes a good story, they are not yet able to translate this awareness into the production of referentially complex and evaluatively rich stories. This was also supported by the observations in the StoryTable Case Study, where younger children were observed to have difficulties producing stories which went beyond a random list of descriptions or incoherent events.

In relation the (b), the pedagogical scenario involved the presence of an audience. The children were instructed to create a story that they would subsequently have to tell to two of the schoolmates (a pair of children from the ten that had been allocated to the 'audience' role). The rationale for introducing an audience into the study was manifold, and it was mainly based on concerns about ecological validity.

Firstly, stories are typically told for an audience, and the presence of an audience was considered to be a key element to help the children frame the storytelling task. As noted in the StoryTable Case Study, the absence of an audience might have contributed to some of the children misunderstanding the task to be about creating any type of recordings: these ranged from nursery rhymes to descriptions of one's family members, or lists of descriptions and events where only some referentially and evaluative elements were included. The fact that the recordings could not always be considered to be stories could have been due to the children not being used to being asked to tell a story in the absence of an audience.

Secondly, the presence of an audience provided a reason for the children to tell the same story twice, as the children were told that the reason they would have to tell their story a second time (retelling) was to make their story more clear for an audience who had presumably not understood every detail in their story the first time they were told it. This approach was similar to that of McGarrigle and Donaldson in their 'Naughty Teddy experiments' (1975), where it was demonstrated that children perform better when the instructions they are given make sense to them are sensitive to the social context in which they are presented. In the case of the "Naughty Teddy experiments", this meant creating motivation for the experimenter asking the same question twice that would seem plausible to the children in the study (i.e., introducing a teddy character); in the case of this experiment, the motivation for asking the children to tell the same story twice was provided by the introduction of an audience who had presumably not understood their story the first time they were told it.

Finally, the task of telling a story in a social setting such as the one where an audience is present was considered to reflect existing pedagogical practices in the school, where children were observed to be asked to tell stories for their classmates on various occasions both during literacy hours and assembly. Also, it was felt that having children tell their stories in a social setting where their schoolmates were playing the role of an audience would provide a friendly and supportive environment for the children telling their stories in what could, otherwise, have felt like an intimidating situation.

In relation to (c), the decision to provide the children with a set of pictures which were already representing a clear story line was informed by the literature review, which has argued for the value of using this type of structured resources for scaffolding children's storytelling. Pearce (2003) found that children using sequences of pictures representing a story produced longer, referentially more complex and evaluatively richer stories. Berman (1995) also found that six and seven year olds benefit more than pre-schoolers from being provided with sequences of story pictures, as it is not until this age that children are capable of moving beyond the tendency to describe pictures rather than producing plot driven stories.

Moreover, children have been found to tell better stories when the picture sequences are problem based, i.e. they represent a story where a problem drives the entire plot, than when they are event based, i.e., they represent a variety of episodes which are not unified by a plot driving problem (Shapiro & Hudson, 1991). The authors argue that children may be aware of the referential requirements of a good story, but they find it hard to do so if they are also required to invent or remember a story. However, making a story based on given story pictures facilitates the storytelling task, thus leading to more referentially complex storytelling. Also, the literature recommends that children should be allowed to preview the picture sequence before they tell their story, as allowing them to see the pictures sequence while they tell their story leads to better understanding of the overarching theme of a story, and therefore to the production of more referentially complex stories (Hudson & Shapiro, 1991).

The importance of providing children with structured resources for them to base their story on was also observed in the StoryTable Case Study, where it became clear that simply providing a set of story settings and characters for the children to actively manipulate was not sufficient to help them tell stories which were referentially complex, evaluatively rich, and coherent. These observations and the above mentioned literature review provided a strong enough motivation to operate with more structured resources than those provided in more open ended environments, such as those used to evaluate the TellTale (Ananny, 2002; Ananny & Cassell, 2001) and Jabbesrtamp (Raffle et al., 2007) storytelling technologies.

The design of the pedagogical scenario also involved decisions about (d) access to the resources: in this study, the children who made their story could access the pictures they were presented with as well as the drawings they had constructed. Allowing children to view the story pictures when they tell their story is common in children's storytelling studies, as it facilitates their inclusion or referential (Shapiro & Hudson, 1991) as well as evaluative (Bamberg & Damrad-Frye, 1991) elements in their stories.

However, the children were warned that their audience would not be allowed to see the pictures or the constructed drawings. This was done in order to ensure that the children would realize that the task was about creating stories as a standalone product which is separate from the representations the stories originates from, and that their story should be comprehensible for an audience without being accompanied by pictures. As Bokus and colleagues (Bokus, 1979, 1991; Bokus & Shugar, 1979) found, children's referential productions are less dependent on the pictures they base their productions on when they produce messages for an audience who is naive to the content of the pictures. Moreover, if the pictures had been available for the children to draw the audience's attention to while telling their stories, they would have found the verbal account to be redundant and almost unnecessary.

This situation was, indeed, observed during a classroom observation session prior to this study, where a child was telling the story of how his football team won a match to the rest of the class, while showing a video recording of the match: because the child was able to refer to the video recording to explain what he wanted to say, he often left his sentences incomplete and did not seem to put as much emphasis on his verbal account. This situation is reflected in the Gricean Conversational Maxim of Quantity (Grice, 1989), which states that speakers do not make their utterance more informative than is required. A similar principle has been formulated for collaborative situations by Clark and Wilkes-Gibbs (1986): they state that collaborators invest the least collaborative effort required for a message to be understood. This means that if a speaker is able to refer to a shared representation to communicate his point, then he will minimise his verbal effort to explain what is represented, as that would be perceived as redundant and therefore against the least collaborative effort principle (Clark & Wilkes-Gibbs, 1986). In literacy education (DCSF)[7], however, one of the most important goals for children to achieve is the use of de-contextualised or dis-embedded language, i.e. language that can be understood without the need to refer to a context which is external to the verbal message formulated (Cassell, 2004; Michaels, 1986; Nicolopoulou, 1996; Snow, 1983). This is a pre-condition for successful

[7] http://nationalstrategies.standards.dcsf.gov.uk/node/104310 [Accessed 10 May 2010]

written communication, where context external to the written word is not available, and therefore the written word needs to make sense to a reader in and of its own. Therefore, this study is aimed at encouraging children to produce stories in the form of verbal accounts that would be understandable for an audience as a standalone product.

Finally, the pedagogical scenario involved grouping children into triads and providing each group with two mice. The decision to involve triads of children was informed by conversations with the school teachers, indicating that children were familiar with working together in pairs of in small groups. Groups of three children meant that potential conflict situations would be less likely to occur, where one child has a story idea and the other children objects to it, resulting in an impasse where the children are unable to find agreement on their collaborative story. Also, groups of more than three children would have made access by all children to the computer screen problematic.

The decision to assign two mice per triad was informed by the literature on the provision of concurrent access to resources, indicating that although concurrent input has been shown to promote higher levels of activity and less time off task (Inkpen, Booth, Klawe, & Upitis, 1995; Inkpen, Ho-Ching, Kuederle, Scott, Shoemaker, 1999), this increased engagement might come at the expense of productive verbal interaction (Stewart, Bederson, & Druin, 1999; Stanton, Neale, & Bayon, 2002; Stanton & Neale, 2003). Therefore, it was decided that while providing one mouse only could have led to the disengagement from the activity on part of the two children without a mouse, providing three mice could have potentially disencouraged children form engaging in verbal interaction. Thus, two mice were provided for each triad.

2. Method

2.1 Design

This study employed a 2 by 2 design with two within subjects factors: the first factor was stage (with two levels: telling and retelling), and the second factor was drawing (with two levels: non-drawing retelling and drawing retelling).

Each triad of children told two stories (one story at Time 1 and one story at Time 2), and each story was told twice: the first time each story was told will be called telling; the second time each story is told will be called retelling. The children used KidPad in all stories, but there were two versions of KidPad: one where drawings could be made (drawing KidPad version) and one where drawings could not be made (non-drawing KidPad version). The first time each story was told (telling), the non-drawing version of KidPad was used. The second time each story was told (retelling), however, one of the two versions of KidPad was used: in the non-drawing retelling, the children used the non-drawing version of KidPad; in the drawing retelling, the children used the drawing version of KidPad. As drawing was a within subjects factor, each triad completed both tasks: one with a story being told using the non-drawing version of KidPad at telling, followed by the non-drawing version of KidPad at retelling, and one with the non-drawing version of KidPad being used at telling, followed by the drawing version of KidPad at retelling.

The order in which the drawing and the non-drawing retellings were administered was counterbalanced (see Table 6).

Table 6 *Counterbalancing of drawing and non-drawing retellings.*

	Time 1		*Time 2*	
Retelling Order	*Telling*	*Retelling*	*Telling*	*Retelling*
1 (Non-drawing /Drawing)	Non-drawing KidPad	Non-drawing KidPad	Non-drawing KidPad	Drawing KidPad
2 (Drawing /Non-drawing)	Non-drawing KidPad	Drawing KidPad	Non-drawing KidPad	Non-drawing KidPad

The two stories were based on two sets of story materials: one was about a monkey who has lost his mum, and another was about a boy who has lost his pet frog. The content of two stories told by the children (henceforth called *frog story* and *monkey story*) was counterbalanced, as shown in Table 7.

Table 7 *Counterbalancing of Monkey and Frog story content.*

	Time 1		*Time 2*	
Content Order	*Telling*	*Retelling*	*Telling*	*Retelling*
1 (Monkey/Frog)	Monkey Story	Monkey Story	Frog Story	Frog Story
2 (Frog/Monkey)	Frog Story	Frog Story	Monkey Story	Monkey Story

2.2 Materials

The children used KidPad to make all their stories (although they used it in different modes according to the retelling condition to which they were assigned). The software allows children to augment drawings by means of different tools for navigating (Hyperlinking tool) and notating (Turn Alive Tool, X-Ray Window tools) the drawings. These tools can be hidden from the user, thus making KidPad non-drawing software. In this study, the non-drawing version of KidPad was used for the non-drawing retelling, while the drawing version (with the above mentioned tools) was used for the drawing retelling.

Two picture story books were used: *Frog, Where are You?* (Mayer, 1969) and *Monkey Puzzle* (Donaldson & Sheffer, 2000). The former has been used extensively in studies investigating children's literacy skills (Bamberg & Damrad-Frye, 1991; Berman, 1988; Boltman, 2001; Trabasso & Nickels, 1992). The latter was selected because of the strong similarities in the structure of the story that was depicted: both stories present a protagonist who has lost someone or something and engages in number of attempts to find them (see Appendix IV). The Monkey Puzzle book was held int he school library, and it is likely that the children will have heard the story before. The Frog story is also a popular one, and the children might have heard about it, too. However, this task was not about retelling a story as they had heard it being told to them, but rather about using the pictures to inspire the construction of a new, collaborative story. For example, the character's emotional states, their thoughts and their reactions to the events could have been different to the ones described in the original book containing text as well as pictures. Moreover, additional characterisation could be added, to represent a departure from the original book. Therefore, although the children's prior knowledge of the stories might have influenced their performance at collaborative storytelling, it is reasonable to assume that this was considered by the children as a new task, providing freedom of expression and negotiation among the children.Finally, prior knowledge of the stories would have presumably impacted equally on both the drawing and non-drawing tasks, and therefore would not have impacred on the key aspect of this study, i.e., the identification of any difference in the quality of the collaborative storytelling in the two tasks.

In order for the story-making exercise to be accomplished within a reasonable time where the children would not lose focus or interest in the activity, a sub-set of 10 pictures from the story books was used in the study. In both stories used, this sub-set of pictures represented the following story elements: an introduction of the main characters (a protagonist and his helper) and the problem (they have lost someone or something), the main character's reaction (the desire to search and find what has been lost), a number of episodes where the main character and a helper pursue their goal, and a resolution.

All pictures in the *Monkey Puzzle* original story book were in colour (Donaldson & Scheffer, 2000), whereas all pictures in the *Frog, Where are You?* original story book were black and white (Mayer, 1969). In order for the story materials to be as similar as possible to each other, a coloured picture version of the *Frog, Where are You?* story was used (Boltman, 2001).

As the *Frog, Where are You?* story book did not present any words while the *Monkey Puzzle* story did, the scanned images from the *Monkey Puzzle* story were electronically modified so that they did not contain any word. An additional caption was added to the first picture in both sets of story pictures, that read "I have lost my frog!, said the boy" in the *Frog, Where are You?* story, and "I have lost my mum!, said the monkey" in the *Monkey Puzzle* story. This was done in order to facilitate children's understanding of the overarching goal in the story pictures they would be using (Hudson & Shapiro, 1991). Without this minimal caption, the goal of the story would not become clear until the children see the last picture, where the object of the protagonist's quest (i.e. the monkey's mum and the boy's frog) is finally displayed. The pictures were uploaded into KidPad and displayed in the same sequence they were presented in the picture story books for the children to use.

Finally, the Vocabulary and the Similarity sections of the Wechsler Abbreviated Scale of Intelligence test (Wechsler, 1999) were used for the purpose of grouping the children in the 'Story-production' group (see Participants and Grouping).

2.3 Participants and Grouping

Forty-six children participated in this study. They were recruited from two Year 2 classes in a local primary school. Consent to take part in the study was obtained from all children's parents or guardians, as well as clearance from the Ethics Committee in the School of Psychology at the University of Nottingham.

Ten children were assigned to the role of 'audience' and grouped into five pairs. The remaining 36 children (14 boys and 22 girls) were allocated to triads and their stories were analysed for testing the hypotheses. The age of the 36 children ranged from six years and four months to seven years and five months, with a mean age of six years and ten months (SD = 4 months).

The 36 children were grouped into triads according to their verbal abilities as well as their personal preferences and attitudes towards working together. In order to obtain a measure of the children's verbal abilities, each child was administered the verbal intelligence sections of the Wechsler Abbreviated Scale of Intelligence (i.e. the Vocabulary and the

Similarity sections) (Wechsler, 1999). Personal preferences and attitudes towards working together were gathered through informal conversations with the children's teachers. By the time of the study, the teachers had worked with these children for over half of the school year, and were considered to be a reliable source of information about children's personal preferences as well as attitudes towards working together.

These criteria (verbal ability and personal preferences and attitudes) generated 12 groups of three children, where each group was as homogeneous as possible. This was done in order to ensure that no group was composed of children (a) whose verbal abilities were so varied that some group members would have been at a clear advantage or disadvantage in carrying out the task, and (b) who disliked working together or who were particularly incompatible at working together.

2.4 The school context

The study was carried out in a local school called Albany Infant and Nursery School, which was situated in a predominantly white, low to middle income community. The most recent Ofsted inspection in 2006[8] found the school to be above the national average for reading, writing and mathematics, and the report graded it as Good (score = 2) on a 4 point scale ranging from Inadequate to Outstanding.

The school accommodates two Year 2 classes of about 20 children; class numbers are kept as small as possible in order to facilitate teaching. Informal observations revealed an enthusiastic and dedicated staff working as a team in a friendly, safe and stimulating environment. Teachers track each child's progress through accurate reports against which individual and group targets are compared. Findings are shared with the children's parents and their suggestions are welcomed and valued. For children with special needs, 'booster' groups are created or support in reading, writing and mathematics, where extra support from teaching assistants is provided to small groups of children. The school also benefits from the

[8] http://www.ofsted.gov.uk/oxedu_providers/full/(urn)/122547 [Accessed 10 May 2010]

support of a trained Special Educational Needs Coordinator (SENCO), an educational psychologist, and works closely with their local health service. Moreover, the school works collaboratively with other local schools and professionals to provide a rich program of extra-curricular activities, such as dance, theatre, foreign language, cooking, and after school clubs. Events such as the Easter Parade, Carnival Day, World Book Day, Chinese New Year, Harvest Festival, PE Week, Pupil Voice Week, Healthy Living Week, Media Week, and many more are organised every year in an effort to facilitate children's cultural awareness and broaden their creative skills. Finally, the promotion of design and technology skills plays an important role in the school's mission, especially in the area of literacy. The school has a long standing tradition of collaboration with the University of Nottingham, including a participation in the EU funded KidStory project in the role of end users for the evaluation of various technologies to support collaborative story-telling.

The study was conducted in the school library, where the triads of children were assembled and instructed to create a story together using KidPad. The study was divided into the five phases illustrated in Procedure. All phases were video-recorded: one camcorder was set up to record interactions in KidPad and one camcorder was set up to record the children themselves (see Figure 24). In order to allow children to access the story pictures at the same time and therefore encourage co-construction, the children were given two mice to make their story. A small version of a normal sized mouse was used, that was designed to facilitate use by children.

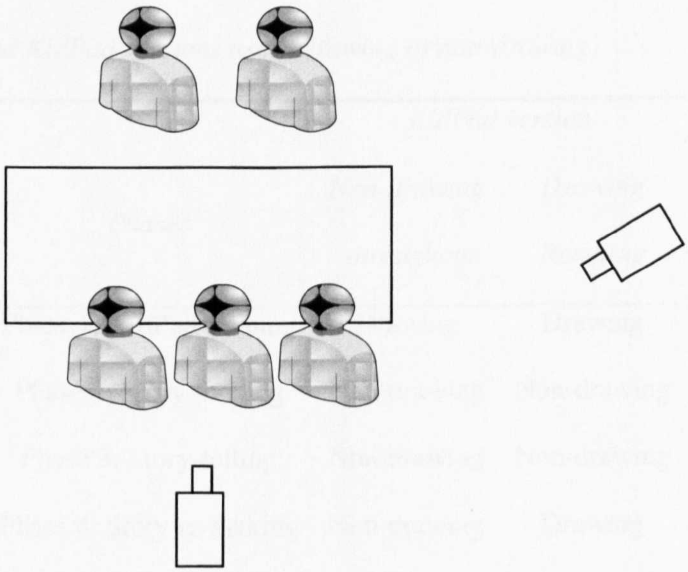

Figure 24. Study set-up: triads of children tell their story to their 'audience'.

2.5 *Procedure*

The intervention task differed from the control task with regards to the KidPad mode used at retelling (drawing or non-drawing). The drawing version of KidPad included the Hyperlinking, the Turn Alive and the X-Ray Window tools (see Chapter 2, Section 4.2), while the non-drawing version of KidPad did not include any of the drawing tools and was simply used as picture browsing tool.

Table 8 illustrates how the different phases map onto tasks. As the table indicates, both the drawing and the non-drawing tasks share the same instructions in Phases 1-3, with the difference between them represented by the two different versions of KidPad used in Phases 4-5.

Table 8 *Phases and KidPad versions used (drawing or non-drawing)*

Phases	*KidPad version*	
	Non-drawing throughout	*Drawing Retelling*
Phase 1: KidPad training	Drawing	Drawing
Phase 2: Story-making	Non-drawing	Non-drawing
Phase 3: Story-telling	Non-drawing	Non-drawing
Phase 4: Story re-making	Non-drawing	Drawing
Phase 5: Story-retelling	Non-drawing	Drawing

2.5.1 Phase 1: KidPad Training

The KidPad training phase took place in the school's computer suite, where children were trained to use KidPad in random groups of three. They were given 30 minutes training, during which the experimenter illustrated the Hyperlinking, the Turn Alive and the X-Ray Window tools, and each child had the opportunity to practice with the software. At the end of the session, the experimenter asked each child in the group to demonstrate how to create a link, zoom in and out, draw something and make it 'wiggly' with the Turn Alive tool, make things appear and disappear with the X-Ray Window, and pan across the screen. If the children were not able to perform these tasks, the experimenter would show them how to do it one more time. This procedure was repeated until all children were able to perform the basic tasks described above (usually no more than two procedure iterations were necessary for the children to be able to demonstrate the use of the three tools).

2.5.2 Phase 2: Story-making

Each triad of children was taken to the school library, where two camcorders and a laptop running KidPad were set up. The pictures from one of the two stories described in Materials had previously been uploaded into KidPad by the experimenter. The children were instructed as follows:

> I am going to show you a sequence of pictures representing a story. The order in which I am showing you the pictures is important for you to understand the events in the story. I want you to tell this story to two of your school mates, who have never seen these pictures or heard the story before. They will not be able to see the pictures on the computer, but you will. You must try and tell the story to them as clearly as possible, so they will understand it. It is important that they understand the story because I am going to ask them to re-tell your story to someone else, someone who has never heard the story before. So, please try and tell your story as clearly as possible to your school mates, so that they will be able to tell it to this other person in the same way as you told it to them.

The experimenter then proceeded to show the pictures to the children. She browsed through the pictures in KidPad one by one, and for each picture she asked the children "What is this picture about?" and "What happens in the story here?". If the children's response to the experimenter's questions indicated that they had not understood what the picture is about, then she would say "I am not sure this is what this picture is about: can you think about what this picture is about in the story?". If their answer still indicated that they had not understood what the picture is about in the story, then she would progressively give more and more hints until it was clear that the children had understood what the picture was about. For example, if the children focused on something in the picture that was not a main feature in the story (e.g., the picture is about bees flying in the air), and neglected the main features (e.g., the dog is trying to find the boy's frog in the bee-hive, and he is being chased by the bees for doing that), the experimenter would encourage them to focus on the main story feature in the picture is (e.g., by saying "What about the dog: what is he doing with the bees, and why?").

Subsequently, the experimenter turned the camcorders on, and the children were given up to 30 minutes to independently browse through the pictures and create their story. If the children said they were ready before the 30 minutes had elapsed, they were asked if they felt confident enough to tell the story straight away, or if they would rather rehearse it for a bit longer. If they answered that they were confident they were ready to tell the story, one of the pairs of children in the 'audience' role was invited to the school library and the next phase (Phase 3) could begin. If the children answered that they would like to take a bit more time to rehearse their story, they were allowed to do so until their 30 minutes were over.

2.5.3 Phase 3: Story-telling

A pair from the children assigned to the 'audience' role was called into the school library space and instructed as follows:

> Your school mates here are going to tell you a story. Please try as hard as you can to understand the story.

The children were then invited to tell their story to their schoolmates[9].

2.5.4 Phase 4: Story-Remaking

In this phase, the pairs of children were invited to go back to their classroom, and the triad of children who had made the story in Phase 2 were invited back into the library. The following instructions were then given to the children:

> Your school mates did not tell your story quite how you had told it to them. You can work on your story again for a while, and then retell it to your school mates again. Let's see if they understand your story, this time! Once again, when you tell the story, you will be able to look at the pictures, but your school mates will not.

[9] These could be from their class or from another Year 2 class in the same school.

The children then proceeded to work on their stories again. In both conditions (Drawing and non-drawing version of KidPad), the children were given up to 40 minutes to work on their stories.

2.5.4.1 Drawing version of KidPad

The children were then given the following instructions on how to work on improving their story:

> Your school mates did not tell your story quite how you had told it to them. You can work on your story again for a while, and then retell it to your school mates again. Do you remember how we used KidPad to create links [Hyperlinking tool] and to make things wiggle [Turn Alive tool] and to make things appear and disappear [X-Ray Window tool]? I'd like you to use those KidPad tools on your story to help you think about how to make it clearer so your school mates understand it when you tell them your story next time. For example, you may want to use one of those KidPad tools to explain that it was important for the boy [or monkey] to find his frog [or mum] back. You could draw a sad face that appears and disappears in the first picture, to mean that the boy [or monkey] becomes sad when he sees he has lost his frog [mum]. Or you could use it to draw what he is thinking. Or you could draw something wiggly to mean that the flowers are moving in the wind. Or you could use a link from the boy [or monkey] to the frog [or mum] in the last picture to mean that he loves her very much. So when you are telling the story to your school mates again, you'll have those things you have created in KidPad to remind you that you should mention that the boy [monkey] becomes sad when he sees that he has lost his frog [mum], etc. Remember that you are trying to improve your story so your school mates understand it, but you are not changing what happens in your story!

The experimenter was available throughout the entire time to assist with possible technical issues or to reiterate the task in case the children showed that they had not understood it (for example if the children had not made use of any KidPad tool after a sustained period of time).

2.5.4.2 Non-drawing version of KidPad

The children in the control group were given the following instructions on how to work on improving their story:

> Your story was good, but I think it can be improved, as your school mates did not understand it very well. So, I'd like you to think about how to make your story clearer so your school mates understand it when you tell them your story next time. For example, you may want to explain that it was important for the boy [or monkey] to find his frog [or mum] back. Or you could explain what he is thinking. Or you talk a bit more about what the place looks like in the story. Or you could say that the boy [monkey] loves his frog [mum] very much. Remember that you are trying to improve your story so your school mates understand it, but you are not changing what happens in your story!

2.5.5 Phase 5: Story-Retelling

In this phase, the same pair of children who had listened to the stories in Phase 3 were called into the library again, and explained that their school mates had been working to improve their story and that the story they were about to listen to was the improved version the children had been working on. Once the story had been re-told, all children were thanked for participating, and were allowed a few minutes of free play with KidPad should they express the wish to.

2.6 Measures

The stories were transcribed and analysed with respect to how many words they contained, how many propositions they contained, and to what extent they included referential and evaluative elements, and to how coherently the turns built on one another. When coding a story, the coder would read the entire story first, in order to get the gist of it, and then proceed to code for referential complexity, evaluative richness, and coherence. For inter-rater reliability coding, the second coder was shown the instructions below, and asked to code a sub-set of the stories. As the concept of a good story includes that it can be understood and appreciated by an audience without it needing to access the pictures the story is based upon, and the children were instructed to tell a story that could be understood by a naíve peer audience, the rater did not have access to the pictures. This was done in order to enable the rater to judge the stories from the perspective of a naive audience.

2.6.1 Story words

The measure used for length was number of story words, and it provided a simple and objective platform to base any further analysis on the quality of the stories.

2.6.2 Story propositions

In order to obtain a first measure of the quality of the story in terms of the number of ideas expressed in it, the stories were segmented into propositions. Propositions are composed of a group of words consisting of a subject and a predicate (where a predicate can be composed of a verb only, or a verb and its attached phrases) (Bamberg & Damrad-Frye, 1991; Foster, Tonkyn, & Wigglesworth, 2000; Peterson & McCabe, 1983). It is important to note that a clause does not correspond to the notion of a sentence, as a sentence can be composed of more than one clause. For example, the sentence: 'I didn't know that this restaurant was run by a famous chef' is composed of the following two clauses: 'I didn't know' (where 'I' is the argument or subject, and 'didn't know' is the predicate) and 'that this restaurant was run by a famous chef' (where 'this restaurant' is the argument or subject, 'was run' is the predicate or verb, and 'by a famous chef' is a prepositional phrase). Although propositions are usually composed of a single verb element, infinitives, modal and aspectual verbs are included within the main verb and are therefore not considered as a separate proposition. So, for example, 'wants to find', 'might know', and 'would ask' are considered as one proposition each.

Numerous studies have used propositions as a unit of analysis for children's stories (Bamberg & Damrad-Frye, 1991; Bamberg & Marchman, 1990; Berman & Slobin, 1994; Peterson & McCabe, 1983; Reilly et al., 2004) and its psychological validity in representing units of meaning has been extensively demonstrated (Kintsch, 1988; Kintsch & van Dijk, 1975, 1978). Very few authors, however, have explicitly addressed the difficulties of segmenting speech due to its often elliptical, unstructured, improvised nature which means that utterances are not always as well formed as written language tends to be. This can be said to be particularly true for children's speech, as the stories collected in this study reveal. Based on Foster, Tonkyn and Wigglesworth's discussion of the treatment of speech segmentation in the psycho-linguistic literature (2000), as well as Berman and Slobin's description of their procedure for segmenting children's oral stories (1994), the following special cases and segmentation rules were formulated:

- False starts and reformulations: the repaired portion is included into the final version of the proposition, to form a single unit of analysis. For example, "and the frog...the boy went out" is considered as one unit.
- Ellipsis: portions of speech where a verb is missing due to grammatical reductions but the verb can be reconstructed from the meaning of the surrounding text are considered as a separate proposition. For example, in the sentence "the boy looks under the bed and the dog in the jar" is composed of two propositions: "the boy looks under the bed" and "the dog [looks] in the jar".
- Onomatopoeic: portions of speech which serve an onomatopoeic function (such as "splash!", "yippie!", etc.) are considered as separate a proposition.

2.6.3 Referential complexity

This measure was aimed at capturing the extent to which the plot driving information contained in the pictures was included in the children's stories. The identification of the referential elements was based on the definition of referential elements provided in Stein & Glenn (1979), which include a setting, an initiating event (i.e. a problem to be addressed), one or more characters' reaction (i.e., their intention to address the problem), their attempt(s) at solving the problem, and a final (positive or negative) resolution of the problem. As explained in more detail in the Literature Review chapter (Chapter 2, Section 1), this definition of the key components of a story's referential quality have been used extensively in the last few decades of research on children's storytelling, and has not been substantially questioned or modified since Stein and Glenn (1979) formulated it. Therefore, this definition served as a foundation for the coding scheme employed here.

Both sets of picture stories used in this study illustrated these referential elements, and these were included in the coding scheme. However, although these elements constituted the backbone for the coding scheme, an additional element was included, to refine and adapt it to the specific story pictures the children were given. The additional element consisted in coding whether the main character's helper (i.e., the butterfly helping the monkey in the monkey story, and the dog helping the boy in the frog story) is mentioned in the various scenes. This was done in order to make the scheme more sensitive to the complexity of the story plot and to capture more subtle differences in the amount of information the children included in their stories based on the picture they were given. The following elements were coded:

SETTING: Introduction of the main characters. In the monkey story, this corresponds to stating that the story is about a monkey and a butterfly; in the frog story, this corresponds to stating that the story is about a boy and a dog.

INITIATING EVENT: A statement of the problem situation which initiates the story quest. In the monkey story, this corresponds to stating that the monkey has lost his mum; in the frog story, this corresponds to stating that the boy has lost his pet frog.

REACTION: A response by the main character which leads to the creation of a goal. In the monkey story, this corresponds to the monkey stating that he intends to look for his mum; in the frog story, this corresponds to the boy stating that he intends to look for his pet frog.

ATTEMPTS: An action carried out by the main character to achieve the goal. In the monkey story, this corresponds to (a) the monkey and the butterfly asking different animals if they have seen the monkey's mum or (b) the butterfly asking the monkey if different animals are the monkey's mum herself. In the frog story, this corresponds to the boy and the dog looking for the boy's pet frog in different places.

RESOLUTION: Attainment or non-attainment of the goal by the character. In the monkey story, this corresponds to the monkey and the butterfly finding the monkey's mum. In the frog story, this corresponds to the boy and the dog finding the boy's pet frog. An explicit statement of the non attainment of the story goal is also acceptable as a Resolution, as the story can be ended in different ways by the children. Because the focus of this analysis is on the presence or absence of a certain details rather than specific content in the story, any content that counts as a positive or negative resolution to the stated problem counts as Resolution.

The content of children's stories was measured by assigning a score to the stories according to the coding scheme described here. The individual elements, how they relate to the pictures provided in the study, and their relative scoring are reported in Appendix IV. As the tables show, a weighted scoring system was developed, whereby 1 point is assigned to elements in the story which only concern the protagonist (the monkey or the boy), and 0.5 point is assigned to elements which involve both the protagonist and his helper. For example, Scene 1 of the Monkey Story contains 3 elements (i.e., setting, initiating event, and reaction) where the protagonist (i.e., the monkey) appears without the helper; for this reason, the children's stories would obtain 1 point for including each of these elements. In Scene 3, however, because the Attempt element is shared by the protagonist and the helper, the children's stories would obtain 0.5 point for mentioning of the protagonist's attempt (i.e., the monkey inquiring about his mum with the elephant), and another 0.5 points for mentioning that the helper (i.e., the butterfly) was there to support the protagonist in his attempt. In case the children mentioned a list of all attempts and stated that the helper was there to support the main character throughout, the story would score a full point for each attempt.

Although this way of assigning scores to the individual elements is specific to the content of the story pictures used and therefore makes it harder to compare story quality results with those found in the existing literature, this focus on capturing the specific quality of the stories produced is not unprecedented in the literature (Graves, Semmel, & Gerber, 1994; Reuterskiöld Wagner, Sahlén, & Nettelbladt, 1999). Fundamentally, although specific to the story content provided in this study, this approach remains true to the way referential complexity has been defined in the literature (e.g., Setting, Initiating Event, Reaction, Resolution). Therefore, this coding scheme was deemed appropriate in that it combines the generality of the notion of referential complexity as defined in the literature, while adapting it to capture the specificity of the story materials provided.

2.6.4 Evaluative richness

2.6.4.1 The coding categories

This measure was aimed at capturing the extent to which the children enriched the plot driving elements presented in the pictures by giving flavour to the story through style, thus making it more interesting for an audience (see Literature Review, Part 1). The coding scheme was fairly complex (it is articulated into 18 categories) and was inspired by previous research analysing evaluative richness in children's stories (Bamberg & Damrad-Frye, 1991; Hudson & Nelson, 1983; Hudson & Shapiro, 1991; Peterson & McCabe, 1983; Reilly, Bates, & Marchman, 1998; Reilly et al., 2004; Ukrainetz, Justice, Kaderavek, Eisenberg, & Gillam, 2005). The first coding scheme to be used extensively by other researchers studying children's stories and their evaluative aspects was devised by Bamberg & Damrad-Frye (1991), and it included the following five categories:

INTERNAL STATE: Affective states (e.g., feel, love, hate) and cognitive states (e.g., think, wonder, know); e.g., "The monkey was feeling scared", "The boy thought it was a rock".

CAUSALITY: The cause or motivation for certain events or states; e.g., "The snake said he didn't know because he was having a nap", "The flowers were happy because the sun was shining".

HEDGE: Indicating a level of (un)certainty; e.g., "She probably left him to go and play", "The frog might be in the mole hole".

CHARACTER SPEECH: Indications that a character is saying something; e.g., "The bat said 'No, I haven't seen your mum'", "The boy shouted out the window 'Frog, where are you?'".

NEGATIVES: Events or behaviours contrary to underlying expectations; e.g., "The monkey asked an elephant, but he didn't know", "the dog looked in the jar, but the frog wasn't there.".

Although these categories are a good starting point for capturing evaluative richness by including important elements (such as characters' internal states and motivations) as well as more nuanced shades in the narrator's way of expressing these elements (such as indications of uncertainty), it has been argued that there are additional ways in which a story can convey a sense of 'flavour' to an audience. Peterson and McCabe (1983), for example, include the two following categories in their scheme for evaluative richness:

EXTERNAL: Location or weather descriptions; e.g., "The sun was shining through the trees", "It was starting to get cold"

ONOMATOPOEIC: Words mimicking sounds; e.g., "Splash!", "Wheeeeez".

More recent research has advocated the use of more comprehensive schemes to capture more formal elements, such as the presence of a formal introducer (e.g., "Once upon a time") and ender (e.g., "And they lived happily ever after"), but also to capture the presence of narrative devices a narrator might use to place emphasis on some elements (e.g. by using repetitions, choosing which elements or themes to stress by reiterating them in an abstract) and to enrich the characters' and settings descriptions (e.g., by giving characters names and personalities, by expressing relations with other characters, etc.), as well as to capture the narrator's use of unusual forms of expression to capture the reader's interest (e.g., sound effects, idiomatic expressions, etc.). One of the most comprehensive attempts at capturing evaluative richness has been proposed by Ukrainetz, Justice, Kaderavek, Eisenberg and Gillam (2005), and subsequently adopted by others (Hayward, Gillam, & Lien, 2007; Justice, Bowles, Eisenberg, Kaderavek, Ukrainetz, & Gillam, 2006). The scheme proposed by Ukrainetz and colleagues (Ukrainetz et al., 2005) includes the following categories:

INTRODUCER: Represents the opening elements indicating the beginning of the story; e.g., "Welcome to our story", "Once upon a time".

ABSTRACT: A summary of the story prior to its plot unfolding; e.g., "This is a story about a monkey who lost his mum", "The boy lost his frog and looked everywhere for it".

THEME: A summary statement while the plot unfolds; e.g., "The monkey kept on asking all the animals", "The dog had been helping all along".

CODA: A general observation about the effect the story had on the characters, such as a lesson learnt; e.g., "The monkey hugged his mum and promised not to walk in the jungle ever again", "The boy was tired from the day's adventure".

ENDER: A formal conclusion; "The end", 'They lived happily ever after".

NAME: Specific identifiers referring to characters; e.g., "Bleautiful Blutterfly", "Bouncy the Frog".

RELATION: Words defining a character's role in terms of relationship or job; e.g., "His mum", "His pet frog".

PERSONALITY: Enduring features or attributes of a character; e.g., "He was a lazy monkey"; "the dog was always getting himself into trouble".

MODIFIER: Adjectives or adverbs which qualify another element; e.g., "A stripey elephant came along", "He was extremely happy to see his frog".

EXPRESSION: Phrases of idiomatic usage; e.g., "As fast as the wind", "Easy peasy".

REPETITION: A word or phrase that is used more than once to ad emphasis; e.g., "Hello butterfly, can you please please help me?", "Frog, froooog, come back".

In this study, the schemes proposed by Bamberg and Damrad-Frye (1991), by Peterson and McCabe (1983) and by Ukrainetz, Justice, Kaderavek, Eisenberg and Gillam (2005) were combined into a comprehensive coding scheme, which included: internal state, causality, hedge, character speech, negatives, external, onomatopoeic, introducer, abstract, theme, coda, ender, name, relation, personality, modifier, expression, repetition. This was done in order to ensure that the evaluative richness of the stories produced by the children could be captured through a coding scheme which was sensitive to the many ways in which children can give 'flavour' to their story and captivate their audience's attention. As some categories required an overall understanding of the story gist (e.g., abstract, theme, coda), the coder was required to read the entire story before starting with the actual coding.

2.6.4.2 Segmentation

The stories were segmented into propositions, i.e., a unit of analysis consisting of an argument and its predicate. Propositions are identified based on the psycholinguistic literature defining this concept as "the smallest unit of meaning that can be put in predicate-argument form (with a verb operating on a noun)" (Harley, 2008, p. 379).

This reflects the practice reported in studies on children's storytelling abilities (Bamberg & Damrad-Frye, 1991; Peterson & McCabe, 1983; Reilly et al., 1998; Reilly et al., 2004). Others (e.g., Ukrainetz et al., 2005) have used T-units, which consist of a main clause and all the dependent clauses that might be attached to it (Hunt, 1970). However, the T-Unit was deemed too large a unit of analysis, as it could potentially encompass large quantities of evaluative content. For example, a sentence like "Once upon a time, there was a scared monkey called Bouncy, who one day got lost in a forest that was far, far away" counts as a single T-Unit, which would have to be coded through multiple categories (in this case, these categories would include Introducer, Internal State, Name, External, Modifier, and Repetition). This is a widespread methodological issue with most linguistics' approaches to analysing stories, as many studies do not seem to recognise the problem of using a unit of analysis which can encompass more than one category from a given coding scheme. As it is common practice in this area that segments are coded with multiple categories (Peterson & McCabe, 1983; Reilly et al., 1998; Reilly et al., 2004; Ukrainetz et al., 2005), this represents a problem for principle of mutual exclusivity (Coolican 1995) and comparability of findings.

Therefore, in this study, the choice of a smaller unit of analysis was deemed necessary in order to make it more likely that one segment would only express content related to one category. Although the choice of a different unit of analysis made it hard to compare findings from this study with those from the main study in the literature employing a similarly comprehensive scheme (Ukrainetz et al., 2005), this unit of analysis was deemed more appropriate for the sake of rigour on mutually exclusivity. For this reason, propositions were selected as a unit of analysis.

Finally, even smaller units such as propositions could express content which falls under more than one evaluative category. For example, the proposition "The boy was very, very sad" would include multiple categories (e.g., Modifier, Repetition and Internal State). On the other hand, a smaller unit of analysis than a proposition would hardly convey any meaning in and of itself. This methodological problem is acknowledged in this thesis, and a solution is adopted in order to circumvent it. Specifically, the propositions are only assigned one code, which indicates whether or not a proposition contains 'any number of categories' from the above illustrated coding scheme. In other words, the approach adopted here accounts for the presence of evaluative element(s) in a given proposition, but does not account for the specific number of categories in any given proposition. While this approach presents a limitation in that it does not account for the density of evaluative devices in any given proposition, it was deemed suitable because by being conservative, it does not break the fundamental requirement for mutual exclusivity in quantitative analysis.

2.6.5 Coherence

This measure was designed in order to capture the extent to which the children built on each others' contributions in their storytelling. As this was a measure of collaboration, consecutive turns were used as a unit of analysis. Each turn was considered with respect to whether it contained an idea expressed in the previous turn, for example by repeating, extending, or modifying it (Bokus, 1992; Tager-Flusberg & Anderson, 1991; Tartaro & Cassell, 2008). Once each segment was coded according to whether it built on the previous turn or not (wither by repeating, extending or modifying), the total number of all coherent turns was computed and normalised against the total number of turns in a story.

A turn is considered to repeat the previous turn's idea if its content is the same, except from minor differences such as use of synonyms, such as in the following example:

Child A: "I have lost my mummy!", said the monkey.

Child B: "I have lost my mum!", said the monkey.

A turn is considered to be an extension of the previous turn's idea if it adds details to the previous idea, whilst not radically changing it, such as in the following examples:

(1) Child A: The boy lost his frog

Child B: His pet frog.

(2) Child A: The sun was shining.

Child B: The sun peaked over the clouds.

(3) Child A: And the monkey said "That ain't my mum: that's my dad!"

Child B: "Even better", said the monkey.

A turn also extends the previous turn when it is a sentence completion, such as in the following example:

Child A: "I have lost my frog"

Child B: said the boy.

In order to establish whether a turn built coherently on the previous one, it was necessary for the two turns to meet some requirements. Firstly, when two consecutive turns did not express ideas in a clear enough way to allow the coder to assess whether they built on one another coherently, they were coded as 'non-coherent'. For example, when direct speech is reported but the identity of the speaker is not expressed and cannot be inferred, it is impossible to conclude whether this turn built coherently on the other. The following example illustrates this, where the two turns do not mention which character in the story is speaking, and it is therefore impossible to determine whether they are part of a coherent dialogue:

Child A: There you are! I wonder where they've gone.

Child B: Come!

Similarly, where pronominal ambiguity is present, a turn was considered to be non-coherent. The following excerpt illustrates this, by showing how it is unclear what the referent for 'she' is in the second turn:

Child A: "The monkey saw lots of animals'

Child B: "And she was his mummy!"

3. Results

The hypothesis tested in this study was that constructing dynamic drawings would lead to better collaborative storytelling. Specifically, it was predicted that at the retelling stage, when the children used the drawing version of KidPad, they would tell significantly better stories (Prediction 1).

A secondary prediction was that the second time a collaborative story is told, its quality is better than the first time. Specifically, it was predicted that at the retelling stage, the collaborative stories would be better than at the telling state. This is regardless of whether the children constructed dynamic drawings or not (Prediction 2).

Before testing the main hypothesis, it was necessary to check whether, and to what extent, the children did, in fact, make use of KidPad's drawing features when they were using the drawing version of KidPad to re-make their stories. For this reason, the number of times the drawing KidPad functionalities were used by the children in the drawing retelling was counted. As Table 9 shows, each triad of children made an average of four representations each over ten story pictures.

Table 9 *Drawings constructed by each triad of children during Phase 4.*

	KidPad tool		
	Hyperlink	Turn Alive	X-Ray Window
Clive Sue Rachel[10]	3	1	1
Danni Karen Steve	0	2	0
James Leo Lizzy	1	2	1
Olga Diane Melanie	0	1	1
Meg Jane Tyler	0	3	1
Abbi Frank Lea	0	2	2
Bart Charles Jenna	1	1	2
Nick Tyler Eleonor	3	1	1
Rob Zed Susanne	1	1	1
Tara Melissa Rita	1	4	2
Rose Brittany Sam	0	4	1
Simon Ciara Lenore	0	2	2

For the statistical analyses, when the data met the requirements of normality, homogeneity of variance and co-variance, parametric tests were used. When data failed to meet these requirements, non-parametric tests were used, instead. This was particularly important in the light of the small size of the sample employed for this study. As all hypotheses were directional, one tailed tests were used.

[10] Pseudonyms are used to protect children's identity.

3.1 Story Words

If the children were benefiting from using the drawing version of KidPad, then their stories at retelling (the only drawing stage) should be better. Specifically, Predication 1.1 stated that stories would be longer when the drawing version of KidPad was used. Also, as children had already practiced telling their stories, Prediction 2.1 stated that retelling stories would be longer than telling stories regardless of drawing condition (i.e. whether they were constructing drawings or not).

In order to test these predictions, a [2 by 2] repeated measures ANOVA was conducted. The first factor was stage (with two levels: telling and retelling), and the second factor was condition (with two levels: non-drawing retelling and drawing retelling). It is important to note that the condition factor only affected retellings, as the stories made at telling did not involve drawing. The data are shown in Table 10 and Figure 25 below.

A significant interaction was found between Stage and Condition ($F(1, 11) = 10.9$, $MSE = 1795.14$, $p = .005$, $\eta_p^2 = .50$). Post-hoc comparisons using the Bonferroni adjustment for multiple comparisons showed no significant differences at telling (both non-drawing) (mean difference = 29.58, $p = .19$) and between the two stages (telling and retelling) when children used the non-drawing version of KidPad (mean difference = 13.67, $p = .35$). However, when children did use the drawing version of KidPad at retelling, their stories contained significantly more words than their first stories (non-drawing telling) (mean difference = 94.42, $p < .001$). A significant difference was also found between the conditions at retelling (mean difference = 51.17, $p = .023$). These findings support Prediction 1.1 about the value of using the drawing version of KidPad to encourage children's production of longer stories.

Prediction 2.1 was also supported, as a significant main effect of stage was found ($F(1, 11) = 16.88$, $MSE = 2076.11$, $p = .001$, $\eta_p^2 = .61$), where retelling stories were significantly longer than the telling ones. Finally, no significant main effect of condition was found ($F(1, 11) = 0.41$, $MSE = 3415.34$, $p = .27$, $\eta_p^2 = .04$), which means that, overall, the condition with non-drawing telling followed by non-drawing retelling did not differ significantly from the condition with non-drawing telling followed by drawing retelling.

Table 10 *Mean number of story words by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).*

	Non-drawing throughout (N = 12)		Drawing retelling (N = 12)	
	Mean	*SD*	*Mean*	*SD*
Telling	161.25	58.52	131.67	53.44
Retelling	174.92	50.33	226.08	82.93

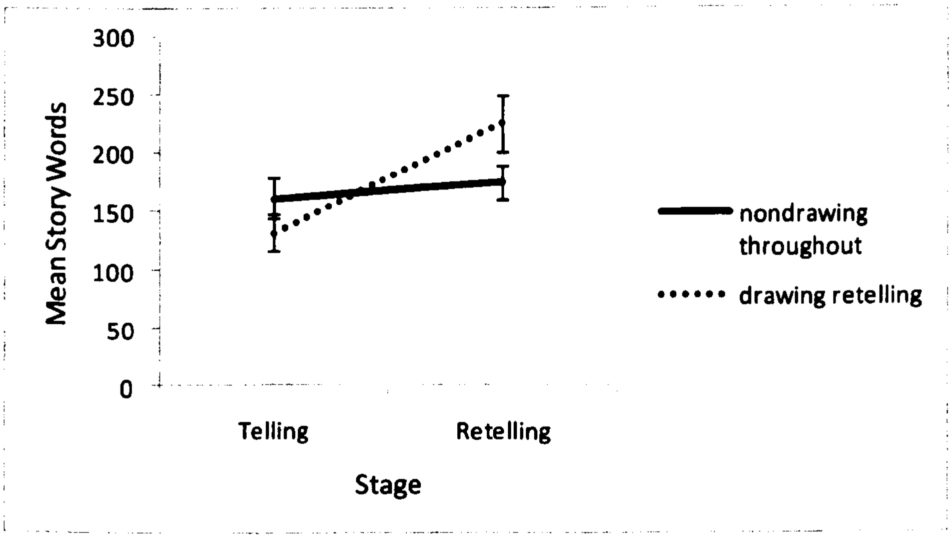

Figure 25. Mean number of story words produced by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).

3.2 Story Propositions

The same predictions for the number of story words were made about the number of story

		Non-drawing throughout (N = 12)		Drawing retelling (N = 12)	
		Mean	*SD*	*mean*	*SD*
Propositions	Telling	34.25	12.85	29.50	14.37
	Retelling	42.58	13.47	51.50	19.75

propositions. In order to test these predictions, a [2 by 2] repeated measures ANOVA was conducted on stage and condition. The data are shown in

Table **11** and Figure 26 below.

A significant interaction between Stage and Condition was found ($F(1, 11) = 4.89$, $MSE = 560.33$, $p = .03$, $\eta_p^2 = .31$). Post-hoc comparisons using the Bonferroni adjustment for multiple comparisons showed no significant difference between the conditions at telling (mean difference = 4.75, $p = .41$) and between the two stages when children did not use drawing version of KidPad (mean difference = 8.33, $p = .09$). However, when children did use drawing version of KidPad at retelling, their stories did contain significantly more propositions than their first, non-drawing stories (mean difference = 22, $p < .001$), although there was no difference between the conditions at retelling (mean difference = 8.92, $p = .23$). These findings support Prediction 1.1 about the value of using the drawing version of KidPad to encourage children's production of longer stories.

Prediction 2.1 was also supported, as a significant main effect of stage was found, where a significantly greater number of propositions were found in retelling stories than in telling ones ($F(1, 11) = 23.76$, $MSE = 2760.33$, $p < .001$, $\eta p2 = .68$). Finally, no significant main effect of condition was found ($F(1, 11) = 0.14$, $MSE = 52.08$, $p = .36$, $\eta p2 = .01$).

Table 11 *Mean number of ftory propositions by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).*

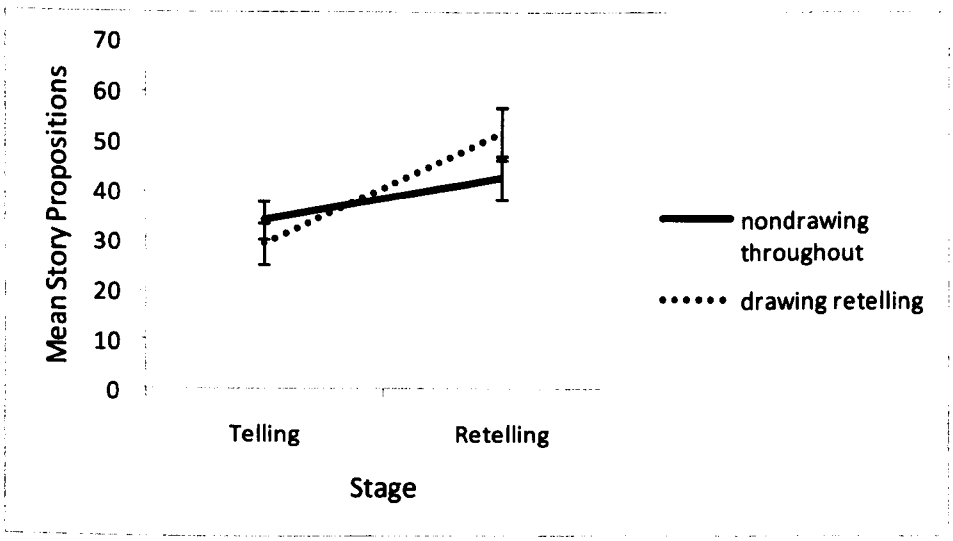

Figure 26. *Mean number of story propositions by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).*

3.3 Referential complexity

All stories were coded according to the Children's Story Content scheme described in Measures. A second coder (blind to condition) coded 25% of the stories and inter-rater agreement was scored for the frog stories (Kappa = .85, $p < .001$) and the monkey stories (Kappa = .87, $p < .001$). Moreover, because the coding scheme was applied to two slightly different stories, the score range for the frog story (0-13 points) was slightly different from the range for the monkey (0-12 points). Therefore, for the purpose of comparison, the scores were normalised. The analysis reported below was conducted on the normalised scores. The data are shown in Table 12 and

Figure *27* below.

If the children were benefiting from using the drawing version of KidPad, then their stories at retelling (the only drawing stage) should be better. Specifically, Predication 1.2 stated that stories would be referentially more complex when the drawing version of KidPad was used. Also, as children had already practiced telling their stories, Prediction 2.2 stated that retelling stories would be referentially more complex than telling stories regardless of drawing condition (i.e. whether they were constructing drawings or not).

In order to test these predictions, a [2 by 2] repeated measures ANOVA was conducted on stage and drawing. The data are shown in Table 12 and

Figure *27* below.

A significant interaction between Stage and Condition was found ($F(1, 11) = 11.82$, $MSE = 1.23$, $p = .005$, $\eta_p^2 = .52$). Post-hoc comparisons using the Bonferroni adjustment for multiple comparisons showed no significant difference between the conditions at telling (mean difference = 1.26, $p = .22$) and between the two stages when children did not use the drawing version of KidPad (mean difference = 0.14, $p = .76$). However, when children did use the drawing version of KidPad at retelling, their stories were significantly more complex than their first, non-drawing stories (mean difference = 2.06, $p = .01$), although there was no difference between the conditions at retelling (mean difference = 0.94, $p = .21$). These findings support Prediction 1.2 about the value of using the drawing version of KidPad to encourage children's production of referentially more complex stories.

Prediction 2.2 was also supported, as a significant main effect of stage was found, where retelling stories scored significantly higher than telling ones ($F(1, 11) = 5.1$, $MSE = 2.16$, $p = .03$, $\eta_p^2 = .32$). Finally, no significant main effect of condition was found ($F(1, 11) = 0.04$, $MSE = 7.52$, $p = .45$, $\eta_p^2 = .004$.

		Non-drawing throughout (N = 12)		Drawing retelling (N = 12)	
		Mean	*SD*	*mean*	*SD*
Referential	Telling	7.43	2.84	6.16	2.73
complexity	Retelling	7.29	2.26	8.23	1.71

Table 12 *Mean referential complexity by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).*

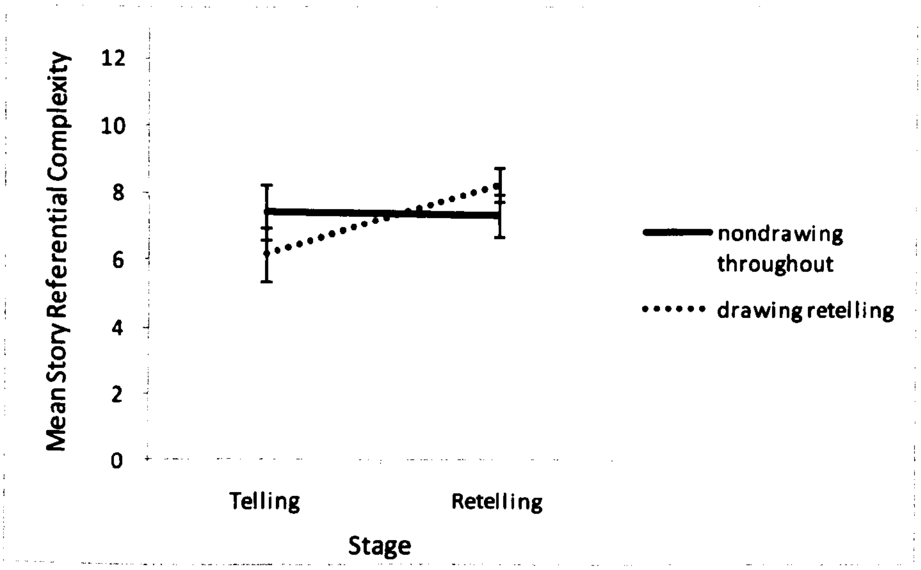

Figure 27. Mean referential complexity by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).

3.4 Evaluative richness

All stories were coded according to the Story Elaboration scheme described in Measures. A second coder (blind to condition) coded 25% of the stories and inter-rater agreement was scored for the frog stories (Kappa = .914, $p < .001$) and the monkey stories (Kappa = .912, $p < .001$).

If the children were benefiting from using the drawing version of KidPad, then their stories at retelling (the only drawing stage) should be better. Specifically, Predication 1.3 stated that stories would be evaluatively richer when the drawing version of KidPad was used. Also, as children had already practiced telling their stories, Prediction 2.3 stated that retelling stories would be evaluatively richer than telling stories regardless of drawing condition (i.e. whether they were constructing drawings or not).

In order to test these predictions, a [2 by 2] repeated measures ANOVA was conducted on stage and drawing. The data are shown in Table 13 and Figure 28 below.

A significant interaction between Stage and Condition was found ($F(1, 11) = 5.94$, $MSE = 85.33$, $p = .02$, $\eta_p^2 = .35$). Post-hoc comparisons using the Bonferroni adjustment for multiple comparisons showed no significant difference between the conditions at telling (mean difference = 2.5, $p = .37$) and between the two stages when children did not use the drawing version of KidPad (mean difference = 2.58, $p = .16$). However, when children did use the drawing version of KidPad at retelling, their stories were significantly richer than their first, non-drawing stories (mean difference = 7.92, $p < .001$), although there was no difference between the conditions at retelling mean difference = 2.83, $p = .44$). These findings support Prediction 1.3 about the value of using the drawing version of KidPad to encourage children's production of evaluatively richer stories.

Prediction 2.3 was also supported, as a significant main effect of stage was found, where retelling stories scored significantly higher than telling ones ($F(1, 11) = 21.43$, $MSE = 330.75$, $p < .001$, $\eta_p^2 = .66$). Finally, no significant main effect of condition was found ($F(1, 11) = 0.003$, $MSE = 0.33$, $p = .48$, $\eta_p^2 = .001$).

		Non-drawing throughout (N = 12)		Drawing retelling (N = 12)	
		Mean	*SD*	*mean*	*SD*
Evaluative richness	Telling	12.08	7.75	9.58	5.85
	Retelling	14.67	7.91	17.50	7.29

Table 13 *Mean evaluative richness by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).*

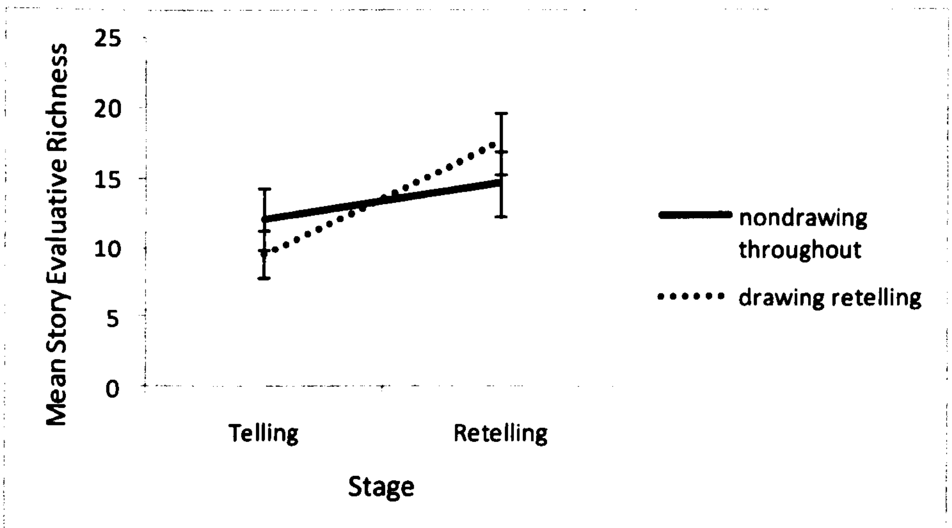

Figure 28. Mean evaluative richness by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).

3.5 Coherence

All stories were coded for Coherence. A second coder (blind to condition) coded 25% of the stories and inter-rater agreement was scored for the frog stories (Kappa = .81, $p < .001$) and the monkey stories (Kappa = .74, $p < .001$).

As the number of turns in the stories varied according to whether they were at telling or retelling stage and whether the children had been drawing or not, the number of turns

		Non-drawing throughout (N = 12)		Drawing retelling (N = 12)	
		Mean	*SD*	*mean*	*SD*
Coherence	Telling	37.53	25.83	34.47	27.33
	Retelling	36.83	20.51	41.83	17.54

building coherently on the previous turn was normalised against the total number of turns in each story (the proportions are expressed as percentages). The data are shown in

Table 14 and Figure 29 below.

If the children were benefiting from using the drawing version of KidPad, then their stories at retelling (the only drawing stage) should be better. Specifically, Predication 1.4 stated that stories would be more coherent when the drawing version of KidPad was used. Also, as children had already practiced telling their stories, Prediction 2.4 stated that retelling stories would be more coherent than telling stories regardless of drawing condition (i.e. whether they were constructing drawings or not).

In order to test these predictions, a [2 by 2] repeated measures ANOVA was conducted on stage and drawing. Unexpectedly, no significant interaction between Stage and Condition was found ($F(1, 11) = 0.70$, $MSE = 194.89$, $p = .21$, $\eta_p^2 = .06$). This finding does not support Prediction 1.4 about the benefits of using the drawing version of KidPad. Also unexpectedly, no significant main effect of stage was found ($F(1, 11) = 0.22$, $MSE = 133.07$, $p = .33$, $\eta_p^2 = .02$); therefore, Prediction 2.4 was not supported. Finally, no significant main effect of condition was found ($F(1, 11) = 0.02$, $MSE = 11.47$, $p = .45$, $\eta_p^2 = .002$).

		Non-drawing throughout (N = 12)		Drawing retelling (N = 12)	
		Mean	*SD*	*mean*	*SD*
Coherence	Telling	37.53	25.83	34.47	27.33
	Retelling	36.83	20.51	41.83	17.54

Table 14 *Mean coherence by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).*

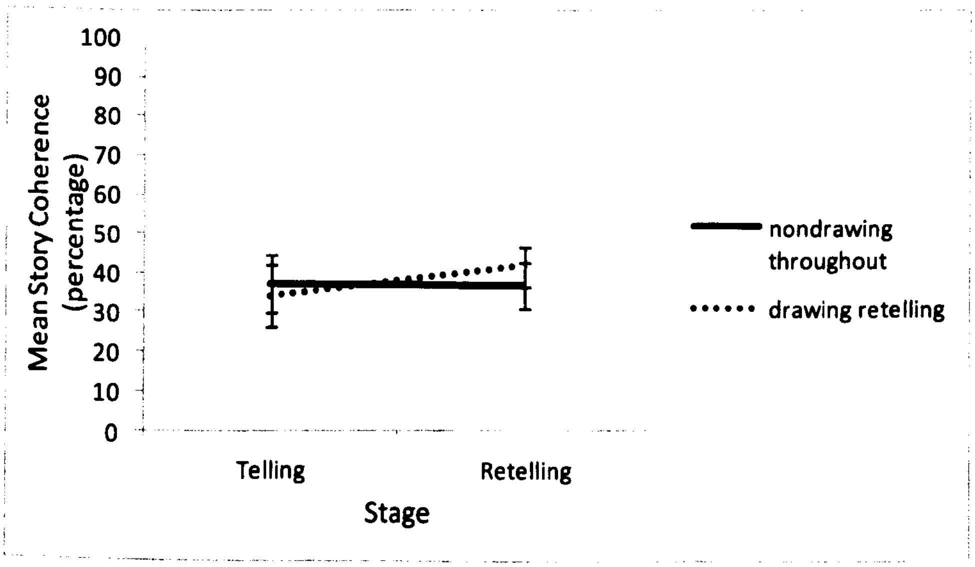

Figure 29. Mean coherence by Stage (Telling, Retelling) and Condition (drawing Retelling, nondrawing throughout).

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4. Discussion

4.1 Summary and interpretation of findings

This study asked whether encouraging children to construct their own representations over provided resources leads to better collaborative storytelling than just manipulating these resources (Research Question 2). It was expected that this activity would encourage the children to attend to the presented and constructed material. This, in turn, was predicted to result in children telling stories which not only include significantly more of the plot driving elements presented in the story pictures (as shown in the story's referential complexity), but also to contain significantly more elaborations of these elements in the form of evaluative devices aimed at enriching the story (as shown in the story's evaluative richness).

Moreover, because the representations produced in KidPad are persistent and shared by the children making the story together, these representations were expected to serve as an 'anchor' for children to engage in interactive discussion, thus facilitating the emergence of a shared understanding. This, in turn, was expected to result in children building significantly more coherently on each others' turns when they tell the story together. Moreover, the articulation and discussion of story ideas was expected to contribute to the telling of referentially more complex and evaluatively richer stories.

Finally, because the stories told after the construction of representations using KidPad were expected to contain significantly more referential and evaluative elements, it was predicted that this difference would affect how long the stories were and how many propositions they contained.

The stories were analysed with respect to how long, referentially complex, evaluatively rich, and coherent they were. The main prediction was that constructing representations in KidPad would lead to retelling stories which were significantly better than the retelling stories where no such support was given (Prediction 1). No difference was expected between the stories at telling, as these involved no construction of representations in KidPad.

The secondary prediction was that due to practice, retelling stories would be significantly better than telling stories, regardless of drawing condition (Prediction 2). Prediction 2 was not specifically about the construction of interactive drawings, and it stated that given the opportunity to make and tell the same collaborative story twice, children will improve the quality of their stories due to a practice effect. This Prediction was supported on most dependent variable measures: analysis showed that retelling stories were significantly longer (both in number of words and propositions), referentially more complex and evaluatively richer than telling stories, regardless of drawing condition.

More importantly, Prediction 1 about the benefits of constructing interactive representations was supported on most dependent variable measures, showing that constructing interactive drawings benefits children's collaborative storytelling.

Results supported Prediction 1.1 about story length with respect to both the number of story words and the number of story propositions. When the children used the drawing version of KidPad at retelling, their stories were made of more words than when they used the non-drawing version of KidPad. Moreover, when the children used the drawing version of KidPad at retelling, their stories contained more words than when they told their story the first time (i.e., non-drawing telling). This last finding was the same for the number of story propositions: when the children used the drawing version of KidPad at retelling, their stories contained more propositions than at (non-drawing) telling. These findings are consistent with the prediction that using the drawing version of KidPad would encourage children's reflection on the story, and therefore the production of longer stories.

A significant improvement from telling to drawing retelling was also found for referential complexity. This supports Prediction 1.2 by showing that using the drawing version of KidPad led to an increase in the number of referential elements contained in the children's stories. Similar findings were reported in Boltman (2001), who demonstrated that presenting children with dynamic representations in KidPad leads to their inclusion of more referential elements in their stories, such as the statement of whether the main character achieves his goal or not. This study shows that similar results can be obtained by asking children to construct their own dynamic representations in KidPad as opposed to being passive receivers of story material. Moreover, the finding in this study shows that similar results to those reported by Boltman can be obtained in a collaborative storytelling context.

Furthermore, a significant improvement from telling to drawing retelling was also found for story evaluative richness. This supports Prediction 1.3 about the benefits of constructing interactive drawings to encourage story elaboration. Previous studies examining children's ability to include evaluative elements in their stories have shown that around the age of six, children start to use these devices consistently (Bamberg & Damrad-Frye, 1991; Botvin & Sutton-Smith, 1977). Ukrainetz, Justice, Kaderavek, Eisenberg and Gillam (2005) also found that by the age of nine, virtually all of the children in their study were able to include some form of evaluative elements in their stories. Although differences in the inclusiveness of the coding schemes used in the different studies as well as story elicitation methods make it difficult to compare among these studies, it is clear that six years old is the age where children become able to include evaluative elements in their stories. This study employed a comprehensive scheme to examine not only whether children included evaluative elements in their stories, but the extent to which they did so, and showed that encouraging the construction of shared representations is an effective way to promote greater inclusion of these devices.

Findings from the analysis on coherence, however, do not support Prediction 1.4. No significant improvement in story coherence was found from telling to drawing retelling; moreover, when the children used the drawing version of KidPad at retelling, their stories were not more coherent than when they used the non-drawing version of KidPad.

An explanation for the lack of effects of construction of shared representations on children's ability to build coherently on each others' story contributions could be that not enough shared representations were constructed in each story-making session. As triads only constructed an average of four representations each over ten story pictures, it is possible that the intervention was not as effective as it could have been. If the children had constructed more representations, it is possible that they would have discussed their story ideas more;

this would have enabled them to achieve a better shared understanding of their collaborative story, and therefore build more coherently on each others' ideas. It is also possible that if more shared representations had been constructed, more extensive benefits could have occurred on the stories' referential complexity and evaluative richness as well. As the results show, at drawing retelling, the children's stories were not significantly better than the non-drawing ones with respect to these two measures. Although this could be explained by the fact that children at this age simply cannot tell stories which go beyond a certain level of referential complexity and evaluative richness, it is also possible that the lack of significant results at retelling was due to the paucity of drawings constructed. The small sample size used in this study could also potentially account for lack of significance in these findings.

An alternative explanation is that the shared representations simply were not a sufficiently engaging 'anchoring point' (Crook, 1995; Crook & Webster, 1997) for children to attend to the story and encode its different aspects through articulation and discussion. In other words, encouraging children to create their own representations in KidPad may not have been enough to encourage the children to engage in interactive discussion during story-making. As a result, the children were in no better position to build on each others' story contributions during storytelling. This could also have affected children's reflection and elaboration on their story ideas, thus leading to a lack of significance between drawing and non-drawing retelling stories on the referential complexity and evaluative richness measures.

Another factor contributing to the lack of discussion could have been the presence of two mice for children to use concurrently. Although concurrent input has been shown to promote higher levels of activity and less time off task (Inkpen, Booth, Klawe, & Upitis, 1995; Inkpen, Ho-Ching, Kuederle, Scott, Shoemaker, 1999), it has been noted that this might come at the expense of productive verbal interaction. As Stewart and colleagues argue (Stewart, Bederson, & Druin, 1999), allowing concurrent interaction, for example through the use of multiple mice, might result in parallel work where users, in fact, collaborate less than if they had to share a single inpur device.This argument is supported by findings by Stanton and colleagues on children's different interaction styles when making stories in

KidPad with multiple or single mouse input (Stanton, Neale, & Bayon, 2002; Stanton & Neale, 2003). They found that although children did verbalise their story ideas for each other when using two mice, the parallel nature of the activity meant that very little interactive discussion was observed, as children did not extend or elaborate on each others' ideas. This was contrasted with the use of a single mouse, where children were found to display a more collaborative behaviour (Stanton & Neale, 2003).

In any case, whether not enough shared representations were produced or whether these did not engage the children enough, the underlying problem is that the children did not engage with the story and with each others' ideas enough. This is shown in their lack of engagement in interactive discussion, which became evident during the unfolding of the study. The following excerpts from the children's story re-making sessions with drawing KidPad exemplify this lack of engagement in articulation and discussion.

> Experimenter: So are we ready to work on our story to make it better? We will use the KidPad tools to help us...
>
> Chiska: Stuart is being silly
>
> Stuart: Can we make the purple thing wiggle?
>
> Experimenter: Yes.
>
> Stuart: I'll make the spider's mouth move.
>
> Chiska: Are you my mummy? I can see you.
>
> Stuart: How do we know how many animals there are left?
>
> Chiska: Because he could like be looking...He could have counted the day before...yeah...and. Ooooh, I've asked loads and loads and loads of people. Come little monkey come come!

End of story re-making.

(Stuart, Chiska and Leanne; Drawing Story Re-making)

As the excerpt above shows, not much discussion is devoted to the story, and the role of the KidPad drawings in the story. For example, it is not clear what the meaning of 'the purple thing' is in the story, and how making it wiggle contributes to the story. The same can be said for the spider's mouth moving, and whether this, for example, signified that the spider is talking, or experiencing emotions, etc.

> Experimenter: We are trying to re-tell the story better, so they understand it. Do you remember KidPad? You can make links...Do you want me to show you again?
>
> Liam: Yes
>
> Experimenter: Ok, now over to you
>
> Jack: What about that then, Liam.
>
> Liam: Let's make the boy's face bigger!
>
> Jack: Yeah!!!
>
> Lauren: Yeah!!!
>
> Experimenter: Ok, so you need to draw a dot here...
>
> Jack: Aaaah!
>
> Liam: Aaaah!
>
> Lauren: Aaaah!
>
> Lauren: Make it tiny! Or can you make it bigger? Bigger!
>
> Liam: Frog, where are you?

End of story re-making

(Jack, Liam and Lauren; Drawing Story Re-making)

Similarly to the previous excerpt, the one above shows a lack of articulation and discussion of the children's story ideas. Given that they were constructing a story over ten pictures, the children are hardly engaging in talk at all. It is not clear what making the boy's face bigger could mean in their story, and the other children do not question Liam on this idea. Once they manage to use KidPad to zoom into the boy's face, their reaction is quite playful; however, this opportunity is not taken up by the children to discuss how this representation could contribute to their collaborative story.

Overall, it can be argued that constructing drawings does not necessarily lead to increased effort towards the interactive discussion during story-making. Similar findings were reported in Stanton and Neale (2003) in their qualitative analysis of children's talk when asked to make stories together using KidPad with one mouse each. They observed how children only rarely engaged in prolonged discussion, and that they mostly limited themselves to verbalising their story ideas for each other.

It can be concluded that discussion over the shared drawings could have provided an opportunity to reflect on the referential and evaluative aspects of the stories, as well as an opportunity for the children to gain a shared understanding of their collaborative stories, thus making it possible for them to build on each others' contributions. Therefore, the next study addresses this issue by investigating the benefits of directly encouraging discussion over the constructed shard representations in order to support collaborative storytelling.

4.2 Conclusions

Overall, these findings indicate that it is possible to improve some aspects of the quality of collaborative stories by encouraging children to construct their own representations with KidPad: the children's stories improved from telling to drawing retelling with respect to how long they were, how many propositions as well as how many referential and evaluative elements they included. Given the developmental literature showing that children in their first years of primary education are only beginning to tell referentially complex stories and do not always do so consistently (Bamberg & Damrad-Frye, 1991; Peterson & McCabe, 1983), these findings are promising because they suggest that scaffolding children's story-making by encouraging them to construct their own representations over presented material helps improve the quality of their stories.

Moreover, by showing that a significant storytelling improvement can be obtained when the children are encouraged to construct their own representations, this study adds to the existing literature on self constructed representations (Ainsworth, 2006; Bodemer et al., 2004; Chi, 2009). It has been argued that when they construct their own representations, learners attend to the presented material in more detail, i.e., they encode its content more (Alesandrini, 1981; Dempsey & Betz, 2001). This study supports this claim by showing that the children constructing their own interactive representations attended to the story more, and therefore produced better stories. These findings also give experimental support to the qualitative findings reported in Caldwell and Moore (1991), Dietz (1976), Ernst (1997), Karnowsky (1986), Steele (1991) suggesting that self constructed representations specifically help improve children's storytelling.

Finally, this study failed to prove that encouraging children to construct their own representations over presented ones facilitates the telling of coherent collaborative stories where children build on each others' contributions. This could have been due to the fact that the drawing construction did not provide a sufficiently engaging 'anchoring point' (Crook, 1995; Crook & Webster, 1997) for the children to discuss their story ideas. Given the literature advocating the value of constructed representations which are shared and persistent in facilitating collaboration (Anderson et al., 2004; Crook, 1995; Crook & Webster, 1997; Roschelle, 1992; Tang, 1991), surprisingly little discussion was observed during story-making. Therefore, this study adds to the literature on collaborative construction of shared representations by suggesting that the construction of shared representations might not be sufficient to promote discussion aimed at shared understanding, and therefore the production of coherent collaborative products. Prangsma and colleagues (2008) have reported similar findings in the domain of collaborative learning of history, and this study represents an addition to their findings by arguing that more direct scaffolding might be needed in order to encourage learners to engage in interactive discussion when constructing representations together.

In the light of these considerations, the next study investigated how to encourage children to be interactive, i.e., to negotiate a shared understanding of the representations they have created, with the ultimate goal of increasing the quality of the resulting stories.

Chapter 5: Guided Reciprocal Questioning to Support Children's Collaborative Storytelling

1. Introduction

This experimental study addressed Research Question 3, "Does encouraging children to engage in interactive discussion whilst making stories lead to better collaborative storytelling?", by investigating whether children tell better stories together when they are required to ask each other questions during story-making. Specifically, the children in this study were required to take turns at asking each other questions by using a set of question prompts provided.

This study also addressed Research Question 4, "Do children still engage in and benefit from interactive discussion once its use is no longer encouraged to do so?". This question was addressed in order to assess whether the reciprocal questioning support provided could be considered not only as an effective way of scaffolding children's collaborative storytelling with this support, but also as an effective way of encouraging children to autonomously use this strategy without being explicitly encouraged to. This would suggest that children can internalise the use of the question prompts provided and are therefore able to use this strategy to engage in interactive discussion during story-making.

This study draws from Experimental Study 1, where it was found that encouraging small groups of children to construct their own drawings over presented story pictures benefits their storytelling. Specifically, the study found that when they constructed their own drawings in KidPad, children told stories which were both significantly longer as well as more referentially complex and evaluatively richer.

The study presented in this chapter builds on these findings by incorporating the construction of drawings in the task design, as all dyads of children in this study were instructed to complement a set of presented story pictures with their own drawings constructed in KidPad.

However, Experimental Study 1 also found that the children did not collaborate as effectively as had been hoped: despite having access to a shared, persistent space where the drawings were constructed, the children were not observed to articulate and discuss their story ideas for one another. As the constructive activity did not lead to the children engaging in interactive discussion during story-making, their collaborative stories were not as good as predicted; specifically, their stories were not evaluatively richer or more coherent.

The present study directly addresses the collaborative aspect of storytelling with an intervention aimed at scaffolding story making in order to facilitate children's engagement in interactive discussion. Requiring that children question each others' ideas and request clarifications is expected to help them engage with each other's story ideas, thus promoting the production of evaluatively richer and more coherent stories.

1.1 The challenge of telling a good story together

Telling a good story means telling a referentially complex and evaluatively rich story (see Chapter 2, Section 1). However, when a story is told collaboratively, it is not sufficient for it to be referentially complex and evaluatively rich: it also needs to be the coherent product of a collaborative process where different contributions build on each other (Ananny, 2002). As Hayes and Casey (2002) noted, maintaining coherence may be even more difficult for children telling stories together, as these stories tend to be richer and include more elements and therefore need a greater effort from the narrators in order for these elements to be woven coherently into the story. This means that during story-making, the collaborating children need to articulate and discuss the elements that they wish to include in the story, so that a shared understanding of the story as a collaborative product can be achieved. A shared understanding is, in turn, the pre-condition for good collaborative storytelling, where the children's ideas are integrated into a coherent product. On the other hand, if a shared understanding is not achieved, a mismatch between the different children's understanding of the story will lead to problems both during story-making (because the story episodes are not built to follow one another coherently) and storytelling (because in the resulting story, the episodes will not follow one another coherently).

The problem was observed in both the StoryTable Case Study and in the KidPad Experimental Study 1, where the children did not articulate their story ideas for each other; as they did not engage in interactive discussion when they were making their stories, their storytelling was not very evaluatively rich and the different contributions did not build on one another coherently. On the other hand, encouraging children to discuss their story ideas, for example by describing the different characters, their internal states, what they say and do, etc., was expected to result in more coherent stories, i.e. stories where each turn follows coherently from the previous one.

1.2 Articulation for shared understanding leading to coherence and elaboration

Given the importance of interactive discussion for the achievement of a coherent and elaborate product (Chi, 2009; Lajoie, 2005; Milrad, 2002; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996), much research has been carried out to investigate what the key aspects of a productive discussion are, and how these can be scaffolded in order to facilitate their emergence during collaboration.

Barron (2003) argues that interactive discussion is favoured by the presence of a positive context, where individual's contributions and proposals are accepted as valid possibilities worthy of debate and discussion, instead of being ignored or rejected before they can be considered for their value. She defines this favourable context as a 'positive relational context', where children are encouraged to articulate ideas for each other in a supportive environment.

Wegerif (1996) also argues for the necessity of a similar premise, where collaborators establish ground rules emphasising the shared nature of the activity and the importance of involving every member of the group. As Webb (1992) demonstrated, this is particularly important where students of lower ability are present in the group, as they are the members that tend to have more difficulty voicing and asserting their ideas and therefore are less likely to gain substantial learning from the group work. Webb (1992) also demonstrated how in general, small groups of peers provide the best context for the emergence of productive discussion where each member feels most at ease with expressing their own contribution; another benefit of peer groups is that collaborators tend to share a common language which can be understood by everyone, thus making the different contributions less likely to be ignored. Barnes and Todd (1978) also stress the importance of a positive context, where collaborators feel comfortable expressing their ideas to the group without fear of being ignored or rejected by other members because of their higher ability, expertise or authority. Similar considerations have been made by Preece (1992) in her observations of children's collaborative storytelling, where a positive and informal environment provided a favourable platform for children to feel at ease with helping each other formulate different story contributions by offering alternative ways of expressing ideas.

However, a productive context for collaborative discussion is not only one where members are encouraged to express their ideas in a positive and informal environment, but also where these ideas are discussed critically and constructively, through offering of suggestions and alternative solutions and perspectives (Mercer, 1996). Barron (2003) demonstrated this in the context of collaborative problem solving: where different perspectives are not only voiced, but also discussed critically and constructively, the quality of the collaborative outcome is greater than in those groups where ideas are simply expressed but not critically evaluated. Specifically, it has been demonstrated that this type of critical and constructive discussion is more likely to occur in those groups where members ask each other questions, request clarifications and elaborate on the ideas expressed, and where these requests are met by adequate explanations that can be understood by all group members (Katz & Lesgold, 1993; Soller, 2001; Webb, 1989, 1992). Because it leads to increased articulation and therefore increased shared understanding, this type of productive interaction has been demonstrated to result in increased motivation and reflection (Barnes &

Todd, 1978; Brown & Palincsar, 1989; Galton & Williamson, 1992; Salomon & Globerson, 1987). As Chi (2009) sums up, encouraging collaborators to engage in interactive discussion about what they are constructing together promotes increased quality of outcomes, where ideas are elaborated, enriched and built upon coherently.

Therefore, in order for collaboration to lead to interactive discussion, it is important that a positive and supportive environment is established where group members feel comfortable expressing their contributions, and that these contributions are not ignored or rejected a priori, but discussed interactively. This often means that collaborators need to be prompted to request for ideas to be articulated and elaborated upon, for example through questioning. This leads to the establishment of a shared understanding about the ideas being articulated, thus resulting in higher quality collaboration outcomes.

1.3 Children's referential skills and their ability to articulate ideas for others

Having stressed the importance of articulation in promoting the establishment of a shared understanding, it is important to examine children's ability to articulate their ideas for others through appropriately elaborate explanations, as well as their ability to identify lack of adequate articulation in others' messages and address this through requests for relevant clarifications and elaborations. As many have argued, simply placing children in groups and asking them to collaborate does not necessarily lead to productive discussion aimed at shared understanding (Galton & Williamson, 1992, Capozzi et al., 1996). Others have also pointed out that requesting that children work together on a learning task while sharing a computer does not automatically lead to interactive discussions, where requests for clarifications are made and explanations are provided (O'Connor, Kerawalla, & Luckin, 2005; Steiner & Moher, 2002). In order to shed light on this lack of discussion, the next sections draw from the literature on children's referential skills as well as literature on group interaction where collaborators construct shared, persistent representations together to make sense of presented learning material.

1.3.1 Children's ability to articulate messages for others

Children may not always be effective producers of articulate enough messages that enable their listener to understand their ideas. In the light of the above literature on the importance of articulation for collaborative tasks, it is necessary to understand the extent to which children are able to produce articulate messages for others, and what might constitute a problem for them when trying to do so effectively.

Findings from the literature on children's ability to produce informative and clear messages for a listener suggest a developmental trend starting around the age of five, when children begin to tailor their messages according to what they know others might know or not know (and therefore need telling). At this age, children move away from the assumption that mere effort on the part of the listener is sufficient to guarantee a correct interpretation of an ambiguous message, and begin to appreciate that they themselves need to provide for the listeners' or readers' needs by tailoring their message for their audience or readers (Robinson & Robinson, 1978; Whitehurst & Sonnenschein, 1981).

Once children acquire the ability to take perspective and realise the need to provide articulate messages for their listeners, their ability to do so effectively begins to develop. Lloyd, Camaioni and Ercolani (1995) found a developmental trend in children's ability to adjust their message to the audience's needs: they compared the ability to produce unambiguous messages in six and nine year old children, and found that children at nine could produce messages that were significantly more informative than children at six (the latter needed feedback from the listener in order to adapt their message so that the listener would be able to identify the message referent). This trend may continue beyond the age of nine: as Flower (1979) and Witte (1987) note, even college students often need support in order to be able to successfully provide articulate messages in their writing. This has been argued to be because an ability to realise that a message needs to be articulate enough to enable the listener to understand needs to be matched by an ability to actually produce such articulate messages (Robinson & Robinson, 1978). In other words, although speakers are aware that their listener may not know everything s/he knows from the young age of five, it takes years of practice for them to develop the ability to formulate articulate enough messages to enable an audience to understand it.

Similarly, in the domain of storytelling, a development trend has been found in children's ability to tell stories which include enough information for an audience to be able to understand it. Specifically, children only begin to become proficient at telling stories in their early years of primary education (Applebee, 1978; Bamberg & Damrad-Frye, 1991; Hudson & Shapiro, 1991; Kernan, 1977; Nicolopoulou, 1996; Stein & Glenn, 1979; Ukrainetz et al., 2005).

Although these findings are about children's ability to tell a story to audience, and not about articulating ideas for the peers they may be telling stories with, it is reasonable to assume that similar findings would apply: if children around the age of six and seven are not yet entirely proficient at producing stories that can be understood and appreciated by an audience, it is likely that they would not be able to articulate their story ideas well enough for a shared understanding on the story to be achieved.

1.3.2 Children's ability to detect lack of articulation in others' messages

In their research on children's referential skills, Lloyd, Camaioni and Ercolani (1995) found that children's ability to produce unambiguous messages is related to their ability to detect ambiguity in messages produced by others, and that this ability does not appear in children until after the age of nine. This is consistent with findings from Robinson and Robinson (1982), who demonstrated that when five to seven year old children are presented with an ambiguous message produced by others, they are unable to deal with this ambiguity by requesting clarifications.

This has been argued to be because children of this age lack sufficient meta-cognitive skills to monitor and test their comprehension, an essential self regulating strategy which only becomes consolidated later (Garcia & Pintrich, 1994; Markman, 1981). However, as with children's referential production, others have argued that young children do, in fact, possess the meta-cognitive necessary skills to realise when they are given an ambiguous message, but are not yet skilled enough communicators to be able to address this problem with appropriate requests for clarifications. As many have argued, clarification requests need to be explicit and specific enough in order for a shared understanding to be achieved between the clarification seeker and the clarification provider (Webb & Farivar, 1994; Webb & Mastergeorge, 2003; Webb, Troper, & Fall, 1995). However, children are not always able to explicitly articulate clarification requests in a specific enough way to enable the other person to provide an appropriate clarification (Markman, 1981; Peterson, Wilkinson, Spinelli, & Swing, 1984; Webb, 1989).

Finally, it has been suggested that children may be aware of the inadequacy of the message they are presented with, and that they may even be able to articulate their clarification requests in an appropriate and productive form, but they may not want to do so because of fear of publicly demonstrating their inability to comprehend the message they are given (Butler & Neuman, 1995; Middleton & Midgley, 1997; Newman, 1998). Although this tends to be more the case for older children, concerns about admitting failure to infer the meaning of a message even when a child is aware of the inadequacy of the message may still play a role in his reluctance to request for clarifications.

1.3.3Achieving shared understanding over shared, self constructed representations

One of the difficulties communicators might encounter when articulating messages for others is over-reliance on shared context (Krauss & Fussell, 1991). When speaker and listener are both co-present and the speaker is producing a message about something that originates from that shared context, s/he may over-rely on the listener's ability to attend to the same aspect of the shared context as s/he is when producing the message, and to interpret it in the same way. For example, a speaker may refer to a drawing both speaker and listener have access to with respect to some specific features, while the listener is attending to other features of the same drawing thus interpreting the speaker's message in the light of these other features. This clearly constitutes a problem for the achievement of shared understanding, but may not be perceived as a problem by the speaker or the listener unless they realise that their interpretations are discordant and that communication needs to be repaired through clarification. Krauss and Fussell (1991) have named this phenomenon 'consensus bias', where a speaker assumes that an ambiguous message is sufficient for a listener to comprehend its meaning, and the listener does not realise that his interpretation of the message is discordant with the one intended by the speaker. Therefore, they conclude, shared access to the same context does not guarantee that a message will be understood.

The idea that speakers rely on a shared context with their listener to produce less articulate messages is not a problem in itself: without the ability to do so, speakers' productions would be very inefficient. As Grice points out in his Conversational Maxim of Quantity (Grice, 1989), good speakers do not make their utterance more informative than is required, and including too much information that can be inferred from a shared context makes a message redundant. Clark and Wilkes-Gibbs (1986) make similar considerations in their principle of the Least Collaborative Effort, which states that participants in communication try to minimise their collaborative efforts, and it has been shown that sharing visual context can help make communication more efficient by enabling collaborators to refer to their shared context through more synthetic messages (Gergle, Kraut, & Fussell, 2004).

However, if a communicator is still developing his or her ability to tailor a message based on their knowledge of what their listener knows, s/he may over-rely on the listener's ability to interpret their message even when this is not articulate enough. Given that research suggests it takes years for children to tune their ability to communicate effectively to others (Kernan, 1977; Lloyd et al., 1995; Robinson & Robinson, 1978, 1982), it is plausible that seven year olds can have problems with over-relying on shared context when expressing their ideas for others.

In the context of children's collaborative storytelling where access to a shared context is available, it is plausible that ideas may not be articulated in a clear and elaborate way due to children over-relying on the shared context to achieve shared understanding. This was indicated in Experimental Study 1, where children making stories together hardly articulated or discussed their ideas about the story elements they were constructing together.

The lack of engagement in interactive discussion between collaborators has been showed in a few recent studies on constructive tasks. Munneke, van Amelsvoort and Andriessen (2003) make similar observations to the ones in Experimental Study 1: in their study, students construct a diagram together without discussing the meaning of the represented ideas. As the authors note that the students appear to perceive the diagrams as a source of information that does not need to be disambiguated within the group, but simply as a repository of ideas (serving the same function of a notebook) that are either accepted or rejected without further discussion. Suthers (2003, 2006) also notes how students constructing a diagram in a shared environment talk about the representations they create but only on a superficial level; for example, the students in his study did not explain the meaning of the arrows they drew between concepts. Students appeared not to perceive the need to question each other or to explain to each other the meaning of the representations they construct together, and this led to lack of shared understanding about the ideas expressed in the constructed diagrams.

Finally, Prangsma, van Boxtel and Kanselaar (2008) conducted a study where children as old as 13 were reported to often over-rely on the self explanatory nature of the representations they had constructed together in a shared and persistent environment. In their study, Prangsma and colleagues (2008) instructed pairs of pupils aged 11-13 to complement some presented drawings about the history of the Roman Empire with their own, self constructed representations. Analysis of the children's discussion revealed how the dyads often took the meaning of the representations for granted and did not feel the need to discuss it; this, in turn, led to misconceptions about the learning content and a missed opportunity for collaborative discussion to lead to increased understanding and elaboration. For example, when they were discussing a drawing of Roman soldiers walking away from a ruin, the children did not relate the drawing to the departure of Roman soldiers from the provinces back to Italy after the fall of the Western-Roman Empire and came up with their own, erroneous interpretations of the drawing with captions such as "the armies revolted", or "wandering of the nations", or "they had built roads and bridges", or even that "the Romans had conquered almost everything they wanted to conquer". Interpreting maps did not prove to be any more straightforward: when presented with a map of the Eastern-Roman Empire with its emperor on the right, and an empty space and an empty chair on the left (a representation of the fact that there the Western-Roman Empire no longer existed), one dyad associated this picture with trade and wrote the caption: "There were large instances between countries, so for trade as well".

De Westelinck, Valcke, de Craene & Kirschner (2005) also found the same problem with the iconic sign system used in their research, where lack of discussion and subsequent misinterpretation of a provided set of iconic representations is argued to have contributed to students' construction of inaccurate or inappropriate representations

Therefore, given the above findings on older students' lack of interactive discussion over self constructed representations as well as the literature on younger children's ability to detect ambiguity and to articulate a message for others, it is reasonable to assume that seven year olds have difficulties achieving shared understanding over self constructed representations. This was suggested in Experimental Study 1, where children did not articulate for each other the meaning of the shared representations they were presented with (i.e., the story pictures) or that of the representations they created (i.e., the KidPad drawings). This study tests whether encouraging children to articulate their ideas for each other through reciprocal questioning is an effective way of promoting shared understanding over the story they make together.

1.4 Approaches to scaffolding children's discussion

Many approaches have investigated what the best strategies are for scaffolding learners' productive discussion. Many of these have focussed on how to scaffold articulation through linguistic prompting, such as requiring students to ask each other questions and to provide explanations for each other. Linguistic prompting has been argued to be a successful way of scaffolding learners' discussion, thus leading to improved understanding and elaboration (Brown & Palincsar, 1989; Christie, Tolmie, Thurston, Donaldson, Howe, Jessiman, Livingston, & Topping, 2009; Davis & Linn, 2000; Scardamalia & Bereiter, 1991; Topping, 1995; Yarrow & Topping, 2001). This has been argued to be because linguistic prompting acts as a 'more able other', i.e., as a scaffold to help students achieve levels of understanding and elaboration which are within their own 'zone of proximal development' (Vygotsky, 1978), but which could not have been reached without the presence of the linguistic prompting acting as an external support.

Discussion structuring prompts have also been demonstrated to lead to more equal patterns of participation (Soller, 2001). As many have pointed out, increased effort into meaning negotiation leads to increased shared understanding, which is an important pre-condition for collaborative learning (Dillenbourg & Traum, 2006; Roschelle & Teasley, 1995; Webb, 1992).

These lessons have been incorporated in the U.K. National Curriculum, where teachers are encouraged to prompt children to use discussion to improve their collaboration. Specifically, one of the main Speaking and Listening objectives for Years 1 and 2 is that children should learn to actively listen to their peers, ask for clarification questions and to provide articulate explanations for their ideas (DCSF[11], QCDA[12]). These skills are not only promoted in the area of literacy, but also across the curriculum as a valuable way of scaffolding children's ability to understand and elaborate on presented learning content.

One of the most popular methods for promoting students' discussion is the Reciprocal Teaching method (Brown & Palincsar, 1989; Palincsar & Brown, 1984), which generally involves encouraging students to prompt each other to explain their understanding of a learning text through questioning, clarifying, discussing and summarizing the presented

[11] http://nationalstrategies.standards.dcsf.gov.uk/node/88619 [Accessed 10 May 2010]

[12] http://curriculum.qcda.gov.uk/key-stages-1-and-2/subjects/english/keystage1/index.aspx [Accessed 10 May 2010]

learning material. This approach has been demonstrated to lead to students' increased understanding and elaboration of the text they are presented with. Based on these findings, a computer supported learning environment called CSILE (Computer Supported Intentional Learning Environment) was designed by Bereiter, Scardamalia, Linn and colleagues to support students' reflection and discussion, and has been extensively demonstrated to led to increased learning outcomes such as the ability to provide articulate explanations, formulate links and connections between different aspects of the learning content, and ultimately leading to more coherent, integrated understanding (Davis & Linn, 2000; Scardamalia & Bereiter, 1991).

The Paired Reading method (Christie et al., 2009; Topping, 1995; Yarrow & Topping, 2001) has also been proved to lead to similar learning outcomes in the area of literacy by encouraging children to take turns at engaging with the learning material and prompting each other to articulate their understanding. The method involves a more able writer helping a less able writer compose a text by providing support with spelling and punctuation whilst encouraging him through positive feedback and praise, as well as by asking questions about the content of the text and how it is assembled into a final product (Sutherland & Topping, 1999; Yarrow & Topping, 2001). Topping and colleagues studied the idea of prompting to the domain of story writing by training pairs of children to ask each other a set of prompting questions about what happens next in the story, and other open ended "w-" questions (e.g., "Why?", "Where?", "What?"). The method was found to benefit children's story writing in a study which compared the quality of stories written by children individually first, and in pairs with the Paired Writing method after, and found the latter to be significantly better. The stories were also compared with those produced individually by children who were not trained in the Paired Writing method, and found that although the individual children's stories were better the second time, the improvement was less than the improvement demonstrated by the children who used the Paired Writing method (Yarrow & Topping, 2001). The authors argue that this was due to the fact that the pairs of children engaged in productive discussion about the story being written, and conclude that structuring peer interaction benefits their writing.

1.4.1 The Guided Reciprocal Peer Questioning method

One approach that has been particularly successful at scaffolding students' learning of presented content is the Guided Reciprocal Peer Questioning. This study applies this method, which makes use of different types of question prompts and involves pairs of students alternating between playing the role of the 'questioner' and that of the 'explainer' in learning about presented learning material (King, 1990, 1994, 1999). The method has been used in a variety of content areas to promote knowledge articulation and elaboration (i.e., interactive discussion), and its effectiveness has been demonstrated in numerous studies with students from fourth grade (nine to ten years old) through to higher education learners (King, 1990, 1994, 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998).

Specifically, it has been argued that this method presents the advantage over others such as Reciprocal Teaching (Brown & Palincsar, 1989; Palincsar & Brown, 1984) and Paired Reading (Christie et al., 2009; Topping, 1995; Yarrow & Topping, 2001) of not constraining the interaction to the extent that learners' independent and generative thinking are impeded. Whilst the Reciprocal Teaching and similar approaches have been criticised for consisting in a highly specified sets of steps through which instruction takes place (Salomon & Globerson, 1989), the Guided Reciprocal Peer Questioning allows more freedom for learners to formulate their own questions beside the question stems provided, thus providing a more agile format which only requires the engagement in question asking and -answering processes. Moreover, whilst other methods were designed to support expert-novice interaction (e.g., Paired Reading) and heavily relied on teachers' modelling of the method (e.g., Reciprocal Teaching), the Guided Reciprocal Peer Questioning is designed to support peer learning with minimal modelling from a teacher or instructor (King, 1999).

In the Guided Reciprocal Peer Questioning method, students are encouraged to use a set of question prompts eliciting the production of explanations for the underlying processes and phenomena they are asked to learn about. Specifically, two types of questions prompts are given: Review questions are designed to encourage learners to restate the content of the presented material (through definitions, descriptions, explanations and the like), while Thinking questions were designed to encourage children to go beyond the material as explicitly presented to make connections and inferences.

King (1999) demonstrated how students learning with the question prompts gained a better understanding of the presented learning content; this, in turn, enabled the establishment of a shared understanding (or 'common knowledge' in King's words) upon which to build further reflection and elaboration. The students who used the question prompts provided more explanations and justifications for their reasoning, made more connections between their prior knowledge and the newly acquired knowledge, and were able to make more inferences than those who were not supported through question prompts. Similar results were found with fifth grade elementary students (10-11 year olds) in the context of science classrooms (King & Rosenshine, 1993).

In their study, King and Rosenshine also compared the effects of providing children with structured and unstructured questions prompts: in the former condition, the question prompts had structured stems such as "How does ... affect ...?", "What is an example of ...?", or "How are ... and ... similar or different?", while in the latter condition, the question prompts were limited to simple step words such as "Why?", "How?", "What?" and "Where?". The study found that students provided more explanations for their reasoning and made more connections and inferences from the learning material when they were given the structured prompting than when they were given the unstructured prompting, and that the students who were not given any prompting scored the lowest of all.

King and colleagues (King 1999; King & Rosenshine, 1993) argue that the students' higher engagement with and reflection on the learning material is promoted by the question prompts, as these provided opportunities for them to activate and consolidate their knowledge of the presented material (through Review questions), and to elaborate on this by creating new knowledge (through Thinking questions).

In the light of the above findings, the Guided Reciprocal Peer Questioning approach was selected for its potential to encourage children to engage in discussion about their collaborative stories. Specifically, it was expected that providing children with structured question prompts addressing the areas of referential complexity and evaluative richness in their stories would lead to increased engagement in interactive discussion during story-making. This, in turn, was expected to promote better collaborative storytelling, i.e., the production of stories which are referentially more complex, evaluatively richer, and more coherent.

1.5 Study hypotheses

Drawing from the literature investigating how to scaffold students' discussion in order to promote shared understanding and reflection, this study examined the potential benefits of encouraging children to articulate their story ideas for each other. It is expected that prompting idea articulation would lead to reflection on the story the children are constructing together. As a result, the stories the children produce together are expected to be more elaborate and coherent.

The method employed draws from King and colleague's Guided Reciprocal Peer Questioning method (King, 1990; 1994; 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998), where students are encouraged to take turns at asking each other questions about the learning content. This has been shown to encourage students to engage in interactive discussion (i.e., where ideas are articulated and negotiated), leading to increased understanding and elaboration of the learning material.

In this study, it was predicted that encouraging children to take turns at asking each other questions about their story ideas would lead to higher involvement in interactive discussion during story-making than when they are not encouraged to do so. More specifically, it was predicted that the children would ask each other questions and give each other answers more when they were asked to use the Guided Reciprocal Peer Questioning method (i.e., the henceforth called Prompted task). This, in turn, was predicted to result in better quality storytelling with respect to the length, structural complexity, evaluative richness and the coherence of the stories told (Research Question 3). It was also predicted that these benefits could be maintained once the prompting support was no longer present (Research Question 4).

The specific predictions are organised into three main blocks:

1. Manipulation check. This predicted that when the children were provided the prompts and required to use them during story-making, they would engage in more interactive discussion than when they were not so supported. Specifically, the following predictions were made:

    1.1 When the children were given the Prompts task, they would be significantly more on task than during the No Prompts task.

    1.2 When the children were given the Prompts task, they would ask each other significantly more questions than during the No Prompts task. Specifically, as the children were provided with more Thinking than Review questions, it was expected that when they were given the Prompts task, the children would ask each other proportionally more Thinking questions than Review questions. Also, it was expected that although some questions would be invented during the Prompts task, proportionally more Given questions would be asked during the Prompts task than during the No Prompts task.

    1.3 When the children were given the Prompts task, they would give each other significantly more answers than during the No Prompts task. Specifically, if prediction above is fulfilled about the proportionally greater number of Thinking questions asked, the children would also give each other proportionally more Thinking Answers.

2. Research Question 3: This predicted that when the children were provided with prompts and required to use them during story-making, their collaborative storytelling would be better than when they were not so supported. Specifically, the following predictions were made:

2.1 When the children were given the Prompts task, they would tell significantly longer stories than when they were given the No Prompts task.

2.2 When the children were given the Prompts task, they would tell stories which were significantly more complex referentially than when they were given the No Prompts task.

2.3 When the children were given the Prompts task, they would tell stories which were significantly richer evaluatively than when they were given the No Prompts task.

2.4 When the children were given the Prompts task, they would tell stories which were significantly more coherent than in the No Prompts task.

3. Research Question 4: This predicted that the potential benefits of the prompting support would be maintained once this support was withdrawn. Specifically, it was predicted that the children would continue to engage in greater interactive discussion once this support was withdrawn, by being more on task, asking each other more questions (and proportionally more Thinking ones and more Given ones) and giving each other more answers. As a result, it was predicted that their collaborative storytelling would continue to benefit from the prompting support once this had been withdrawn. Specifically, the following predictions were made:

   3.1 When they were given the No Prompts task, the children who had previously been given the Prompts task would tell significantly longer stories than the children who had been given the No Prompts task first.

   3.2 When they were given the No Prompts task, the children who had previously been given the Prompts task would tell stories which were significantly more complex referentially than the children who had been given the No Prompts task first.

   3.3 When they were given the No Prompts task, the children who had previously been given the Prompts task would tell stories which were significantly richer evaluatively than the children who had been given the No Prompts task first.

3.4 When they were given the No Prompts task, the children who had previously been given the Prompts task would tell stories which were significantly more coherent than the children who had been given the No Prompts task first.

2. Method

2.1 Design

The study employed a within subjects design, with task as a within subjects variable; this means that each pair of children told two stories, one during the Prompts task and one during the No Prompts task. The same two stories used in Experimental Study 1 were used in this study; as in Experimental Study 1, the order in which they were given to the children was counterbalanced. The order in which the Prompts and the No Prompts tasks were administered was also counterbalanced. Unfortunately, due to an oversight during data collection in school, one extra group was allocated to Task Order 1, which made the two groups slightly unbalanced: 10 pairs were allocated to Task Order 1, and 8 pairs were allocated to Task Order 2. This problem was addressed in the analysis by randomly taking 2 pairs out of the Task Order 1 group.

For both tasks, the pairs of children were instructed to take turns at animating one story picture each, and to create at least one drawing per picture. For the Prompts task, however, the children were told that once a child had finished creating his drawing on a picture, the other child would have to ask at least one question from the set of questions presented on a board and that the child who had made the drawings would have to try and answer those questions as well as they could. Only once this process had taken place would the children be allowed to switch roles, with the child who had asked the questions now drawing the drawings on the next story picture and the child who had been drawing now asking the questions. For the No Prompts task, the questions were not available to the children, and the children were not required to ask each other any question before they could exchange turns at animating the next story picture.

2.2 Materials

Like in the drawing task in Experimental Study 1, in this study the KidPad software was used, with its Hyperlinking, Turn Alive and X-Ray Window features. Because the instructions involved only one child creating drawings in KidPad at a time, only one mouse was used.

Ten pictures from the book Frog, Where are You? (Mayer, 1969) and ten from the book Monkey Puzzle (Donaldson & Scheffer, 2000) were uploaded into KidPad to create a story sequence, with both sequencing depicting the story of a protagonist who has lost someone or something and engages in number of attempts to find them. These stories were the same used in Experimental Study 1. For the practice task, pictures from the Tiny Planet website were used[13] (see Appendix V).

The materials also included the Vocabulary and the Similarity sections of Wechsler Abbreviated Scale of Intelligence test (WASI), which were used for the purpose of grouping the children (see Participants and Grouping).

For the Prompts task, an easel was set up showing the question prompts (see Figure 30 and Table 15). Some of the words were in red is because it was felt that this would draw the children's attention to the important words in the question, i.e. the setting and the characters' internal and external states. The "Why?" question was on a separate column to show that this could be asked as a follow-up to any of the questions of the left column.

[13] http://www.tinyplanets.com/ [Accessed 10 May 2010]

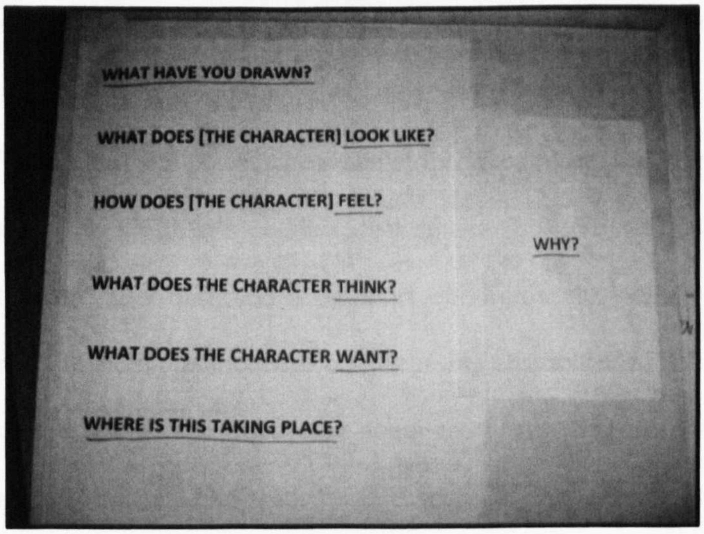

Figure 30. The question prompts.

Table 15 *The question prompts*

WHAT HAVE YOU DRAWN?	
WHAT DOES [THE CHARACTER] LOOK LIKE?	
HOW DOES [THE CHARACTER] FEEL?	WHY?
WHAT DOES [THE CHARACTER] THINK?	
WHAT DOES [THE CHARACTER] WANT?	
WHERE IS THIS TAKING PLACE?	

The choice of question prompts was related to Stein and Glenn's (1979) definition of a story, which was based on their work on children's storytelling and was informed by the literature on story grammars as well as Labov and Waletzky's (1967) definition of a story as a combination of referential complexity and evaluative richness. The question prompts were also partially based on those used by Carnine and Kinder (1985) for their study, where they evaluated the benefits of teacher driven questioning for low performing children's narrative abilities.

The question prompts were designed to promote these important aspects of a story. For example, encouraging questioning about the story characters (e.g., their physical appearance and goals) and the place where the story takes place was aimed at benefiting referential complexity in children's collaborative stories (i.e., Orientation, Reaction). The question prompts were also designed to support children's storytelling with respect to evaluative richness. For example, the focus on discussing characters' affective and epistemic states was expected to encourage discussion about the character's internal states, and the "Why?" question was expected to encourage discussion about causality. This type of discussion was expected to lead to increased evaluative richness in children's collaborative storytelling.

Moreover, some of the questions provided were aimed at encouraging children to articulate the content of the presented pictures, while others were aimed at encouraging children to go beyond the presented pictures by making elaborations and inferences. This distinction reflects the one made by King (King, 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998) in the Guided Reciprocal Peer Questioning method which this study draws upon, where the former type of questions are defined as Review questions category, and the latter type as Thinking questions category. In this study, Thinking Questions included "How does [the character] feel?", "What does [the character] think?", "What does [the character] want?", and "Why?", the latter being applicable to any of the above.

Overall, more questions were aimed at encouraging children to engage in elaborative and inferential thinking (i.e., Thinking questions), as these have been found to benefit learning more than Review questions about the presented material (King, 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998). These were mostly aimed at encouraging reflection on the evaluative aspects of the story (e.g., causality, internal states).

Finally, some story aspects, such as characters' actions and behaviours, are not included in the set of question Prompts. This choice was made for pragmatic reasons, as providing too many question prompts might overwhelm children, but also theoretical ones, as too much task structuring has been found to contrive learners' ability to elaborate and create new knowledge through productive discussion (Salomon & Globerson, 1989).

2.3 Participants and Grouping

Forty-six children participated in this study. They were recruited from two Year 2 classes in a local primary school. Consent to take part in the study was obtained from all children's parents or guardians, as well as clearance from the School of Psychology Ethics Committee.

Ten children were grouped into dyads and randomly allocated to the 'audience' role. The remaining thirty-six children constituted the participants for this study and were instructed to make a story and tell it to a dyad from the 'audience'.

The age of the thirty-six subjects (18 boys and 18 girls) in the story ranged from six years to seven years and five months, with a mean age of six years and nine months (SD = 6 months). They were grouped into 18 dyads according to their personal preferences and attitudes towards working together as well as their verbal abilities. These criteria (verbal ability and personal preferences and attitudes) were used in order to ensure that the dyads were as homogeneous as possible. Personal preferences and attitudes towards working together were gathered through informal conversations with the children's teachers. By the time of the study, the teachers had worked with these children for over half of the school year, and were considered to be a reliable source of information about children's personal preferences as well as attitudes towards working together. In order to obtain a measure of the children's verbal abilities, each child was administered the verbal intelligence sections of the Wechsler Abbreviated Scale of Intelligence (i.e. the Vocabulary and the Similarity sections) (Wechsler, 1999); these scores were used as a general guideline for ensuring that the children not only had a positive attitude to working together, but also that the children in dyad had roughly the same verbal abilities.

2.4 The pedagogical scenario

The pedagogical scenario for this study maintained some of the key features of the Experimental Study 1 scenario, where children were asked to make a story together using a set of story pictures, and to subsequently tell it to an audience who did not have access to the pictures.

However, in this study, the children were grouped into pairs instead of triads. This choice was based on theoretical and ecological validity reasons. Firstly, the intervention tested in this study was about reciprocal questioning, and it required that one child should ask questions and another should answer them. The lack of a third role in the intervention meant that the addition of a third child would have confounded the process and made the results difficult to interpret. Moreover, during informal observations, children had often been noticed working in pairs during literacy teaching, for example when they were asked to make a story in pairs and discuss it together before telling it to their peers. This practice reflects objectives from the National Curriculum, where it is recommended that children are given plenty of opportunities to work in pairs at making a story and subsequently presenting it to an audience (DCSF[14], QCDA[15]). Finally, the choice to group children into pairs increased the number of observations for analysis.

Moreover, in this study, the children only had one mouse available, as the task required that they should take turns at creating drawings over one story picture each. Also, because it was observed that the children in Experimental Study 1 did not take advantage of the simultaneous access afforded by KidPad, but orderly took turns at drawing on one story picture at a time instead, it was felt that only allowing one child to interact with the story

[14] http://nationalstrategies.standards.dcsf.gov.uk/node/88619 [Accessed 10 May 2010]

[15] http://curriculum.qcda.gov.uk/key-stages-1-and-2/subjects/english/keystage1/index.aspx [Accessed 10 May 2010]

pictures at a time would not constitute a significant deterrent to the children's motivation. That the children spontaneously took turns at creating the drawings in KidPad might have been due to the fact that this type of sequential approach to collaboration is valued as a positive attitude within the school culture, and the children felt it was the most effective and respectful way of proceeding. Moreover, despite the fact that they were demonstrated the various functionalities, including how they could access the shared space simultaneously and that they had been able to practice doing so themselves, the children may not have been familiar enough with the technology to explore the possibility of simultaneous access. Finally, it may have been the case that, because emphasis had been placed on the importance of helping each other during collaboration, the children considered it appropriate to take turns at letting one child draw the representations while the others would help by providing assistance with any technical issues. It was therefore decided that sequential access to the creation of drawings (through one mouse only) would not only be desirable for the purpose of the intervention task tested in this study, but that it would also not constitute a deterrent for children's engagement with the task.

Finally, the choice of requiring children to take turns at creating drawings on one story picture each was informed by research on the benefit of pairs alternating between the role of the 'doer' and that of the 'observer'. It has been argued that role switching is an effective way for small groups to facilitate perspective taking which, in turns, helps increasing understanding (Soller, 2001). Specifically, it has been argued that when pairs of collaborators take different roles, different epistemic stances emerge and contribute to more productive interactions. Miyake (1986) studied pairs collaborating to understand the working of a sewing machine, where collaborators spontaneously took turns at playing the role 'doer' and 'observer'. She observed how this strategy proved to be a productive one: as different epistemic stances were taken (a more local stance for the 'doer' and a more global one for the 'observer'), the collaborators were able to understand the device's working mechanisms. Miyake's findings suggest that a pedagogical scenario where one collaborator is encouraged to gain a 'local' view on the representations by playing the 'doer' role and the other collaborator is encouraged to maintain a 'global' view by being an 'observer' might constitute a favourable context for productive interaction to occur.

Finally, the scenario required that children created at least one representation per story picture. This choice was motivated by the need to have sufficient items for discussion during the intervention task (i.e., the Prompts task) as well as to have a consistent base for comparison within the different pairs of children participating in the study.

2.5 Procedure

The study was carried out in the same school as the Experimental Study 1. The set-up was also the same: the children made their stories on a laptop in a quiet room near the school library and they told their story to two of their school mates (the 'audience'); the 'audience' were not able to see the pictures on the laptop while they were told the story.

The collected data consist of video-recording of the sessions, from two different camcorders: one camcorder recorded what the children were doing on the computer, while the other recorded the dyads from the front. Video-recordings were aimed at capturing verbal (dialogue) and non verbal (gesture, drawings, etc.) data from story-making and storytelling.

2.5.1 Phase 1- KidPad Training

The KidPad training phase took place in the same room where the Wechsler Abbreviated Scale of Intelligence (WASI) testing had been carried out. The children were divided into random sets of four or five and were given 30 minutes training. For this initial phase, the composition of the sets was random because this phase was not part of the experimental testing (where the children were assigned to homogeneous dyads according to the guidelines described above). The training consisted in the experimenter illustrating the Hyperlinking, the Turn Alive and the X-Ray Window tools and giving each child the opportunity to practice with the software. At the end of the session, the experimenter asked each child in the group to demonstrate how to create a link, zoom in and out, draw something and make it 'wiggly' with the Turn Alive tool, make things appear and disappear with the X-Ray Window, and pan across the screen. If the children were not able to perform these tasks, the experimenter would show them how to do it one more time. This procedure was repeated until all children were able to perform the basic tasks described above (usually no more than two procedure iterations were necessary for the children to be able to demonstrate the use of the three tools).

2.5.2 Phase 2- Story-Making

On a different day to the day when the WASI was administered and the day the KidPad training were carried out, the children were asked to make their story. The children were explained that they were going to make a story together, and that this meant that they should take turns at creating one drawing each. In order to make sure that the children understood that working together means listening to each other and using each others' ideas in order to create a joint product, the concept of 'making a story together' was explained to the children in the following terms:

> When your turn comes, it is OK to use other children's ideas to continue the story. This does not mean that you are 'stealing' ideas from your team mates, but rather using these ideas to make a good story. For example, if we were making a story together, and you [points to a child in the group] were to say 'it was a sunny day and the boy was happy', and then I was to say 'He was happy because he loved sunny days, where one could go swimming in the sea and do lots of fun things', then I would be using your idea to continue the story. That is a good thing to do when you make a story together.

From this point onwards, the instructions differed according to the task the children were in. Arrangements were made in order to make sure that no more than 7 days would pass between the two tasks.

2.5.2.1 No Prompts task

Before the No Prompts task the children were given the following instructions:

> You are going to make a story together. Please take turns at making one story bit each, and I will make sure each of you creates 5 story bits altogether. Each story bit can be as long as you want, and have as many characters as you like. However, for each story bit, you will have to make one drawing with KidPad. In the meantime, the other child will be there to watch what you are doing. Once you are ready with your story bit and drawing, the other child will continue from there and make his own drawings in the next picture.

These instructions were repeated and exemplified if necessary, until the two children understood what they were required to do.

2.5.2.2 Prompts task

Before the Prompts task, the children received training in asking and answering each other questions about their drawings in the story. From this phase on, the children remained in the dyads they were originally assigned to according to the above mentioned criteria (see Participants and Grouping).

The children were called into the room, where a laptop had been set up with a few pictures from the Tiny Planet stories (see Appendix V), and an easel had been mounted showing the question prompts (see Figure 30). In order to make sure that the children could read the questions, each child was asked to read from the set of question prompts on the easel.

Then, the experimenter went on to explain about the questions they had just read from the easel. She explained to the children that the questions were there to help them about important aspects of a story, such as describing what the characters and the place the story takes place in looks like, as well as the characters' feelings and thoughts. In order to ensure that the children were familiar with the word character and place in reference to a story, the experimenter asked the children to name a story they like, and asked them to give an example of a character and a place. The experimenter then asked what the characters and the place looked like, as well as a character's feeling and thought in a specific story situation. This was done in order to ensure that the children understood the importance of characters and settings in a story and what the questions on the easel were about.

Subsequently, the experimenter asked the children to take turns at creating one drawing each to create a short story with KidPad using the set of Tiny Planets pictures. Once each child had finished making his story, the experimenter asked him or her to explain what the meaning of the drawing was in the story. For example, if a child had created an X-Ray Window with a sun drawn in it, the experimenter would ask: "What does this sun in the X-Ray Window mean in the story?". If the child did not provide a satisfactory answer, the experimenter would prompt him or her again until a satisfactory answer was obtained. If this was not obtained after three requests, the experimenter would exemplify what she meant when asking what the meaning of the drawing was in the story by giving an example: for example, in the case of the sun drawn inside an X-Ray Window, the experimenter would say that "the sunshine was coming and going: when the X-Ray window is in place, the sun is shining; when I move it, the sunshine is gone". This process was aimed at ensuring that the children were capable of producing answers which were related to the story, as opposed to answers that were limited to describing the functioning of a KidPad tool (e.g., "I have drawn an X-Ray window: see, if you move it around, the things inside it disappear") or tautological ones (e.g., "I've drawn this because I want to/I like it").

Finally, the children were asked to take turns at asking and answering one question about the other child's drawings each from those displayed on the easel. The experimenter stressed once again that the questions were there to help them make their story. She also explained that the words in red were the important ones indicating what the question was about, that the word [character] was to be replaced by the character they wanted more information about, and that the "Why?" question was on a separate column on the right because it could be asked as a follow up question to any of the questions in the column on the left (see Figure 30).

Once the children were trained in using the question prompts, the instructions went on in a similar fashion to the No Prompts task, with the experimenter saying:

> You are going to make a story together. Please take turns at making one story bit each, and I will make sure each of you creates 5 story bits altogether. Each story bit can be as long as you want, and have as many characters as you like. However, for each story bit, you will have to make one drawing with KidPad. In the meantime, the other child will be there to watch what you are doing.

The instructions, however, were different to those for the No Prompts task in that they included the following additional part:

> Once the child who has been drawing is ready with their story bit, the other child (who has been watching) will ask him at least one question from those on the board. The child who had been drawing will then need to answer that or those question(s) so the other child can understand your story idea properly. Do you both understand what you need to do?

These instructions were repeated and exemplified if necessary, until the two children understood what they were required to do.

2.5.3 Phase 3 - Storytelling

Finally, at the end of each story-making session, the children were asked to tell their story to two of their school mates from the ten children who had been selected to act as 'audience'.

Due to the Prompts task involving extra engagement with the task, i.e., the question prompts training and the implementation of the question prompting during story-making, the Prompts task was estimated to take longer than the No Prompts task. Because the school curriculum arrangements meant that the children could only spend a maximum of 30 minutes with the experimenter, the activity had to be carried out over two distinct sessions. In the first session, the children were trained in question prompting and started making their story (beginning of Phase 2-Story-Making); in the second session, the children finished making their story and told it (end of Phase 2- Story-Making, followed by Phase 3-Storytelling). In order to ensure that, in the second session, the children would start telling the story (Phase 3-Storytelling) after having worked on their story (Phase2-Story-Making) for roughly as long as they had during the No Prompts task (this was expected to take between 25 and 30 minutes), during the Prompts task the bulk of the story-making was left to the second session (while the first session was mainly about question prompts training and beginning the story-making). Arrangements were made in order to ensure that no more than seven days would pass between the two sessions. Moreover, before the beginning of the second session, the children were briefly reminded of the story they had made up to that point. Thus, whilst these differences between conditions were not ideal, every effort was made to reduce the impact of these differences.

2.6 Measures

As the focus of this study was on how the children's story making discussion could be influenced by the prompting intervention, and on the potential benefits of encouraging interactive discussion on the children's collaborative storytelling, both the story-making process and the storytelling outcome were analysed.

2.6.1 Story-Making

The children's talk during story-making was transcribed and, for analysis purpose, the transcripts were segmented into turns according to the method described in Barron (2003). Every time a child took up a turn, this was marked as the beginning of a new segment or unit of analysis; each turn was defined as a segment of speaker-continuous speech. If an interruption stopped a speaker from speaking, then the turn was considered completed, even if the content of the turn was resumed later. If the student did not stop talking even though someone else was speaking, then the turn was considered as a whole, and the interruption as a separate turn. Backchannel responses, such as 'yes', 'uhm', and so on, were also considered as turns.

2.6.1.1 On and Off task coding

Each turn was coded according to whether it contained talk related to the task (On Task) or not (Off Task). On Task turns were those which included discussion about the story or about how to use the software to construct a certain representation. All turns that were not coded as On Task were coded as Off Task; these were comments that were not related to the story and were not coded further.

In order to determine whether a turn was On Task or Off Task, it was sometimes necessary to consider the (verbal and non-verbal) context around the utterances contained in the turn. For example, the utterance "Oh my gosh!" could be considered to be part of the story (e.g., an exclamation by one of the characters), a comment on the appearance of one of the representations constructed in the story, but it could also be unrelated to the story (e.g., the child pronouncing it is expressing his concern for having spilled some water on the desk). In this case, watching the video-recordings of both the child and the interface, it was possible to conclude that the comment was related to the appearance of a representation, as the child expressed amazement at how big the representation was made by the Zooming Tool.

2.6.1.2 Questions coding

Within each turn that was coded as On Task, the questions were highlighted and a decision was made as to whether the question was about the story (e.g., "Where is the story taking place?") or about how to use of KidPad to construct a representation (e.g., "How do you make this go wiggly?"). Only those questions which were about the story were coded. Naturally, story related questions were only uttered by the child whose turn it was not to draw. On those (quite rare) occasions where a turn included more than one question, each question was coded separately.

The story related questions were coded as *Given or Invented.* Given questions were questions which reproduced those given as Prompts more or less verbatim (see Materials), except from the question stem "Why?" question; for example, a question such as "What is [the character] thinking?" is considered as a rephrasing of the Prompts question "What does [the character] think?" and therefore coded as Given. When coding the No Prompts task, questions were considered as Given when they corresponded to the ones that would have been in the question prompts, if these had been used. Invented questions were questions produced by the children themselves and which did not reproduce those given as the Prompts, such as "What is [the character] doing?". Questions which started with the provided question stem "Why?" were also coded as Invented, as the children were free to fill the rest of the question with any content they liked.

The questions were also coded according to whether they were *Review* or *Thinking* questions. This coding is independent of the one described above, and therefore does not reflect the distinction among Given and Invented questions. On one hand, Review questions are about the visible elements in the presented pictures or in the drawings created by the children, such as "What have you drawn?", "What does [the character] look like?", "What is [the character] doing?", "Where is this taking place?", or "What does the place look like?". Thinking questions, on the other hand, are about what is not visible in the pictures or drawings, and therefore needs inferring. These include questions about the characters' internal states and goals (e.g. "How does [the character] feel?", "What does [the character] think?", "What does [the character] want?") and motivations for a story idea (e.g., "Why have you drawn that?", "Why does [the character] look like that?", "Why is [the character] felling like that?", "Why is [the character] thinking that?", "Why does [the character] want that?", or "Why is [the character] doing that?).

As with coding for On or Off Task turns, the process of coding a segment sometimes involved considering the context around the segment, in order to clearly disambiguate its meaning. For example, in the following exchange, the question "Why?" could not have been coded without considering the previous exchange: 'What have you drawn' makes it clear that the following "Why?" question should be re-phrased as 'Why have you drawn a box near the monkey that says 'Wow!'?", and coded accordingly)

T: What have you drawn?

E: I've drawn a box near the monkey that says 'Wow!'.

T: Why?

E: Because...he's saying "wow" because he's noticed the butterfly in the air and he thinks he...she could find his way to his mum.

(Thomas and Emily, Prompts task)

2.6.1.3 Answers coding

The children's answers to the questions asked by their partner were coded according to whether they provided a *Review*, and *Thinking* answer. When a question did not receive an answer, the turn following the question was coded as *No Answer*. Similarly to Review questions, Review answers are about the visible elements in the presented pictures or in the drawings created by the children, such as "I have drawn...", "[The character] looks like...", "The character is doing...", "This is taking place....", or "The place looks like...". Similarly to Thinking questions, Thinking answers are about what is not visible in the pictures or drawings, i.e., the meaning of those elements in the story with respect to characters' inner states (e.g. feelings, thoughts and desires), their motivations, or the motivations for a child to have made a drawing, such as "I have drawn this because...", "[The character] looks like that because...", "The character] feels...", "[The character] thinks...", "[The character] wants...", "The character is felling like that because...", "[The character] is thinking that because...", "[The character] wants that because...", or "[The character] is doing that because...".

2.6.2 Storytelling

Like in Experimental Study 1, the stories children made were transcribed and rated according to how long they were, how many propositions they included, how referentially complex and evaluatively rich they were, and how coherent they were.

The coding schemes used to capture referential complexity, evaluative richness and coherence are the same used in Experimental Study 1, and are described in Section 2.2 of Chapter 4.

3. Results

The hypothesis tested in this study was whether encouraging children to engage in interactive discussion during story-making through question prompts would lead to increased quality of storytelling (Research Question 3). This meant testing whether during the Prompts task the children told significantly better stories than during the No Prompts task with respect to length (as operationalised by number of words and number of propositions), referential complexity, evaluative richness and coherence.

The analysis also tested whether the increased quality of collaborative storytelling could be maintained once the children were no longer encouraged to engage in interactive discussion through question prompts (Research Question 4). This meant testing whether, during the No Prompts task, the children who had been given the Prompts task first would score better at story-making and storytelling than the children who were given the No Prompts task first. It was predicted that children who had been exposed to the question prompt support would score better during the subsequent No Prompts task, as they would have practiced asking each other questions during the Prompts task already.

However, before these two main predictions could be tested, a manipulation check was performed in order to ensure that the children did use the question prompts when asked to, and whether this meant that they engaged in interactive discussion during story-making.

The children were expected to be more on task as well as to ask each other more questions and give each other more answers when they were given the Prompts task. The analysis also examined the types of questions asked, i.e., whether the children would ask each other proportionally more Thinking Questions and more Given Questions when they were given the Prompts task.

The analysis also tested whether there were any differences between the scores of the children who were given the Prompts first and those who were given the Prompts task second, regardless of task. This was done on all dependent variables, both for story-making and storytelling, in order to ensure that the counter-balancing had been effective at ensuring that overall, the children did not score differently depending on the order in which they were given the two tasks.

For the statistical analyses, when the data met the requirements of normality, homogeneity of variance and co-variance, parametric tests were used. When data failed to meet these requirements, non-parametric tests were used instead. Like in Experimental Study 1, this was particularly important in the light of the relatively small size of the sample employed for this study.

Parametric testing involved the use of mixed [2 by 2] ANOVAs where the within subjects factor was prompting (the levels were No Prompts task and Prompts task) and the between subjects factor was order (the levels were No Prompts task first followed by Prompts task - henceforth called No Prompts first, and Prompts task first, followed by No Prompts task - henceforth called Prompts first). Non-parametric testing was carried out through two Wilcoxon Signed Ranks for the within subjects factor prompting, and two Mann-Whitney for the between subjects factor order.

As more pairs of children were assigned to Task Order 1 (No Prompts task followed by Prompts task) than those assigned to Task Order 2 (Prompts task followed by No Prompts task), two pairs were randomly selected from Task Order 1 and removed from the analysis.

As the predictions were directional, one tailed tests were used throughout.In order to test whether there was a significant (positive) correlation between the number and type of questions asked and the quality of the collaborative stories (regardless of task), a series of correlation tests were carried out. The data on the total number of question presented an outlier (3.2 SD away from the mean, mean = 52.88), which made the data not normally distributed. The same pair represented an outlier in the total number of Thinking questions variable (3.3 SD away from the mean, mean = 25.19). This pair of children was taken out of the analysis in order to allow for parametric testing, as all story variables which the number of questions was tested against met the requirements for parametric testing. Once the outlier was taken out of the total number of questions, all data met the requirement for parametric testing; therefore, the Pearson correlation test was used throughout.

Finally, the analysis would have benefited from the inclusion of a regression analysis, in order to show whether the number of questions asked by the children could explain and predict the quality of the collaborative stories produced. Unfortunately, the sample size was too small to allow for such as analysis (Field, 2009).

3.1 Story-Making

The general prediction about story-making was that when the children were given the Prompts task, they would engage in more and better interactive discussion than when they were given the No Prompts task, and that these benefits would be maintained during the subsequent No Prompts task (manipulation check). Specifically, these predictions were expected to be true for the extent to which children were on task, asked each other questions and gave each other answers.

3.1.1 On and Off Task turns

All story-making sessions were coded according to the On and Off Task scheme described in Measures. A second coder (blind to condition) coded 25 % of the sessions and inter-rater agreement was scored for the frog stories (Kappa = .84, $p < .001$) and the monkey stories (Kappa = .79, $p < .001$).

As the total number of turns produced by each pair during the No Prompts and Prompts task varied, the number of On Task turns in each story-making session was normalised against the total number of turns in that session. Therefore, the number of On Task turns is expressed as a percentage over the total number of turns in each story-making session. The total number of On Task and Off turns for each pair of children is shown in Appendix VI.

In order to test whether children were significantly more On Task during the Prompts task than during the No Prompts task, and to test whether Prompting interacted significantly with Order, a mixed [2 by 2] ANOVA was carried out. The data are shown in Table 16 and Figure 31 below. No significant main effect of order was found ($F(1, 14) = 0.43$, $MSE = 69.54$, $p = .26$, $\eta_p^2 = .03$). A significant main effect of prompting was found ($F(1, 14) = 7.89$, $MSE = 14.01$, $p < .01$, $\eta_p^2 = .36$), with significantly more On Task turns during the Prompts task than during the No Prompts task. This supports the prediction that the Prompts task would benefit interactive discussion (Prediction 1.1). However, no interaction was found between Prompting and Order (F (1, 14) = 0.42, MSE = 14.01, p = .27, η_p^2 = .03). This result does not support the prediction related to Research Question 4 that the benefits of the Prompts task on interactive discussion would be maintained once this type of scaffolding was withdrawn. The data are shown in Table 16 and Figure 31 below.

Table 16 *Mean percentage of On Task turns by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		mean	*SD*	*mean*	*SD*
On Task turns	No Prompts	92.19	7.80	89.41	7.82
(percentage)	Prompts	95.06	4.66	93.98	4.74

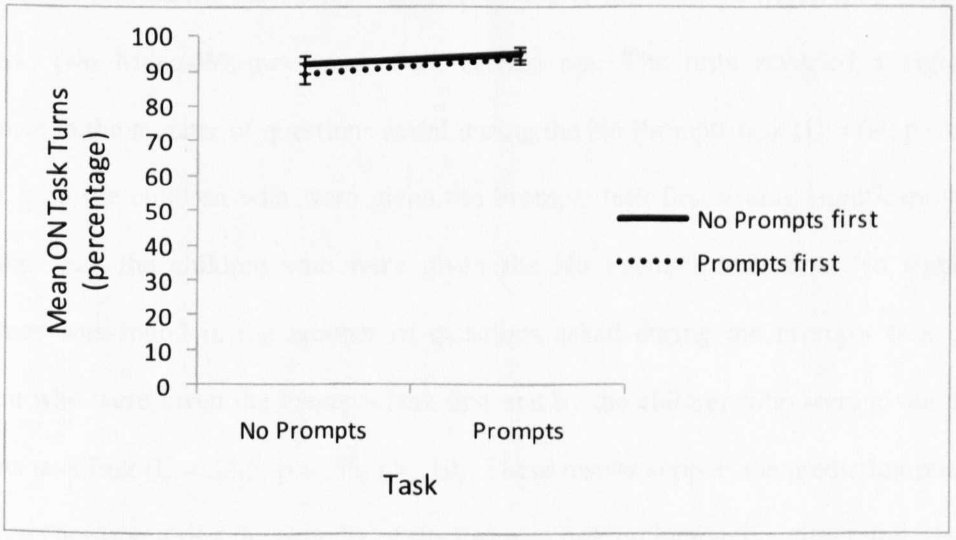

Figure 31. *Mean percentage of ON Task turns by Task (Prompts, No Prompts) and Order (No Prompts first, Prrompts first).*

3.1.2 Number of questions

Due to the data failing to meet the requirements for parametric testing, non-parametric tests were used. In order to test whether children asked significantly more questions during the Prompts task than during the No Prompts task in the two orders, two Wilcoxon Signed Ranks test were conducted. The data are shown in Table 17 and Figure 31 below.

The tests revealed a significant difference between the number of questions asked during the Prompts and No Prompts task by the children who were given the No Prompts task first ($Z = 2.52$, $p = .01$, $r = .63$ and a significant difference between the number of questions asked during the Prompts and No Prompts task by the children who were given the Prompts task first ($Z = 1.99$, $p = .05$, $r = .50$). These results support the prediction that the Prompts task would benefit interactive discussion by means of a question asking (Prediction 1.2).

In order to compare the number of questions asked by the children during the No Prompts task and during the Prompts task according to the order in which they were given the task, two Mann-Whitney tests were carried out. The tests revealed a significant difference in the number of questions asked during the No Prompts task ($U = 64$, $p = .001$, $r = .60$), with the children who were given the Prompts task first asking significantly more questions than the children who were given the No Prompts task first. No significant difference was found in the number of questions asked during the Prompts task by the children who were given the Prompts task first and by the children who were given the No Prompts task first ($U = 37.5$, $p = .56$, $r = .10$). These results support the prediction related to Research Question 4 that the benefits of the Prompts task on interactive discussion would be maintained once this type of scaffolding was withdrawn.

Table 17 *Median number of questions asked by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		Median	*IQR*	*median*	*IQR*
Total questions	No Prompts	4	3	16.5	16
	Prompts	34	26	37	38

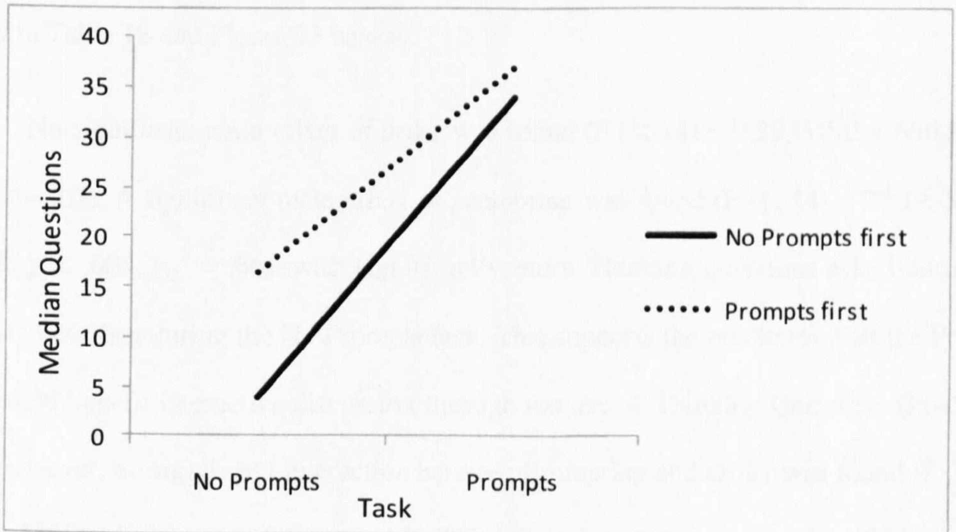

Figure 31. Median number of questions asked by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.1.3 Types of questions

3.1.3.1 Thinking questions

In order to test whether children asked a significantly greater proportion of Thinking questions during the Prompts task than during the No Prompts task, and to test whether there was a significant interaction between Prompting and Order, a mixed [2 by 2] ANOVA was carried out. As there was a difference between the number of questions that the children asked during the Prompts task and during the No Prompts task, normalisation was necessary for the Thinking Questions. This meant that for each pair of children and each task, a percentage was computed which expressed the proportion of Thinking Questions they asked during a task over the total number of questions they asked during that task. The data are shown in Table 18 and Figure 33 below.

No significant main effect of order was found ($F(1, 14) = 0.29$, $MSE = 696.58$, $p = .30$, $\eta_p^2 = .02$). A significant main effect of prompting was found ($F(1, 14) = 27.19$, $MSE = 173.31$, $p < .001$, $\eta_p^2 = .66$), with significantly more Thinking questions asked during the Prompts task than during the No Prompts task. This supports the prediction that the Prompts task would benefit interactive discussion through the use of Thinking Questions (Prediction 1.2). However, no significant interaction between Prompting and Order was found ($F(1, 14) = 2.18$, $MSE = 173.31$, $p = .08$, $\eta_p^2 = .14$). This result does not support the prediction related to Research Question 4 that the benefits of the Prompts task on interactive discussion would be maintained once this type of scaffolding was withdrawn.

Table 18 *Mean percentage of Thinking questions (over total questions) asked by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		mean	*SD*	*mean*	*SD*
Thinking questions	No Prompts	16.61	23.09	28.52	20.40
(percentage over total)	Prompts	47.75	20.38	45.91	19.37

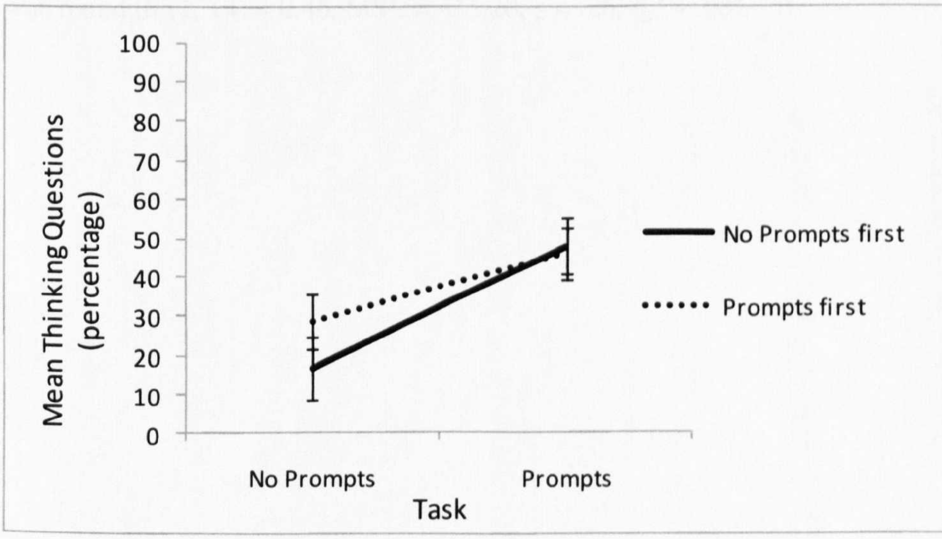

Figure 32. Mean percentage of Thinking questions asked (over total questions) by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.1.3.2 Given questions

In order to test whether children asked a significantly greater proportion of Given questions during the Prompts task than during the No Prompts task, and to test whether there was a significant interaction between Prompting and Order, a mixed [2 by 2] ANOVA was carried out. As with the number of Thinking Questions, Given Questions are expressed as a percentage of the total number of questions asked. For the No Prompts task, questions were intended as Given when they corresponded to the ones that would have been in the question prompts, if these had been used. The data are shown in Table 19 and Figure 34 below.

No significant main effect of order was found ($F(1, 14) = 0.30$, $MSE = 964.80$, $p = .30$, $\eta_p^2 = .02$). A significant main effect of prompting was found ($F(1, 14) = 6.32$, $MSE = 415.20$, $p = .04$ $\eta_p^2 = .31$). However, the main effect was in the opposite direction to the one that was predicted, as significantly more Given questions were asked during the No Prompts task than during the Prompts task. Therefore, the null hypothesis was accepted, which stated that the children did not ask significantly more Given Questions during the Prompts task than during the No Prompts task. Finally, no significant interaction between Prompting and Order was found ($F(1, 14) = 0.46$, $MSE = 415.20$, $p = .26$, $\eta_p^2 = .03$).

Table 19 *Mean percentage of Given questions asked (over total questions) by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first (n = 8)		Prompts first (n = 8)	
		mean	*SD*	*mean*	*SD*
Given questions	No Prompts	69.94	37.13	59.08	23.21
(percentage over total)	Prompts	46.94	21.28	45.85	19.76

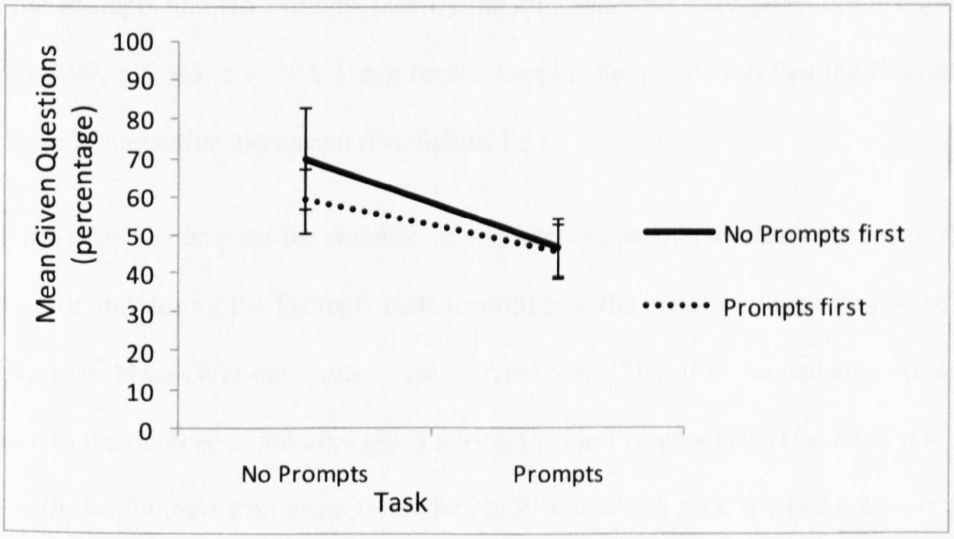

Figure 33. Mean percentage of Given questions asked (over total questions) by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.1.4 Number of answers

Before the hypothesis was tested, the number of questions that went unanswered during the No Prompts and the Prompts task was calculated, to see if these constituted a large portion, and therefore would present a problem for the analysis of the answers given. This was not the case: overall, 11.7 % of the questions asked went un-answered during the No Prompts task (a mean of 1.44 questions went un-answered out of a total mean of 12.31 questions asked) and 11.1 % of the questions asked went un-answered during the Prompts task (a mean of 4.50 questions went un-answered out of a total mean of 40.56 questions asked).

Due to the data failing to meet the requirements for parametric testing, non-parametric tests were used. The data are shown in Table 20 and Figure 35 below. In order to test whether children gave significantly more answers during the Prompts task than during the No Prompts task in the two orders, two Wilcoxon Signed Ranks test were conducted. The tests revealed a significant difference between the number of answers given during the Prompts and No Prompts task by the children who were given the No Prompts task first ($Z = 2.52$, $p = .01$, $r = .63$) and a significant difference between the number of questions given during the Prompts and No Prompts task by the children who were given the Prompts task first ($Z = 1.99$, $p = .05$, $r = .50$). These results support the prediction that the Prompts task would benefit interactive discussion (Prediction 1.3).

In order to compare the number of answers given by the children during the No Prompts task and during the Prompts task according to the order in which they were given the task, two Mann-Whitney tests were carried out. The tests revealed a significant difference in the number of answers given during the No Prompts task ($U = 63.5$, $p = .001$, $r = .59$), with the children who were given the No Prompts task after the Prompts task giving significantly more answers than the children who were given the No Prompts task first. No significant difference was found in the number of answers given during the Prompts task by the children who were given the Prompts task followed by the No Prompts task and by the children who were given the No Prompts task followed by the Prompts task ($U = 37$, $p = .6$, $r = .09$). These results support the prediction related to Research Question 4 that the benefits of the Prompts task on interactive discussion would be maintained once this type of scaffolding was withdrawn.

Table 20 *Median number of answers given by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts (n = 8)		Prompts first (n = 8)	
		median	*IQR*	*median*	*IQR*
Total answers	No Prompts	2.5	4	28.5	20
	Prompts	28.5	27	33.5	36

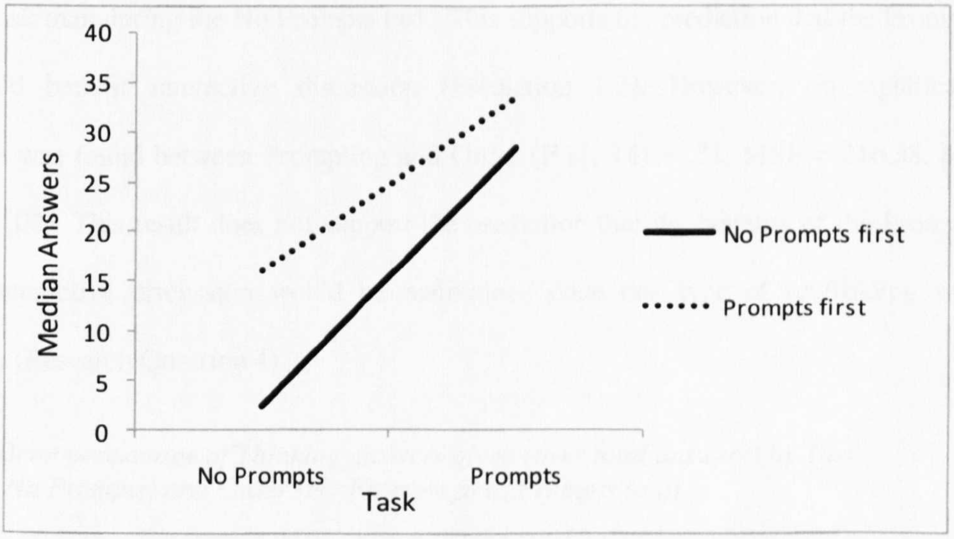

Figure 34. Median number of answers given by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.1.5 Types of answers

In order to test whether children gave significantly more Thinking answers during the Prompts task than during the No Prompts task, and to test whether there was a significant interaction between Prompting and Order, a mixed [2 by 2] ANOVA was carried out. Like with Thinking Questions, Thinking Answers are expressed as a percentage of the total number of answers given. The data are shown in Table 21 and Figure 35 below.

No significant main effect of order was found (F, 1, 14) = 0.41, MSE = 755.61, p = .26, η_p^2 = .03). A significant main effect of prompting was found (F (1, 14) = 19.28, MSE = 216.38, p = .001, η_p^2 = .58), with significantly more Thinking answers given during the Prompts task than during the No Prompts task. This supports the prediction that the Prompts task would benefit interactive discussion (Prediction 1.3). However, no significant interaction was found between Prompting and Order (F (1, 14) = .31, MSE = 216.38, p = .29, η_p^2 = .02). This result does not support the prediction that the benefits of the Prompts task on interactive discussion would be maintained once this type of scaffolding was withdrawn (Research Question 4).

Table 21 *Mean percentage of Thinking answers given (over total answers) by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first (n = 8)		Prompts first (n = 8)	
		mean	*SD*	*mean*	*SD*
Thinking answers	No Prompts	17.25	26.88	26.38	22.29
(percentage over total)	Prompts	43	17.34	46.30	20.59

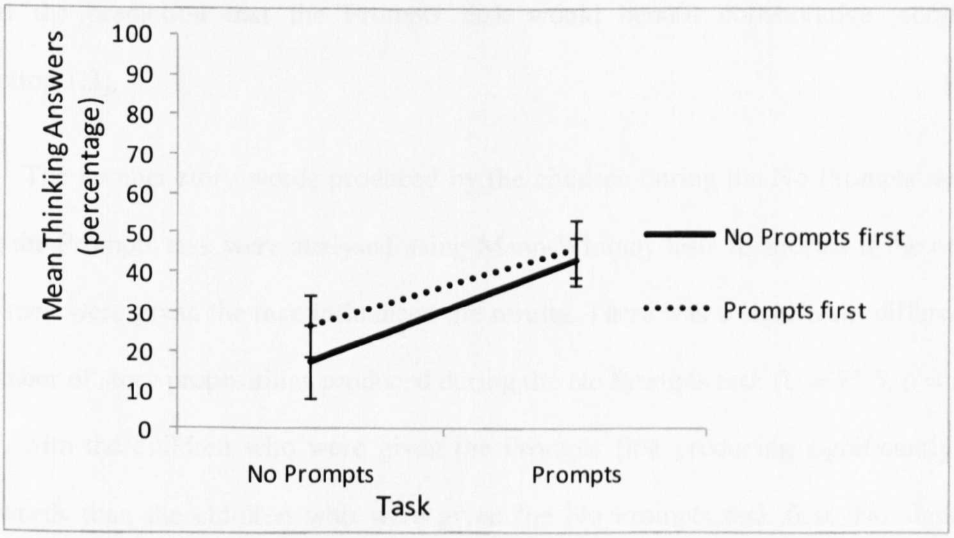

Figure 35. Mean percentage of Thinking answers given (over total answers) by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.2 Storytelling

The general prediction about storytelling was that when the children were given the Prompts task, they would tell better collaborative stories than when they were given the No Prompts task (Research Question 3), and that these benefits would be maintained during the subsequent No Prompts task (Research Question 4). Specifically, these predictions were expected to be true for the stories' length, referential complexity, evaluative richness and coherence.

3.2.1 Number of words

Due to the data failing to meet the requirements for parametric testing, non-parametric tests were used. The data are shown in Table 22 and Figure 36 below. In order to test whether children told significally longer stories during the Prompts task than during the No Prompts task in the two orders, two Wilcoxon Signed Ranks test were conducted. The tests revealed a significant difference between the number of story words produced during the Prompts and No Prompts task by the children who were given the No Prompts task first ($Z = 2.1$, $p = .04$, $r = .53$). However, no significant difference was found between the number of story words produced during the Prompts and No Prompts task by the children who were given the Prompts task first ($Z = .52$, $p = .06$, $r = .13$). Overall, however, these results support the prediction that the Prompts task would benefit collaborative storytelling (Prediction 1.3).

The number story words produced by the children during the No Prompts task and during the Prompts task were analysed using Mann-Whitney tests to address if the order in which they were given the task influenced the results. There was a significant difference in the number of story propositions produced during the No Prompts task ($U = 55.5$, $p = .001$, $r = .44$), with the children who were given the Prompts first producing significantly more story words than the children who were given the No Prompts task first. No significant difference was found between conditions during the Prompts task ($U = 32$, $p = 1$, $r = .00$). These results support the prediction related to Research Question 4 that the benefits of the Prompts task on collaborative storytelling would be maintained once this type of scaffolding was withdrawn.

These results support the prediction related to Research Question 3 that the Prompts task would promote longer collaborative storytelling (Prediction 2.1). Moreover, these results support the prediction related to Research Question 4 that the benefits of the Prompts task on children's collaborative storytelling would be maintained once this type of scaffolding was withdrawn (Prediction 3.1).

Finally, in order to test whether there was a relation between question asking and the quality of the children's collaborative storytelling, a Pearson correlation test was carried out, which showed a significant positive correlation between the total number of questions asked and number of story words ($r = .63$, $p = .01$).

Table 22 *Median number of story words produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first (n = 8)		Prompts first (n = 8)	
		median	*IQR*	*median*	*IQR*
Story words	No Prompts	162	54	308	313
	Prompts	228	122	253	279

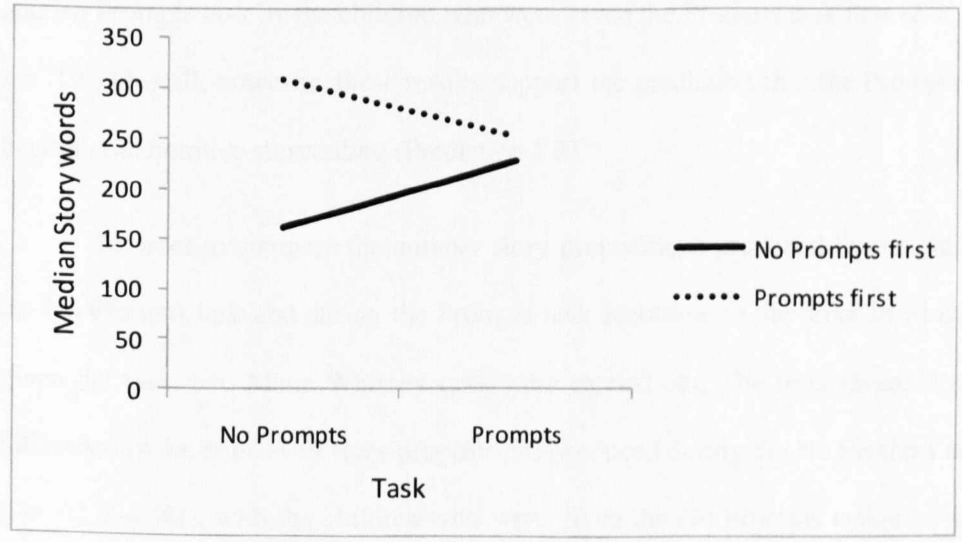

Figure 36 Median number of story words produced by the children in the No Prompts and the Prompts task when they were given the No Prompts task first and when they were given the Prompts task first.

3.2.2. Number of propositions

Due to the data failing to meet the requirements for parametric testing, non-parametric tests were used. The data are shown in Table 23 and Figure 37 below.

In order to test whether children told significally longer stories during the Prompts task than during the No Prompts task in the two orders, two Wilcoxon Signed Ranks test were conducted. The tests revealed a significant difference between the number of story propositions produced during the Prompts and No Prompts task by the children who were given the No Prompts task first ($Z = 2.04$, $p = .04$, $r = .51$). However, no significant difference was found between the number of story propositions produced during the Prompts and No Prompts task by the children who were given the Prompts task first ($Z = .74$, $p = .46$, $r = .19$). Overall, however, these results support the prediction that the Prompts task would benefit collaborative storytelling (Prediction 1.3).

In order to compare the number story propositions produced by the children during the No Prompts task and during the Prompts task according to the order in which they were given the task, two Mann-Whitney tests were carried out. The tests revealed a significant difference in the number of story propositions produced during the No Prompts task ($U = 54$, $p = .02$, $r = .41$), with the children who were given the No Prompts task after the Prompts task producing significantly more story propositions than the children who were given the No Prompts task first. No significant difference was found in the number of story propositions produced during the Prompts task by the children who were given the Prompts task followed by the No Prompts task and by the children who were given the No Prompts task followed by the Prompts task ($U = 31$, $p = .92$, $r = .02$). These results support the prediction related to Research Question 4 that the benefits of the Prompts task on collaborative storytelling would be maintained once this type of scaffolding was withdrawn.

These results support the prediction related to Research Question 3 that the Prompts task would promote longer collaborative storytelling (Prediction 2.1). Moreover, these results support the prediction related to Research Question 4 that the benefits of the Prompts task on children's collaborative storytelling would be maintained once this type of scaffolding was withdrawn (Prediction 3.1).

Finally, in order to test whether there was a relation between question asking and the quality of the children's collaborative storytelling, a Pearson correlation test was carried out, which showed a significant positive correlation between the total number of questions asked and number of story propositions ($r = .61$, $p = .01$).

Table 23 *Median number of story propositions produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		median	*IQR*	*median*	*IQR*
Story propositions	No Prompts	31	21	54	51
	Prompts	45	23	45.50	43

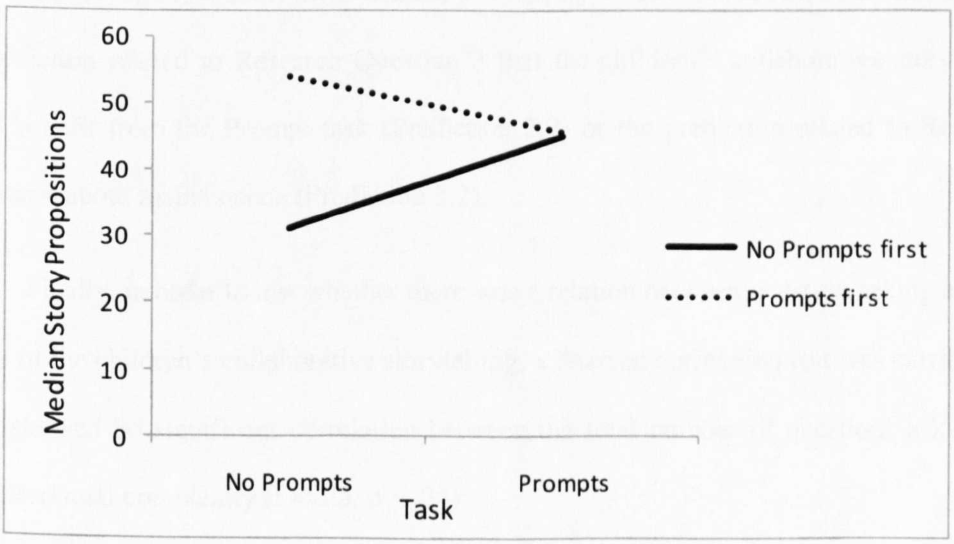

Figure 37. Median number of story proposition produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.2.3 Referential complexity

All stories were coded according to the Children's Story Content scheme described in Measures. A second coder (blind to condition) coded 25 % of the stories and inter-rater agreement was scored for the frog stories (Kappa = .84, $p < .001$) and the monkey stories (Kappa = .91, $p < .001$). Moreover, because the coding scheme was applied to two slightly different stories, the score range for the frog story (0-13 points) was slightly different from the range for the monkey (0-12 points). Therefore, like in Experimental Study 1, for the purpose of comparison the scored were normalised. The analysis reported below was conducted on the normalised scores.

In order to test whether children told significantly better structured stories when given the Prompts task than when given the No Prompts task, and to test whether there was a significant interaction between Prompting and Order, a mixed [2 by 2] ANOVA was carried out. The data are shown in Table 24 and Figure 38 below.

No significant main effect of order was found ($F(1, 14) = 1.44$, SME = 2.26, $p = .12$, $\eta_p^2 = .01$). Moreover, no significant main effect of prompting ($F(1, 14) = 0.14$, SME = 2.26, $p = .35$, $\eta_p^2 = .01$). Finally, no significant interaction between Prompting and Order were found ($F(1, 14) = 1.44$, SME = 2.26, $p = .13$, $\eta_p^2 = .09$). These results do not support the prediction related to Research Question 3 that the children's collaborative storytelling would benefit from the Prompt task (Prediction 2.2) or the prediction related to Research Question 4 about maintenance (Prediction 3.2).

Finally, in order to test whether there was a relation between question asking and the quality of the children's collaborative storytelling, a Pearson correlation test was carried out, which showed no significant correlation between the total number of questions asked and story referential complexity ($r = .25$, $p = .34$).

Table 24 *Mean referential complexity in the stories produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		Mean	*SD*	*Mean*	*SD*
Referential	No Prompts	6.95	2.44	7.86	1.42
complexity	Prompts	7.39	1.59	7.03	1.48

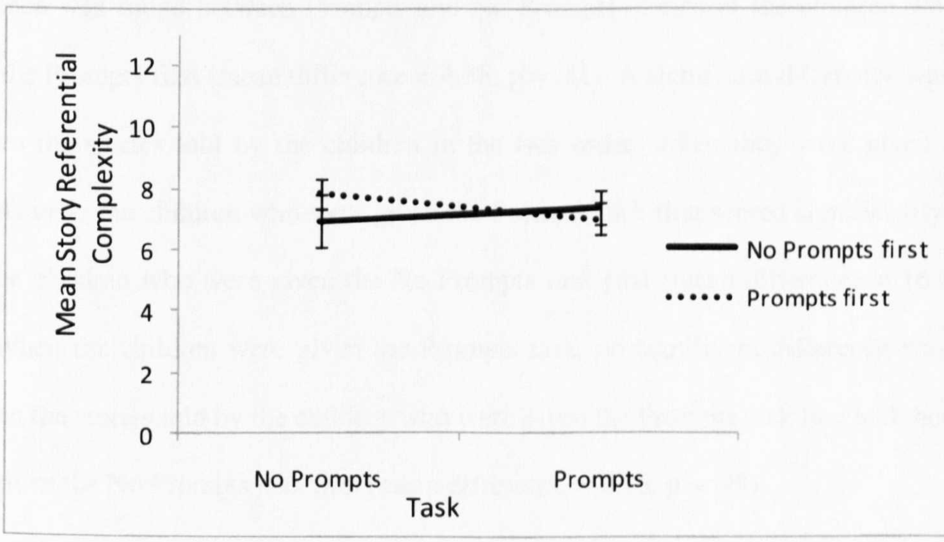

Figure 38. Mean referential complexity in the stories produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

3.2.4 Evaluative richness

All stories were coded according to the Story Elaboration scheme described in Measures. A second coder (blind to condition) coded 25% of the stories and inter-rater agreement was scored for the frog stories (Kappa = .85, p < .001) and the monkey stories (Kappa = .88, p < .001).

In order to test whether children told significantly more evaluative stories when given the Prompts task than when given the No Prompts task, and to test whether there was a significant interaction between Prompting and Order, a mixed [2 by 2] ANOVA was carried out. The data are shown in Table 25 and Figure 39 below.

No significant main effect of order was found ($F(1, 14) = 2.30$, $MSE = 236.38$, $p = .08$, $\eta_p^2 = .14$). Moreover, no significant main effect of prompting was found ($F(1, 14) = 1.19$, $MSE = 107.49$, $p = .14$, $\eta_p^2 = .08$). However, a significant interaction was found between Prompting and Order ($F(1, 14) = 5.22$, $MSE = 107.49$, $p = .02$, $\eta_p^2 = .27$). Post-hoc comparisons using the Bonferroni adjustment for multiple comparisons showed that the children who were given the No Prompts task first scored significantly higher for the Prompts task than for the No Prompts task (mean difference = 12.38, $p = .03$). No significant difference was found between Prompts and No Prompts stories of the children who were given the Prompts first (mean difference = 4.38, $p = .41$). A significant difference was found between the stories told by the children in the two orders when they were given the No Prompts task: the children who were given the Prompts task first scored significantly higher than the children who were given the No Prompts task first (mean difference = 16.63, $p = .04$). When the children were given the Prompts task, no significant difference was found between the stories told by the children who were given the Prompts task first and those who were given the No Prompts task first (mean difference = 0.13, $p = .98$).

These results support the prediction related to Research Question 3 that the Prompts task would be related to better collaborative storytelling (Prediction 2.3). Moreover, these results support the prediction related to Research Question 4 that the benefits of the Prompts task on children's collaborative storytelling would be maintained once this type of scaffolding was withdrawn (Prediction 3.3).

Finally, in order to test whether there was a relation between question asking and the quality of the children's collaborative storytelling, a Pearson correlation test was carried out, which showed a significant positive correlation between the total number of questions asked and story evaluative richness ($r = .57$, $p = .02$). A significant correlation was also found between the total number of Thinking questions asked and story evaluative richness ($r = .5$, $p = .04$).

Table 25 *Mean evaluative richness in the stories produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		Mean	*SD*	*Mean*	*SD*
Evaluative	No Prompts	20.13	11.77	36.75	16.67
Richness	Prompts	32.50	7.25	32.38	14.79

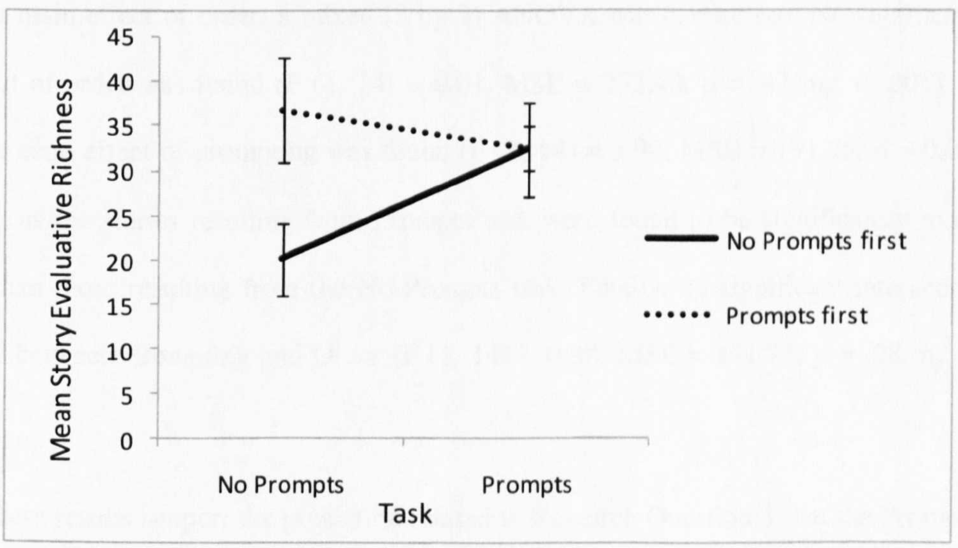

Figure 39. Mean evaluative richness in the stories produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first)

3.2.5 Story coherence

All stories were coded for Coherence according to the scheme described in Measures. A second coder (blind to condition) coded 25 % of the stories and inter-rater agreement was scored for the frog stories (Kappa = .81, $p < .001$) and the monkey stories (Kappa = .73, $p < .001$).

As the number of turns in the stories told in the No Prompts and the Prompts task varied, the number of turns that build coherently on the previous turn was normalised against the total number of turns in each story, and the proportions were expressed as percentages. The data are shown in Table 26 and Figure 40 below.

In order to test whether children told significantly more coherent stories when given the Prompts task than when given the No Prompts task, and to test whether there was a significant main effect of order, a mixed [2 by 2] ANOVA was carried out. No significant main effect of order was found ($F(1, 14) = 0.01$, $MSE = 233.40$, $p = .47$, $\eta_p^2 < .001$). A significant main effect of prompting was found ($F(1, 14) = 3.90$, $MSE = 191.75$, $p = 0.03$, $\eta_p^2 = .22$), as the stories resulting from Prompts task were found to be significantly more coherent than those resulting from the No Prompts task. Finally, no significant interaction was found between Prompting and Order ($F(1, 14) = 0.38$, $MSE = 191.75$, $p = .28$, $\eta_p^2 = .03$).

These results support the prediction related to Research Question 3 that the Prompts task would be related to better collaborative storytelling (Prediction 2.4). However, these results do not support the prediction related to Research Question 4 that the benefits of the Prompts task on children's collaborative storytelling would be maintained once this type of scaffolding was withdrawn (Prediction 3.4).

Finally, in order to test whether there was a relation between question asking and the quality of the children's collaborative storytelling, a Pearson correlation test was carried out, which showed no significant correlation between the total number of questions asked and story evaluative richness (r = .24, p = .36).

Table 26 *Mean cohenrece percentage in the stories produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).*

		No Prompts first		Prompts first	
		(n = 8)		(n = 8)	
		Mean	*SD*	*mean*	*SD*
Coherence	No Prompts	30.27	10.37	33.71	14.13
(percentage)	Prompts	42.95	18.73	40.36	13.88

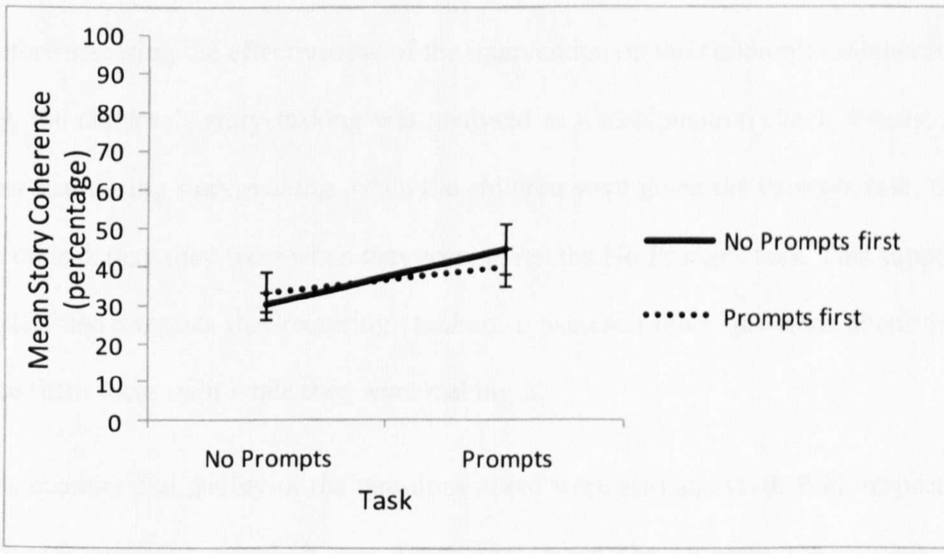

Figure 40. Mean coherence percentage in the stories produced by Task (Prompts, No Prompts) and Order (No Prompts first, Prompts first).

4. Discussion

4.1 Summary and interpretation of findings

The first question in this study asked whether encouraging children to engage in interactive discussion whilst making stories would lead to better collaborative storytelling (Research Question 3). It was expected that requiring children to ask each other questions using a set of provided question prompts would lead to more interactive discussion. This, in turn, was predicted to result in children reflecting more on their own and each others' ideas, thus enabling them to produce better stories, i.e., longer, referentially more complex and evaluatively richer. Engagement in interactive discussion was also predicted to lead to children achieving a better shared understanding of each others' story idea, thus enabling them to build more coherently on each others' contributions during storytelling.

Before assessing the effectiveness of the intervention on the children's collaborative storytelling, the children's story-making was analysed as a manipulation check. Firstly, the results show that during story-making, when the children were given the Prompts task, they were more on task than they were when they were given the No Prompts task. This supports prediction 1.1, and suggests that requiring children to ask each other questions about their story helped them focus on it while they were making it.

The quantity and quality of the questions asked were also analysed. With respect to the quantity of questions asked, it was found that when the children were given the reciprocal prompting task, they asked a much greater number of questions than when they were not so supported. This supports prediction 1.2 about the number of questions asked. Specifically, the median number of questions asked by the children during the reciprocal prompting task was 35, against a median of 9 during the no prompting task. The reciprocal prompting task required that children ask each other at least one question per story picture and each story was made of ten pictures. This means that the children were required to ask each other at least ten questions during the reciprocal prompting task. As the median number of questions asked shows, a much greater number of questions than ten were asked, thus showing that the children did not limit themselves to asking each other at least one question in each turn. This suggests that the children found asking each other questions about the story something engaging and possibly even enjoyable to do.

The question prompts which were provided included a greater proportion of Thinking Questions, as these have been shown to promote greater levels of reflection and elaboration than Review Questions (King, 1999; King & Rosenshine, 1993; King, Staffieri, & Adelgais, 1998). Therefore, it was expected that proportionally more Thinking Questions would be asked during the reciprocal prompting task. The findings show that proportionally more Thinking questions were, indeed, asked during the reciprocal prompting task. This suggests that the intervention was successful at promoting questioning about the story elements which went beyond the presented pictures, for example through formulation of elaborations and inferences, thus benefitting the quality of the interactive discussion.

Moreover, in order to establish whether the requirement to use at least one of the question prompts limited the children's own ways of interacting with each other through questions, the proportion of questions asked which were given was compared during the reciprocal prompting and during the unsupported task. During the unsupported task, no questions were given, but questions similar to the ones given in the Prompts task could happen to be asked. The results show that the children did not limit themselves to asking each other the provided prompts as they were instructed to, but they also invented a great number of questions. Interestingly, proportionally fewer Given questions were asked during the Prompts task than during the No Prompts task, suggesting that providing a set of question prompts and requiring that children ask each other questions encouraged children to invent their own question more than they would in the absence of this support.

Together, the findings about the proportion of Thinking questions and about the proportion of Given questions suggest that when they were given the Prompts task, children asked proportionally more Thinking questions than in the unsupported task, and that a great part of these will have presumably been Invented ones.

Having established that the children did engage in interactive discussion during story-making – i.e., they were on task, they asked each other questions (both given and invented) about the story and gave each other answers that were relevant – it was legitimate to address Research Question 3 about the value of encouraging children to engage in interactive discussion for their collaborative storytelling.

The results support prediction 2.1 about the question prompting promoting the production of longer stories: when the children were given the question prompts and required to ask each other questions, they told longer stories than when they were not. This was true for both the number of words and the number of propositions their stories were composed of. These findings suggest that promoting children's engagement in interactive discussion through prompting was successful at encouraging them to attend to the presented and constructed pictures and to elaborate on them, and this led to the production of longer stories. This consideration is also supported by the significant positive correlation between the total number of questions asked and the length of the collaborative stories.

Prediction 2.2 about the increased referential complexity, however, was not supported: when the children were given the Prompts task, they told stories which were as referentially complex as the stories they told when they were given the No Prompts task. It can be argued that this was the case because children at this age are simply not able to tell stories which include a great number of referential elements.

However, it can also be argued that the type of scaffold was not effective enough in achieving this. The children were provided with more Thinking than Review questions, and they also asked more Thinking than Review questions. As Thinking questions were mainly about evaluative aspects of the story, i.e. aspects which went beyond the plot driving events illustrated in the pictures, a greater part of the story-making discussion would have presumably been dedicated to evaluative aspects of the story than to referential ones. This is likely to have resulted in stories which were not referentially better than those made during the No Prompts task.

Prediction 2.3 about increased evaluative richness was supported: when the children were given the Prompts task, they told stories which were evaluatively richer than when they were not so supported. This suggests that encouraging children to engage in interactive discussion through question prompts promotes children's elaboration on their story ideas; this, in turn, led to good collaborative storytelling. Specifically, this could be explained by the fact that the children asked a proportionally greater number of Thinking Questions, which were specifically aimed at encouraging children to elaborate on what was illustrated in the pictures provided. These considerations are also supported by the significant positive correlation that was found between the number and type of questions asked during story-making and the collaborative stories' evaluative richness: the more questions were asked, and specifically the more Thinking questions were asked, the more evaluatively rich the children's collaborative stories were.

Finally, prediction 2.4 about coherence was also supported: when the children were given the Prompts task, they built on each others' contributions more coherently than they did when they were not so supported. This suggests that as a result of encouraging children to articulate and discuss each other's ideas, shared understanding was made possible. This, in turn, made it possible for children to build coherently on each others' ideas. However, the results on correlation between number of questions asked and stories' coherence show that there was no significant correlation between the two. This was unexpected, as the prompting scaffolding was shown to benefit stories' coherence. This was possibly due to the fact that the data might not have provided sufficient variance in order for the correlation test to prove significant, thus incurring in a Type II error.

The other question addressed in this study was whether it would be possible to withdraw the requirement for children to ask each other questions whilst still maintaining the potential benefits of the prompting for interactive discussion (Research Question 4). In other words, the study investigated whether the potential benefits of the scaffolding provided would be maintained once the scaffolding was no longer present.

It was found that the children continued to engage in interactive discussion during story-making even after the reciprocal prompting support was withdrawn. Specifically, the children continued to ask each other questions and to give each other answers when they were no longer required to do so.

Prediction 3.1 was supported with respect to story length: once the prompting scaffold was withdrawn, the children continued to tell stories which contained significantly more words and propositions than the children who had not been given the prompting. It was also found that the children continued to ask each other questions during story-making, once they were no longer required to do so (prediction 1.4), suggesting that the children might have internalised the reciprocal questioning strategy. Together, these findings suggest that continuing to engage in interactive discussion during story-making promoted to the production of longer stories.

Prediction 3.3 about evaluative richness was also supported: after they had experienced the reciprocal questioning, the children continued to tell stories which were evaluatively richer than those produced by the children who had not been exposed to the scaffold yet. Like with story length, it is reasonable to assume that the children had internalised the reciprocal questioning strategy, and this enabled them to engage in interactive discussion during story-making which, in turn, led to the production of richer stories.

The predictions about referential complexity (Prediction 3.2) or coherence (Prediction 3.4), however, were not supported. The result about referential complexity is not surprising, considering that the children were not found to tell referentially more complex stories as a result of the reciprocal questioning intervention. However, the result about coherence was unexpected, as the children were found to tell significantly more coherent stories when they were exposed to the reciprocal questioning scaffold.

4.2 Conclusions

This study examined whether encouraging children to engage in interactive discussion during story-making through reciprocal questioning would benefit their collaborative storytelling (Research Question 3), and whether these benefits could be maintained once the scaffolding was no longer present (Research Question 4).

The findings showed that the Prompting intervention was successful at scaffolding children's collaborative storytelling: while they were making their stories, the children engaged in interactive discussion through the question prompts, and this benefited the quality of their collaborative storytelling on many measures. Specifically, this study showed that when children were provided with picture story material and encouraged to complement it with their own self constructed drawings, requiring them to ask each other questions through question prompts was an effective way to promote their engagement in interactive discussion. This, in turn, might have encouraged the children to attend to the story material as well as their own and each others' constructions. As a result, their collaborative stories were longer, evaluatively richer and more coherent.

However, it must be recognised that the Prompts task did involve the children spending a longer time on their stories, as well as about ten minutes extra training where they were familiarised with the Guided Reciprocal Peer Questioning method. This could have influenced the children's performance by improving the quality of their storytelling. The fact that the Prompts task had to be carried out throughout two sessions also could have confounded the results. Therefore, future studies involving this method would ideally include a suitable control task for the No Prompts task, to ensure tasks comparability.

The other finding in this study was the positive correlation between the number of questions asked and the length and evaluative richness of the children's collaborative stories. Together, these findings and the ones about the quality of the collaborative story-making and story-telling suggest that the reciprocal questioning scaffold was successful at promoting engagement in interactive discussion during story-making, and that this was related to better collaborative storytelling.

Finally, the beneficial effects of reciprocal questioning could be maintained once this form of scaffolding was withdrawn. The children continued to engage in reciprocal questioning even once they were no longer required to do so or provided the prompts, and their collaborative stories were and evaluatively richer than those produced by the children who had not been supported by the reciprocal questioning. This suggests that the children internalised the reciprocal questioning strategy and continued to benefit from this scaffolding once it was no longer provided.

Given the developmental literature showing that children in their first years of primary education are only beginning to tell stories which can be understood and appreciated by a naive audience and do not always do so consistently (Bamberg & Damrad-Frye, 1991; Peterson & McCabe, 1983), these findings are encouraging, as they suggest that promoting children's engagement in interactive discussion during story-making can benefit their collaborative storytelling.

These findings also add to those from Experimental Study 1 and to the literature on self constructed representations in general (de Westelinck et al., 2005; Munneke et al., 2003; Prangsma et al., 2008), by showing that the benefits of self constructed representations can be augmented by encouraging learners to engage in interactive discussion through reciprocal questioning. Encouraging interactive discussion appears to promote children's attending to and elaborating of the presented and constructed representations, ultimately facilitating the production of better collaborative outcomes.

Furthermore, these findings add to the literature on the value of the Guided Reciprocal Peer Questioning method (King, 1990; 1994; 1999; King & Rosenshine, 1993;

King, Staffieri, & Adelgais, 1998). This method had been previously shown to be effective at scaffolding students' engagement with and reflection on the learning material by providing opportunities for them to activate and consolidate their knowledge of the presented material. The present study provided additional evidence for the benefits of this method by showing that similar benefits can be obtained with younger children than those tested by King and colleagues. Moreover, this study showed that specific questions can be effectively devised to tailor the Guided Reciprocal Peer Questioning to the storytelling domain, and that children are able to use these productively. The study also adds to the existing evidence on the value of reciprocal questioning by showing that this can be used not only to prompt comprehension, but also production. Crucially, in this study, the benefits could be maintained even once the support was withdrawn. Lastly, this study adds to the literature on Guided Reciprocal Peer Questioning through its analysis of the different types of questions asked by the children with respect to whether these are provided through the prompts, or invented by the children. Although King differentiates between providing question prompts (such as "Why is [...] important?") and providing questions formulated by students in previous lectures where the same material was taught (such as "Why is measurement important?") (King, 1994), she and her colleagues do not report differentiating between given and invented questions. Therefore, the existing literature does not discuss whether the students engaged with the reciprocal questions were able to appropriate the strategy by inventing their own questions.

Finally, the fact that children could be effectively encouraged to engage in interactive discussion during story-making is a valuable finding in itself. Given the literature showing that children around six and seven are not yet proficient at articulating their ideas for others or at detecting lack of articulation in others' messages (Lloyd et al., 1995; Robinson & Robinson, 1978, 1982; Whitehurst & Sonnenschein, 1981), the findings from this study shows that reciprocal questioning could be an effective way of addressing this problem. These results are also promising with respect to the broader literature on collaboration, where it is suggested that even older learners can find it difficult to engage in interactive discussion when not explicitly prompted to do so (de Westelinck et al., 2005; Munneke et al., 2003; Prangsma et al., 2008).

Chapter 6: General Discussion

1. Summary of findings

The broad aim of this thesis was to investigate how children's collaborative storytelling can be supported through constructive and interactive story-making. Specifically, this thesis examined how providing children with a variety of resources (Research Question 1), encouraging them to construct their own representations (Research Question 2) and to interact with each other while they make their story (Research Question 3) benefits their collaborative storytelling. Moreover, this thesis investigated whether the benefits observed from combining the constructive and interactive scaffolding could be maintained once the children were no longer encouraged to be interactive through provided question prompts (Research Question 4).

1.1 Resourcing children's collaborative storytelling

The first question addressed in this thesis was about how to resource children's collaborative storytelling, i.e., what the features might be of good resources for encouraging children to actively manipulate and base their story on, to construct their own representations, and to engage in interactive discussion during story-making. Existing relevant research was reviewed in Chapter 2, and the question was explored in the StoryTable Case Study, which focused on supporting children's collaborative storytelling with and around technology.

The literature review argued that, in technologically unmediated scenarios where individual children are instructed to produce a story, presenting children with a sequence of story pictures is a more effective way of eliciting better storytelling than simply providing a picture story scene (Pearce, 2003). Research has also demonstrated that problem based picture sequences are a better resource for supporting children's individual storytelling, and that this is even more so when they are allowed to pre-view the entire sequence before telling the story (Hudson & Shapiro, 1991). However, these studies were about children being presented with these resources without being able to engage with them actively or constructively. Moreover, these studies were conducted in technologically unmediated environments, and involved individual storytelling.

The literature review on technology mediated storytelling presented studies where good collaborative storytelling was achieved with young children through technology scaffolding where more or less structured resources were provided for children to actively manipulate or to be constructive on. In some of these cases, pictures of story settings and characters were provided, but the selection and positioning was decided by the children (Machado et al., 2001; Steiner & Moher, 2002); these resources appeared to benefit children's collaborative storytelling. However, other studies evaluate storytelling technologies where no resources are provided, practically giving children a 'blank slate' to fill with their own story content (Ananny, 2002; Raffle et al., 2007). These studies showed how children could successfully tell stories together with these technologies, thus suggesting that children might not need to be provided with structured resources to base their stories on.

The literature review also reported practice based evidence of the benefits of providing opportunities for children to construct their own representations over presented resources with traditional resources (Caldwell & Moore, 1991; Dietz, 1976; Ernst, 1997; Karnowski, 1986; Steele, 1991) as well as evidence technology mediated resources (Ananny, 2002; Marshall et al., 2004; Raffle et al., 2007). However, these evaluation studies mostly involved the provision of additional support, such as prompting for children to reflect on their character's goals and emotional states or a central theme for children to base their stories around (Raffle et al., 2007).

Therefore, the question remained open as to the features of the resources which could benefit children's collaborative storytelling, with respect to both their active and constructive engagement. The StoryTable Case Study provided further insight on this by exploring a variety of ways in which children's active and constructive storytelling can be resourced, for example by providing opportunities for children to select and arrange characters and settings and by constructing audio recordings and arranging them into different story sequences. Moreover, in StoryTable, some of the selections had to be made jointly, in the hope that this would encourage children to engage in interactive discussion during story-making.

The first two sets of observations focused on this question by exploring how children's collaborative storytelling could be scaffolded through provision of both traditional and technology mediated resources. The observations from these sessions revealed that these types of resources were not sufficient to encourage good collaborative storytelling, as the children mostly produced recordings which were very simple stories, and sometimes only produced lists of descriptions which could not even be considered stories. Moreover, none of the children appeared to take advantage of the resources provided in order to discuss their ideas with each other for making and telling complex stories.

These observations suggested that children might need a more structured set of resources to base their own constructions on, such as a sequence of story pictures instead of a list of story settings and characters. The audio modality might also have been problematic due to the fact that a recording's content is ephemeral and can only become available progressively during played back. This may have made reflection and engagement in interactive discussion harder for children than other persistent modalities, such as drawing.

The other constructive resource was the story PlayList, where children could arrange their recordings into different sequences and play them back. However, despite the fact that children had been able to use it during training, this resource was not used by the children in the first two sets of observations. This made it impossible to evaluate its benefits, and ultimately suggested that it might not be the most suitable feature to support children's collaborative storytelling. Finally, the requirement for joint action in order to select a story setting and to play the entire story back did not seem to encourage children's engagement in interactive discussion or to benefit their collaborative storytelling.

Other valuable findings emerged from the first two sets of observations, which provided important insight into the design of subsequent investigation. For example, younger children (aged four to six) were found to produce particularly poor stories and to be even less likely to engage in interactive discussion during story-making than slightly older children (ages seven and eight). These considerations were supported by literature on the development of children's ability to tell stories individually, showing that it is not until around the age of six and seven that children begin to tell stories which are referentially complex and evaluatively rich (Applebee, 1978; Bamberg & Damrad-Frye, 1991; Berman, 1995; Hudson & Shapiro, 1991; Peterson & McCabe, 1983; Stein & Glenn, 1979; Trabasso et al., 1989).

It also appeared that children might not benefit from telling stories with a partner they are not familiar with. This was also reflected in the literature, suggesting that literacy based practices tend to be more productive when children are familiar with the social context in which these practices take place (Pellegrini et al., 1998; Preece, 1992).

As a result of these observations, in the two subsequent experimental studies, children's active manipulation was supported through pictures representing a goal based story, and no joint selection was required. Secondly, due to the lack of persistency of the audio modality, subsequent studies involved encouraging constructive engagement through dynamic drawings instead of audio.

1.2 The benefits of self constructed representations

The second question addressed in this thesis asked whether encouraging children to construct their own representations over provided resources would benefit collaborative storytelling more than simply manipulating these resources. Existing relevant research was reviewed in Chapter 2, and the question was addressed in Experimental Study 1, which compared scaffolding children's collaborative storytelling through active and constructive engagement with scaffolding children's collaborative storytelling through active engagement only.

The literature review showed that many have argued for the benefits of encouraging learners to be constructive (Biswas et al., 2005; Bodemer et al., 2004; Chi et al., 1989; Chi et al., 1994; Graesser & Person, 1994; Roth & Roychoudhury, 1994; Suthers & Hundhausen, 2003). However, the literature review also showed how little evidence has been reported on the benefits of encouraging constructive activity with children in order to support their collaborative storytelling. Moreover, as this evidence is mainly practice based and not strictly pertaining collaborative storytelling (Caldwell & Moore, 1991; Constantino, 1986; Dietz, 1976; Ernst, 1997; Fisher, 1976; Karnowski, 1986; Steele, 1991), further research is needed in order to establish the value of constructive engagement for children's collaborative storytelling.

The literature review on technology mediated constructive storytelling also showed how this type of scaffold can be beneficial. However, it is also argued that this may only be the case when constructive story making is complemented by additional adult support (Ananny, 2002; Marshall et al., 2004; Raffle et al., 2007).

Therefore, the question about the value of scaffolding children's collaborative storytelling through technology mediated constructive engagement was investigated in Experimental Study 1. This study found that when children are encouraged to use KidPad to construct their own dynamic drawings over presented picture sequences, their collaborative stories were longer. This was true for both the number of words and propositions the stories were made of: when the children used the drawing version of KidPad, they told longer stories the second time around. Moreover, the second time stories were told, they contained more words when the dynamic drawings had been constructed than when they had not. These findings suggested that encouraging children to construct their own dynamic drawings could have led them to attend to the presented and constructed pictures and to elaborate on them.

This study also found that encouraging children to construct their own representations led to an improvement in the collaborative stories' referential complexity as well as evaluative richness. The same pattern as above was found: when the children were given the drawing task, the second time they told their story, they scored better on both referential complexity and evaluative richness. Despite the lack of difference between story retellings during the drawing and the non-drawing task, these findings suggest that the construction of representations over presented resources did benefit children's collaborative storytelling, as no significant improvement was found when the children were given the non-drawing task.

These results showed that encouraging children to construct their own representations led to an improvement in their collaborative stories from the first to the second time these were told. These are promising findings, as they suggest that children's collaborative storytelling can be scaffolded through constructive activity, thus providing empirical evidence for the practice based observations reported in studies where children are encouraged to engage in similarly constructive activities (Caldwell & Moore, 1991; Constantino, 1986; Dietz, 1976; Ernst, 1997; Fisher, 1976; Karnowski, 1986; Steele, 1991).

These findings also add to the literature on computer supported collaborative storytelling by showing that encouraging children to use KidPad to construct dynamic drawings over presented pictures benefits their collaborative storytelling (Ananny, 2002; Marshall et al., 2004; Raffle et al., 2007). Specifically, these findings complement a study conducted by Boltman showing that when children are presented with dynamic representations in KidPad, their retelling is better with respect to referential complexity (Boltman, 2001). Experimental Study 1 extends those findings by showing that children's storytelling can be supported through KidPad for more complex tasks, where children are encouraged to collaborate with a peer and to construct their own dynamic representations through KidPad.

Finally, these findings extend the literature on learning through construction (Alesandrini, 1981; Chi et al., 1994; Dempsey & Betz, 2001; Van Meter & Garner, 2005) and on collaborative learning in general, as they show that this can be supported by constructive engagement (Dillenbourg & Traum, 2006; Prangsma et al., 2008; Schwartz, 1995; Suthers & Hundhausen, 2003).

However, this study also found that the construction of drawings did not benefit the extent to which the children built coherently on each other's contributions during storytelling. This could have been due to the fact that the children only engaged in the constructive activity to create an average of four drawings per story, and this may have provided too few opportunities for them to discuss their story ideas with each other. However, it may have been the case that the drawings simply did not represent a compelling 'anchoring point' (Crook, 1995; Crook & Webster, 1997) to encourage children to articulate and discuss their ideas. Similar findings were also reported by Stanton and Neale (2003), who analysed the quality of children's talk when using KidPad with one mouse each to make a story together, and found that the children did not engage in prolonged discussion about their story ideas. The lack of engagement in interactive discussion may have prevented the establishment of a shared understanding among the children about their collaborative story, thus making it hard for them to build coherently on each others' contributions during storytelling.

This missed opportunity to engage in interactive discussion during story-making may have contributed to the lack of difference between non-drawing and drawing retelling stories with respect to referential complexity and evaluative richness. It is plausible that if the children had engaged in more interactive discussion, they would also have told more complex and rich stories than they did in this study. Therefore, the subsequent experimental manipulation addressed this issue by investigating the value of explicitly encouraging children to engage in interactive discussion during story-making.

1.3 The benefits of encouraging interactive discussion during story-making

The third question investigated in this thesis asked whether encouraging children to engage in interactive discussion during story-making would benefit their collaborative storytelling.

This question was addressed in both the StoryTable Case Study and Experimental Study 2. The StoryTable Case Study began to address this issue by exploring whether interactive discussion could be promoted by providing adult guidance around the StoryTable technology. Given the promising findings from this set of observations, Experimental Study 2 investigated whether children could be encouraged to engage in interactive discussion through minimal instruction on how to ask each other questions, and then be left to do so autonomously.

The Literature Review (Chapter 2) argued for the importance of interactive discussion by presenting a number of studies illustrating the benefits of learners' articulation and discussion. This type of activity has been shown to lead to increased attending to and elaborating of ideas (Barron, 2003; Chi, 2009; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996; Wegerif, 1996). Specifically, children's collaborative storytelling has been found to benefit from their engagement with each other, but only when children engage with each others' ideas through interactive discussion when they make their stories (Devescovi & Baumgartner, 1993; Hayes & Casey, 2002; Preece, 1992). As Hayes and Casey point out, children's collaborative stories can become quite complex due to the greater quantity of ideas that need to be integrated into the story (Hayes & Casey, 2002). Therefore, in order for a story to be coherent, it is important that children discuss the story and achieve a shared understanding. As some have argued (Devescovi & Baumgartner, 1993; Hayes & Casey, 2002; Preece, 1992), one cannot take for granted that because children are asked to make a story together, they will strive to engage in interactive discussion and achieve shared understanding.

The two initial sets of observations in the StoryTable Case Study reflect and extend these considerations by showing that encouraging children to actively manipulate presented resources and to construct their own recordings was not a sufficient way of promoting interactive discussion during story-making and, ultimately, the production of good collaborative stories. Experimental Study 1 also reflects these findings by showing that children's collaborative storytelling can only benefit to a certain extent from constructive activities, and it is suggested that this might be due to the children's lack of engagement in interactive discussion. Thus, it is suggested that even the construction of persistent representations might not be a sufficiently effective 'anchoring point' for children' engagement in interactive discussion.

Children's engagement in interactive discussion was explored in the third and final set of observations in the StoryTable Case Study, which was aimed at exploring the potential benefits of complementing children's use of the StoryTable resources with additional guidance outside technology. A pair of children was observed making stories together with the guidance of an adult facilitator, who used questions and suggestions to encourage them to articulate and discuss their ideas and to ensure that they produced stories which were referentially complex and evaluatively rich. This pair of children was selected from the pairs that had participated in the previous two sets of observations because they had displayed a slightly better potential to engage with each other and to tell good collaborative stories.

It was found that complementing technology based resources with additional guidance around the technology could benefit children's collaborative storytelling. The children engaged in interactive discussion about their story ideas through clarification requests, articulation of ideas, and provision of suggestions and feedback. Moreover, the children produced long stories which were both referentially and evaluatively mature.

Given these promising findings, a more systematic manipulation was designed for Experimental Study 2, where the potential benefits of complementing technology mediated scaffolding with scaffolding around technology were investigated. For this study, a method was selected which would allow children to produce stories together without the need for adult guidance and with only minimal instruction on how to interact with each other.

Chapter 5 (Section 1) presented a variety of techniques which have been employed to encourage children to engage in interactive discussion, such as Reciprocal Teaching

(Brown & Palincsar, 1989; Rosenshine & Meister, 1994) and the Paired Reading method (Christie et al., 2009; Topping, 1995). However, some have argued that these approaches are too structured to enable learners to elaborate and create new knowledge (Salomon & Globerson, 1989). Moreover, due to the complexity entailed in both the Paired Reading and the Reciprocal Teaching methods, these were too reliant on extensive teacher modelling to be applied to a peer collaboration context. Finally, the Paired Reading method was too specifically designed for expert-novice interaction. Therefore, an alternative method was employed in this study, namely the Guided Reciprocal Peer Questioning, which was specifically designed to support peer learning in a semi-structured way, by allowing learners the freedom to formulate their own questions whilst being guided through the provision of a set of question prompts.

The Guided Reciprocal Peer Questioning method was originally devised by King and colleagues and had been found to effectively promote collaboration in other domains and with older students (King, 1990, 1994, 1999; King & Rosenshine, 1993; King et al., 1998). The method involves pairs of students alternating between the role of the 'questioner' and that of the 'explainer', so as to help students gain a better understanding of the learning material through interactive discussion. Students are encouraged to use a set of question prompts eliciting the production of explanations for the underlying processes and phenomena they are asked to learn about. Specifically, two types of questions prompts are given: Review Questions are designed to encourage learners to restate the content of the presented material (through definitions, descriptions, explanations and the like), while Thinking Questions were designed to encourage children to go beyond the material as explicitly presented to make connections and inferences. King and colleagues demonstrated the benefits of both types of question prompts, but showed how Thinking questions especially encouraged students to elaborate their understanding.

Experimental Study 2 applied this method to the storytelling domain to establish whether encouraging children to engage in interactive discussion during story-making through question prompting during story-making would benefit their collaborative storytelling. Specifically, the study compared scaffolding children's collaborative storytelling through a combination of active and constructive engagement and requiring them to use question prompts to articulate and negotiate ideas, with scaffolding children's collaborative storytelling through active and constructive engagement only.

Many benefits were found in to the reciprocal questioning intervention. Firstly, when they were supported through reciprocal prompting, the children were more on task. Secondly, the children asked each other more questions and providing relevant answers to those questions. These findings suggested that the reciprocal promoting method was effective at encouraging children's engagement in interactive discussion during story-making.

It was also found that during the prompting task, the children asked proportionally more Thinking questions than during the non-prompting task. This finding showed that the children did not only engage in a greater number of question asking, but that the quality of their questions was better than during the non-prompting task.

Finally, it was found that when they were given the prompting task, the children used the provided question prompts to invent their own questions. The proportion of provided questions was compared for the reciprocal questioning task and the non-reciprocal questioning one. In the unsupported task, no questions were given, but questions similar to the ones given in the reciprocal questioning task could happen to be asked. Interestingly, it was found that the children asked proportionally fewer of the provided questions during the reciprocal questioning task than they did when they were not so supported. This suggested that the prompting intervention did not constitute too structured a task for children to freely engage in interactive discussion. Together with the findings on the greater proportion of Thinking questions asked during the prompting task, these findings suggest that for the reciprocal questioning task, the children were able to use the provided question prompts to invent their own Thinking questions.

Having established that the children did engage in interactive discussion during story-making as a result of being prompted to ask each other questions, the study showed that their collaborative stories were better. This is an important finding, as the main objective of this study was to promote better collaborative storytelling.

Specifically, it was found that when the children were given the reciprocal questioning task, they told longer stories; this was true for both the number of words and propositions the stories were composed of. The quality of the stories was also better, as the stories told when the children were given the reciprocal prompting task were evaluatively richer and more coherent than those told in the unsupported condition. Although the greater length of time spent on the reciprocal questioning task might have contributed to the better quality of the collaborative stories, these findings suggest that the reciprocal prompting method was effective at encouraging children to engage with their collaborative stories by reflecting on the presented and the constructed elements, and that this led to increased length and richness. These findings also showed that articulating and discussing each others' ideas enabled the establishment of shared understanding. As a result of this shared understanding, children were able to build on each others' contributions coherently.

As the prompting support led to greater engagement in interactive discussion as well as better collaborative storytelling, these findings provide support for the prediction that encouraging interactive discussion during story-making would result in better collaborative storytelling. Further support for this is provided by the correlational findings, which showed that the more questions were asked during story-making, the longer and evaluatively richer the children's collaborative stories were. Specifically, increased numbers of Thinking questions were related to increased evaluative richness in the stories. This showed that the more children discussed the elements beyond the presented pictures through Thinking questions, the more their stories went beyond the simple recollection of facts and plot driving events, to include richer elements.

However, this study also found that the stories produced when the children were given the reciprocal questioning task were not referentially more complex than those produced in the unsupported condition. Although this could suggest that children at this age may not be able to go beyond a certain level of proficiency with respect to referential complexity, it seems more plausible that this is due to the types of questions provided in the prompting intervention. Because proportionally more Thinking questions were provided and asked by the children when they were prompted, it seems reasonable to assume that the children focused more on those aspects which fall under the realm of evaluative richness. Thinking questions were concerned with aspects of a story which are not immediately depicted in the presented picture sequence, such as the characters' internal states and the reasons for these internal states, and the characters' goals, and are mostly captured by the evaluative aspect of stories, rather than the referential one. Therefore, asking more Thinking questions could have led children to discuss the evaluative aspects of their story more than the referential ones, and ultimately to affect the production of evaluatively richer stories, but not of referentially more complex ones. Finally, it is also possible that the drawings constructed by the children expressed ideas which were more related to the evaluative aspect of stories and that, by asking questions about those drawings, the children steered the discussion in this direction rather than discussing the referential aspects of the story.

Overall the StoryTable Case Study and Experimental Study 2 found that children's collaborative storytelling can be effectively supported by complementing technology mediated scaffolding through resources with scaffolding around the technology aimed at promoting interactive discussion. Not only did the children in these studies produce long stories, they also produced stories which were referentially complex and evaluatively rich. Moreover, through engagement with each others' ideas during story-making, the children were able to establish a shared understanding about their story, which enabled them to build coherently on each others' contributions during storytelling.

Given the developmental literature showing that children in their first years of primary education are only beginning to tell stories which can be understood and appreciated by a naive audience and do not always do so consistently (Bamberg & Damrad-Frye, 1991; Peterson & McCabe, 1983), these findings are promising, as they suggest that encouraging children to engage in interactive discussion during story-making can benefit their collaborative storytelling.

The findings from Experimental Study 2 also add to the literature on the value of the Guided Reciprocal Peer Questioning method (King, 1990; 1994; 1999; King & Rosenshine, 1993; King, Staffieri and Adelgais, 1998). This method had been previously shown to be effective at scaffolding students' engagement with and reflection on the learning material by providing opportunities for them to activate and consolidate their knowledge of the presented material. Experimental Study 2 provides additional evidence for the benefits of this method by showing that similar benefits can be obtained with younger children than those tested by King and colleagues. The study also showed that specific questions could be effectively devised to tailor the Guided Reciprocal Peer Questioning to the storytelling domain, and that the children could use these productively. Finally, the study adds to the existing evidence on the value of reciprocal questioning by showing that this can be used not only to prompt comprehension, but also production.

Overall, the findings from both the StoryTable Case Study and Experimental Study 2 add to those from Experimental Study 1 and to the literature on self constructed representations in general (de Westelinck et al., 2005; Munneke et al., 2003; Prangsma et al., 2008), by showing that the benefits of self constructed representations can be augmented by encouraging learners to engage in interactive discussion. Given the literature showing that children around six and seven are not yet proficient at articulating their ideas for others or at detecting lack of articulation in others' messages (Lloyd et al., 1995; Robinson & Robinson, 1978, 1982; Whitehurst & Sonnenschein, 1981), the findings from these studies are valuable, because they showed how children can be scaffolded to articulate ideas for each other. This was shown to be possible not only through the support of an adult facilitator (StoryTable Case Study), but also in the absence of this direct form of control (Experimental Study 2).

1.4 The lasting benefits of encouraging interactive discussion

The fourth and last question investigated in this thesis asked the benefits of encouraging children to engage in interactive discussion during story-making could be maintained once the children were no longer encouraged to do so. Like Question 3, this question was addressed in both the StoryTable Case Study and Experimental Study 2. The StoryTable Case Study began to address this issue by exploring whether children would continue to engage in interactive discussion during story-making and to tell good collaborative stories when the adult guidance was progressively withdrawn. Experimental Study 2 investigated this aspect further by analysing whether children would continue to engage in interactive discussion and to tell good stories together once they were no longer required to use the reciprocal questioning support.

The StoryTable Case Study suggested that the benefits of providing additional guidance around technology with the aim of encouraging engagement in interactive discussion could be maintained once the adult guidance was faded. This implies that once the children had been exposed to the guidance, they were able to internalise it and continued to tell good stories together.

The findings from Experimental Study 2 were also promising, as the children who were given the reciprocal questioning task first continued to engage in interactive discussion during story-making once this support was no longer provided. Specifically, the children continued to ask more questions and to provide relevant answers than those who were given the unprompted task first. These children also continued to produce longer and evaluatively richer stories, thus providing additional evidence for the relation between discussion through question prompting and quality of the resulting collaborative storytelling.

The findings from the StoryTable Case Study and Experimental Study 2 suggest that children might have internalised the means through which to engage in interactive discussion, as they became able to apply them once the scaffolding through prompts was no longer present. Many have argued for the value of transforming tasks through scaffolding so as to allow learners to approach it productively as well as the importance of being able to withdraw the scaffolding whilst maintaining learners' performance on a task (Quintana et al., 2004; Sherin et al., 2004). These studies provided both qualitative and quantitative evidence of the effectiveness of scaffolding both while the scaffolding is provided, i.e. what Salomon, Perkins and Globerson (1991) define as 'effects with scaffolding', and after the scaffolding has been removed, i.e., what they define as 'effects of scaffolding'. As the scaffolding provided was shown to transform the collaborative storytelling task in such a way as to facilitate the production of good collaborative stories, the work presented in this thesis is said to have achieved its overarching objective.

2. Conclusions

2.1 Scaffolding children's collaborative storytelling

The findings in this thesis showed that children benefited from the provision of structured resources, such as picture sequences representing a problem based story. This thesis also found that it is not until their first years of formal schooling that children appear to become able to tell a collaborative story which is mature enough for other to understand it.

Moreover, the context in which the children are encouraged to tell stories together was found to influence their understanding of the task as well as their ability to perform it. As many have argued, the use of technology mediated resources is not sufficient without a careful consideration of the social and pedagogical practices in which these resources are embedded (Brown, Collins, & Duguid, 1989; Crook, 1995; Koschmann, 1996; Papert, 1980; Salomon et al., 1991; Wertsch, 1991). Elements such as the perceived activity goals and the way technology resources are used can be affected by the social context in which a technology is used. In this thesis, it was found that the use of audio recording technology, the absence of a real audience and the children's lack of familiarity with their storytelling partner did not help to convey the purpose of the activity in a clear enough way for the children to understand that they should record stories instead of nursery rhymes or descriptive statements.

Within the context of an ecologically valid task, where children are familiar with telling stories together and are asked to produce a story together for a real audience, the experimental work carried out for this thesis provided some insights into the use of technology to encourage constructive engagement with provided resources. It was found that when children were provided with structured resources and encouraged to integrate them with their self constructed dynamic drawings, their collaborative storytelling was longer, referentially more complex, and evaluatively richer than when the children were simply provided with these resources.

This suggests that when they construct their own representations, children engage with the represented material more, presumably by attending to it and elaborating on its content. However, this constructive activity might not provide a strong enough 'anchoring point' for children to engage in interactive discussion during story-making. Therefore, additional scaffolding might be needed in order to encourage children to articulate and negotiate their own ideas for each other.

Many have argued for the importance of interactive discussion to promote development and elaboration (Chi, 2009; Roschelle & Teasley, 1995; Salomon & Perkins, 1998; Schwartz, 1995; Webb & Palincsar, 1996), as well as the establishment of a shared understanding between the interlocutors (Dillenbourg & Traum, 2006; Roschelle & Teasley, 1995; Webb, 1992), thus enabling them to build on each others' ideas. Given the importance of interactive discussion, additional scaffolding around the technology mediated constructive activity is crucial.

This thesis showed that children can be encouraged to engage in interactive discussion through adult mediation, where a facilitator encourages children to articulate their ideas and provides suggestions about improving their collaborative stories. This thesis also showed how interactive discussion during story-making can be promoted through minimal adult guidance, where children are provided with a set of question prompts and instructed to take turns at asking each other questions. This was found to effectively promote good collaborative storytelling, as the children's stories were found to be longer, richer and more coherent than those produced in the absence of this form of support.

Finally, this thesis found that children's constructive engagement with presented resources only needed to be complemented by additional scaffolding for interactive discussion for a limited time, as children continued to engage in interactive story-making and to tell good quality stories together once the additional scaffolding was withdrawn. This suggests that children might be able to internalise strategies to engage in interactive discussion, such as asking each other questions and articulating ideas for each other, and that they are thus able to independently complement their technology mediated constructive activities with these strategies. As the notion of scaffolding is closely related to the idea that support is only provided when and where necessary (i.e., 'effects of the scaffolding'), and then removed where evidence of learning exists, this was an effective form of scaffolding.

2.2 Strengths of this work and its implications

2.2.1 Research

The work presented in this thesis adds to the literature in a number of areas. Firstly, the literature on computer support for collaborative storytelling is enriched by this work. Not only did this thesis add to the body of evaluation of the benefits of an existing storytelling technology such as KidPad (Abnett et al., 2001; Stanton et al., 2001; Stanton et al., 2002), but it also presents an evaluation of StoryTable, a novel technology which had not been evaluated before. These two technologies bring together many of the features of other systems (Ananny, 2002; Marshall et al., 2004; Raffle et al., 2007; Steiner & Moher, 2002), which have been shown to benefit children's collaborative storytelling in different ways. These systems' evaluations enabled the findings in this thesis to be situated within the broader literature on computer supported collaborative storytelling.

Moreover, by reflecting on how the features presented in the systems might have contributed to the benefits observed with respect to children's collaborative storytelling, this thesis contributes to the literature on scaffolding collaborative storytelling in general. Specifically, this thesis identifies some of the features in a set of resources which promote good collaborative storytelling as well as what types of activities are more beneficial for children to engage with while using these resources. Moreover, this thesis proposes how collaboration can be promoted more directly through encouragement for interactive discussion around technology.

Secondly, this thesis adds to the existing evidence supporting the claims made by Chi (2009) about the benefits of providing opportunities for learners to be active, constructive and interactive. The framework she proposes represents learners' engagement in interactive discussion (i.e., being interactive) as a more effective learning strategy than the construction of representations (i.e., being constructive), or active manipulation (i.e., being active). This, in turn, is argued to be a more effective learning strategy than active manipulation of presented resources. Finally, the least productive learning activity is being passively presented with resources. In this thesis, Experimental Study 1 added evidence to the claim that being constructive is better than being active. It found that when children were encouraged to not only manipulate some presented resources actively, but also to construct their own representations, their collaborative storytelling was better than when they were simply encouraged to actively manipulate the presented resources. This thesis also added evidence to the claim that being interactive is better than being constructive in Experimental Study 2, where it was found that when children were encouraged to engage in interactive discussion while being constructive, they told better collaborative stories than when they were constructive only. This effort to abstract the findings into a more general framework makes them less dependent on the specific technology tool used. Although these findings can only be safely said to apply to the specific context in which the investigations were situated (i.e., with a specific task configuration involving choices about technological tools, participants' age, familiarity with each other, the settings, etc.), they can be argued to provide evidence for a set of more general claims about the benefits of certain resources and activities around them.

Finally, the findings in this thesis add to the literature evaluating the learning benefits of encouraging discussion. Specifically, it provides empirical evidence for the value of the Guided Reciprocal Peer Questioning method showing how this can be an effective way to scaffold students' engagement with and reflection on the learning material by providing opportunities for them to activate and consolidate their knowledge of the presented material. This thesis shows that this method can be effective with young children, by providing evidence of children as young as six and seven being able to engage with and benefit from scaffolding through reciprocal questioning. It also extends the range of domains in which the method has been tested. Previous research demonstrated the effectiveness of the Guided Reciprocal Peer Questioning method in science understanding, while this thesis shows its effectiveness in the open ended domain of storytelling. Also, unlike previous research, this thesis employed this method for a production task, rather than a comprehension one.

2.2.2 Methodology

Besides adding to the literature in a variety of areas, this thesis also presents some methodological strengths and innovations. Firstly, by employing a mixed methodology, this thesis combined the strengths of qualitative and quantitative methods in order to suitably address each research question. Specifically, the work in this thesis followed a sequential exploratory design, with an initial exploration of the collaborative storytelling task by means of qualitative observations, followed by a more systematic approach where specific predictions are tested through quantitative methods (Creswell & Plano Clark, 2007; Greene et al., 1989). The initial phase was represented by the StoryTable Case Study, where the more general question about features of good resources (Research Question 1) was addressed, and Research Questions 3 and 4 about encouraging interactive discussion around these resources were explored. This initial qualitative exploration provided valuable insight into the design of subsequent experimental manipulations, where the task was designed so as to ensure that children were familiar with telling stories together and that an audience was present in order to grant greater ecological validity to the task. Moreover, the StoryTable Case Study suggested the importance of the construction of persistent shared representations, and this helped design Experimental Study 1. Finally, the StoryTable Case Study revealed the importance of directly encouraging children's engagement in interactive discussion, and how this could be achieved with children in their first years of formal schooling to effectively support children's collaborative storytelling.

Another aspect of the methodology which involved careful consideration was the adaptation of the Guided Reciprocal Peer Questioning method to the domain of storytelling. As this method had been tested in science understanding domains, adapting it to story production involved the elaboration of question prompts which were specific to this domain, and testing whether the children could use them productively.

Finally, this thesis employed a comprehensive coding scheme aimed at capturing the multifaceted aspects of storytelling, including length, referential complexity, evaluative richness and coherence. Although these aspects are established and have been used extensively in psycholinguistics research investigating children's individual storytelling in non-technologically mediated environments, these have not been as widely used in research on computer supported collaborative storytelling. Therefore, this thesis contributed to the field by providing a combination of tools to capture the richness of children's storytelling.

2.2.3 School based practice

The findings presented in this thesis also provide input for existing pedagogical practice in the classroom. Technology is becoming increasingly pervasive in classroom practice, and teachers are more and more confident about incorporating them into their practices. Moreover, technology has been shown to provide opportunities to support teaching of key areas of the National Curriculum, such as group work as well as speaking and listening skill, and this has been found to benefit literacy based teaching.

In the last decade, technology has played a growingly important role in school based teaching and learning. In the U.K., several schemes have been implemented in order to promote the use of technology, such as the Next Generation Learning campaign and the Harnessing Technology programme (Becta, 2008). A recent survey showed that between 2005 and 2008, great improvements had been made in technology provision in primary schools, with novel technologies such as interactive whiteboards being increasingly used in daily practice (Becta, 2008). Teachers were found to be increasingly provided with training on how to include technology into their classroom practices as well as exposure to examples of good practice championed by the more confident teachers. This has led to an increasing sense of confidence by teachers in their ability to use technology as part of their teaching in new and creative ways. Moreover, the increasing number of computers available in primary schools has led to an average of 14 pupils to every desktop computer and 32 pupils for every laptop in 2008 (Becta, 2008). Although this is still far from providing continuous access to a computer for every small group of children, the trend is promising, as more and more schools are taking advantage of Government funding to provide computers to their pupils.

Literacy based activities in particular have been found to benefit from use of technology such as drawing and animation software, allowing pupils to be creative and work collaboratively to present artefacts to an audience of peers (Ofsted, 2009). As the National Curriculum emphasises the importance of group work and communication skills such as listening and discussing, the new opportunities for creative group work in the area of literacy clearly posit a potential for the future of teaching and learning in early education.

Given that technology is increasingly being used in schools to support key areas of the National Curriculum in literacy teaching, this research could provide input for classroom based literacy activities. Firstly, it illustrates how teachers could use technology to support collaborative storytelling. The benefits of the forms of scaffolding described in this thesis were based on minimal instruction, as they consisted in learner initiated activities, where pupils were engaged in peer based learning. Specifically, this research showed that, given the appropriate form of support, same ability pupils can effectively engage in interactive discussion and benefit from them in terms of their ability to tell stories. This is relevant to school based practices, where children tend to be grouped by same ability especially during numeracy and literacy teaching (Hallam, Ireson, Lister, Anton-Chaudury, & Davies, 2003). This thesis also provides an illustration of how collaborative work could be supported not only in storytelling activities, but also across the curriculum. Subjects where supporting interactive discussion would be welcome in the early years of primary education include shared reading and writing as well as drama and the arts in general, where paired and small group work is promoted.

2.3 Limitations and future work

One of the limitations in the work presented in this thesis is the limited size of the samples used. Five pairs of children participated in the StoryTable Case Study, 12 triads participated in Experimental Study 1, and 18 pairs in Experimental Study 2. Although sufficient for statistical analysis, the sample used in the two experimental studies was not large, and this might have reduced the power of statistical analysis, especially by limiting variance in the correlation tests in Experimental Study 2. Sample size limitations are not uncommon in school based studies, where it is often difficult to recruit due to difficulties in obtaining parents and guardians to return consent forms as well as difficulties fitting research agendas into the school's curricular activities. Moreover, the intensive nature of the verbal data collected meant that the analysis could not have been carried out within the remit of this thesis.

Another potentially controversial aspect of this thesis is that the participants' grouping varied in the two experimental studies: in Experimental Study 1, children were grouped into triads, while in Experimental Study 2, children were grouped into pairs. The original decision to group children into triads was related to informal conversations with the school teachers, indicating that children were used to working together in small groups, and by the fact that a group of more than three children would have made sharing the computer screen problematic. The change from triads to pairs was made due to the nature of the reciprocal questioning task explored in Experimental 2, where the tested method had been designed for pairs of learners alternating between the role of the questioner and that of the asker (King, 1990, 1994, 1999). Moreover, the change to pairs meant that a greater sample size, and therefore a greater number of observations, could be gained.

Moreover, as they were recruited in a research institute and in a local middle class school, the children participating in all three studies came from a white middle class background. It is questionable whether similar results could have been found in a different socio-cultural context, for example with low SES children, as additional teacher support might be needed, or greater training in using technology or even reading the question prompts in the case of the reciprocal questioning intervention.

Another limitation in this thesis is the change of technology used from the Case Study, where StoryTable was used, to the two Experimental Studies, where KidPad was used. This was due to a change in circumstances where this research was conducted, as well as to a series of considerations about the shortcomings of using a complex technology such as StoryTable, and one where the transience of audio recordings did not allow for the review and reflection on story content. Therefore, a different, more suitable technology was introduced into the research agenda. Besides providing a better tool for the systematic investigation of the issues explored in the case study, the change in technology from StoryTable to KidPad also allowed for the findings in this thesis to be more generalisable.

Specifically, the considerations on the value of being active and constructive could be drawn on the basis of research carried out on different modalities (e.g., audio and drawing) and on different levels of complexity (e.g., using a complex, multifunctional technology such as StoryTable and using a more basic technology such a s KidPad). At the same time, the findings in this thesis can be situated into different contexts, thus providing a richer picture of how being active and constructive using different technologies in different contexts can yield different outcomes in terms of quality of collaborative storytelling.

A key limitation in this thesis is that the studies were not conducted in a classroom context. This might limit the ecological validity of the findings, as a real classroom environment might be busier and richer in distractions than the quiet rooms in which the studies in this thesis were carried out. However, much effort was devoted to creating an ecologically valid environment – for example by creating a toy and media rich environment in the StoryTable Case Study and by conducting the two experimental studies in a school where children were familiar with each other and with telling stories together.

As the studies were not conducted in a classroom, it is also impossible to generalise these findings to a whole class teaching practice. The fact that the studies were conducted with one small group or pair of children at a time means that these findings would need to be complemented by further research investigating whether similar benefits to those found in this thesis could be obtained in a classroom environment, where the intervention is delivered by a teacher to several groups or pairs of children. This might mean that more distractions are available to the children, thus making it more difficult for them to keep focused on the task. Moreover, different teaching styles might mean that children might be more or less familiar with this type of literacy activities, where they are required to work together using technologically mediated resources.

Concerning the issue of bringing the intervention into the classroom, different school contexts might mean that teachers and children have a greater or lesser exposure to technology, thus making the use of software like KidPad more or less practical and welcome. However, the use of applications for constructing drawings and animations are now becoming the norm rather than the exception in schools in the U.K (Ofsted, 2009), and teachers are gradually becoming more familiar and proficient at using technology to support their teaching.

As the effects of the interventions described in this thesis were not tested in a classroom environment, this will be one of the avenues to be explored in future work. The value of using technology to support the construction of shared representations combined with explicit support for engagement in interactive discussion though reciprocal questioning will be explored in the context of whole class teacher mediation. Should similar findings emerge from these investigations, this would grant greater ecological validity to the claims made in this thesis.

Moreover, scaling this research to several classrooms would allow for the involvement of a greater number of children, therefore allowing for a greater number of pairs to be observed. This would increase the robustness of the findings presented in this thesis.

Other potential avenues for further research include the investigation of the value of encouraging more extensive use of self constructed representations in the absence of explicit encouragement to engage in interactive discussion. As Experimental Study 1 showed, when the children were left free to construct any number of interactive representations, they only constructed an average of four drawings per story. This may have been due to the fact that the children had only been exposed to the KidPad technology during previous training, and therefore needed quite a long time negotiate the use of the tools for constructing their drawings; combined to time limitations related to experimental constraints, this meant that only few drawings could be made. However, more extensive practice with KidPad or even use of a similar technology then children might be more familiar with, as well as longer time allocation to the constructive exercise might result in the construction of more representations. This might impact on the quality of the stories produced, as the children might have more opportunities to engage in interactive discussion and to enrich the stories they make together.

Furthermore, future research might explore different ways of directly encouraging children's engagement in interactive discussion during story-making through prompting. For example, a broader set of question prompts could be provided, which addresses the referential aspects of storytelling. In Experimental Study 2, more questions were provided which addressed the motivations behind the events and actions taking place in the story (i.e., Thinking Questions). The children asked proportionally more of these Thinking Questions, and this was positively correlated with the evaluative richness of the collaborative stories they produced. However, the collaborative stories did not improve with respect to their referential complexity, and it was argued that this might have been due to the fact only few of the provided questions addressed this aspect of their storytelling. Therefore, future research might investigate whether directly addressing referential complexity through a more substantial number of question prompts could benefit the children's storytelling. Moreover, future research might investigate the optimal number of question prompts provided, as children might become overwhelmed by the range of the support provided. This would complement the investigation on the quality of the prompts with an insight into the quantity of prompting.

Another aspect of Experimental Study 2 which would need improving in further investigations is the quantity and quality of time that the children would spend on their stories in the unprompted task. In this thesis, during the unprompted task, the children did not spend as long on their stories as they did in the prompted task, which required being instructed on the reciprocal questioning method, and generally spending a longer time discussing their stories as a result of the reciprocal questioning. This might have impacted on the different quality of the children's collaborative storytelling in the two tasks. In future studies, this shortcoming would need to be addressed, by either introducing the children in the unprompted task to the idea of questioning, or by using a suitable control task.

Finally, future research might explore whether the prompting support could be effectively incorporated into the technology environment. A number of technologies have been developed to scaffold learners' discussion, and the evaluation results show that this might be a promising avenue for future research. The most famous technology to date is CSILE (Computer Supported Intentional Learning Environment), which was designed by Bereiter, Scardamalia, Linn and colleagues to support students' reflection and discussion, and has been extensively demonstrated to led to increased learning outcomes such as the ability to provide articulate explanations, formulate links and connections between different aspects of the learning content, and ultimately leading to more coherent, integrated understanding (Davis & Linn, 2000; Scardamalia & Bereiter, 1991). Other technologies have been developed to include a set of sentence openers with the purpose of providing structured prompts for discussion (Baker & Lund, 1997; Soller, 2001). Although learners using these kinds of systems have been found to participate more equally to the discussion (Soller, 2001), mixed findings have emerged on the learners' perception of these tools. For example, Baker and Lund found that learners in their study felt the use of the discussion support technology to be contrived, perhaps due to the highly structured nature of the sentence openers (Baker & Lund, 1997). On the other hand, other have found that these types of technologies were effective in supporting the discussion without interfering with its natural flow (Sandoval, 2003), even when the technology was used by young children (Robertson, Good, & Pain, 1998). Finally, an online environment was recently developed which incorporates the question prompts developed by King (1990; 1994; 1999), in order to provide templates for pre-service teachers to learn about student generated questions and peer assessment (Yu, 2009).

Overall, the inclusion of discussion support into technologies appears to be a promising area of research, where learners might benefit from the provision of these tools, but only when these are designed without over constraining the interaction. Moreover, different types of scaffolding might be needed with different age groups and task domains. Children's collaborative story production remains an unexplored area, where further research is needed in order to provide insights into ways of productively scaffolding children's engagement in interactive discussion.

2.4 Computer supported collaborative storytelling in the classroom of the future

With technology being increasingly employed in classroom based activities and government schemes being developed to fund and support technology implementation, it seems plausible that the classroom of the future will include a range of sophisticated technologies supporting collaboration through new forms of interacting and sharing[16]. Therefore, it is interesting to speculate on implications of this research in the longer term.

As many have argued for their potential to support collaboration through multiple user input and direct interaction (Marshall, Hornecker, Morris, Dalton, & Rogers, 2008), interactive surfaces are key technologies which are likely to be introduced in the classroom of the future. Technologies such as Interactive Whiteboards (IWB) have already been introduced in schools throughout the U.K., and the last five years have seen their increased use, especially by primary teachers (Becta, 2008[17]). IWBs allow teachers as well as pupils to access existing content from the internet or from local software, and share it with the rest of the class. Own content can also be created and shared, for example through the use of digital cameras especially designed for classroom use[18].

These technologies provide great opportunities for literacy based activities in the classroom. For example, the scenarios presented in this thesis could be extended to encompass technology augmented practices, where children use devices such as digital cameras to capture images that are personal and meaningful for them, and upload them on the IWB for making stories with their peers. One could imagine pairs or triads of children constructing and discussing their own stories on the IWB, while others might be engaged in similar activities on another IWB, or on a laptop or desktop based computer, and overseeing

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[16] This claim is somewhat made more speculative by the recent political developments in the U.K., with new Conservative Government applying cuts to funding to technology development agencies. However, despite the cuts in funding which might result in delays in technology adoption by the education sector, it is hard to imagine a classroom in the future where new technology developments are completely ignored.

[17] http://research.becta.org.uk/index.php?catcode=_re_rp_02&rid=15952&section=rh [Accessed 15 August 2010]

[18] http://www.tuffcam.org.uk/

their peers' ongoing activities. This would allow children to be aware of and be inspired by each others' stories while working on their own group's stories. Moreover, the stories created could be displayed on IWBs when these are not being used for other teaching purposes, thus reflecting schools' pervasive practice of displaying pupils' artefacts on classrooms' walls.

Although the potential of interactive walls to encourage collaboration and sharing in public spaces has been extensively researched (O'Hara, Perry, Churchill, & Russell, 2003; Tang, Lanir, Greenberg, & Fels, 2009), the opportunities of using interactive surfaces in schools remain still relatively unexplored. This is despite incursions into this arena such as the one reported in Brignull, Izadi, Fitzpatrick, Rogers, & Rodden (2004) and Stanton-Fraser, Smith, Tallyn, Kirk, Benford, Paxton, Price, & Fitzpatrick (2005), showing the potential of large interactive displays for encouraging students' sharing, collaborating and even performing practices.

Other technologies have been researched in conjunction with interactive surfaces, such as smart objects, which are able to store content and facilitate its sharing among collaborators. The KidStory project (Stanton, Neale, & Bayon, 2002) and the Pogo project (Decortis, Saudelli, & Rizzo, 2003) are pioneering examples of research exploring the potential of smart objects to facilitate content sharing in classroom based storytelling activities. In these projects, RFID tagged objects were used to enable children to seamlessly store and share images and sound with each other in order to create stories together. Evaluation of children's use of this type of tangible technology suggests that it facilitates collaboration by supporting the distributed nature of complex activities where several children engaging in the creation and presentation of image and sound based stories.

Horizontal interactive surfaces are another fairly unexplored area of potential for introducing novel technologies into schools. These have been observed to effectively support small group collaboration, as they are less likely to lead to one person dominating the interactive space (Jordan & Henderson, 1995; Rogers & Lindley, 2004). The StoryTable Case Study also showed that when the interactive resources provided are carefully designed and their use is facilitated effectively, interactive tabletops can benefit children's collaboration. Although it is still rather uncommon for schools to employ interactive tabletops, much research has been carried out in the last decade on the potential of this type of technology, showing the potential benefits of these technologies to support collaboration.

The Pogo project explored the value of interactive tabletops to support children's collaborative storytelling in the classroom, and found that when these technologies were used, children took a more active role in their learning while the teacher took facilitating rather than directing approach (Decortis et al., 2003). Recently, Cao, Lindley, Helmes, & Sellen (2010) conducted a school based evaluation of a tabletop based storytelling system called TellTable, which was partially inspired by the design of StoryTale as well as Pogo. TellTable allows children to upload their own pictures and to construct their own drawings over these pictures; children can use these representations to create stories together, which they can record and review. The system was deployed in a primary school library space and children were observed using it in their free time. The study found that children enjoyed using the system not only to create their own stories, but also to view others' stories some of which became particularly prominent within the school community. This created a connection between storytellers and audience which contributed to the children's engagement in collaborative storytelling activities and their enjoyment. Finally, TellTable was so successful at motivating children's engagement, that some reported spending time out of school to prepare their stories and to source the pictures to be uploaded onto the system.

These studies and projects present some promising findings about the potential of interactive tabletops for supporting rich collaborative storytelling in schools. Combined with the growing enthusiasm for the use of IWBs in the classroom and recent suggestions for moving away from teacher centred use of these technologies to encourage children's collaborative use of these resources (Rudd, 2007), research findings on the potential of interactive tabletops and IWBs are more than likely to become key resources supporting children's collaboration in the classroom of the future.

The findings presented in this thesis could be applied to research on the potential of these interactive technologies to explore how classroom storytelling can be facilitated through engagement of several small groups of children making different stories. Specifically, these technologies entail great potential for enriching the scenarios explored in this thesis by allowing children to create and share content in several ways, as well as being aware of each others' activities when working in small groups.

As interactive technologies are becoming an increasing presence in schools, this research points to the potential of these technologies to support children's collaboration in the literacy domain, and how a careful combination of technology and support around it can greatly benefit children's ability to work together.

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Appendix I

Parental consent form for StoryTable Case Study (in Italian and English)

Autorizzazione dei genitori a partecipare alla ricerca

Gentile signora/signore, la ricerca per la quale chiediamo la collaborazione della vostra/o figlia/o fa parte del progetto di ricerca Peach di cui l'ITC-irst è uno dei partners principali.

Lo scopo della seguente ricerca è di valutare l'utilita', nell'ambito della capacita' di raccontare storie, di un nuovo strumento didattico multimediale. A ciascun bambino chiederemo di provare ad usarlo e l'interazione verra' ripresa con una videocamera.

Le saremmo grati se volesse acconsentire alla partecipazione di sua figlia/ figlio alla nostra ricerca. A tal fine, la preghiamo di compilare la parte terminale di questa lettera, restituendola ad una delle due sperimentatrici.

Il sottoscritto ____

autorizza la propria figlia/ figlio__________________________________

a partecipare alla ricerca, si impegna ad accompagnarla/accompagnarlo in ogni luogo frequentato esonerando l'Istituto da qualsiasi responsabilità (Per qualsiasi incidente possa capitare al bambino, la cui responsabilità civile ricade sull'Istituto, esiste un'apposita copertura assicurativa di Responsabilità Civile Terzi. La vigilanza sul comportamento del bambino rimane specifica responsabilità del genitore che lo accompagna durante la sua presenza in Istituto) ed autorizza i ricercatori ad utilizzare i dati che ne risulteranno per analisi statistiche ed eventuale pubblicazione dei risultati.

SI **NO**

Firma____________________

"Informativa ai sensi della legge 675 del 31.12.1996 e ss.mm.

Si informa, ai sensi dell'art. 10 della L. 675/96 e ss.mm. recante disposizioni a tutela delle persone e di altri soggetti rispetto al trattamento di dati personali, che i dati da Voi forniti o altrimenti acquisiti nell'ambito dello studio di valutazione saranno utilizzati unicamente dai ricercatori della Divisione TCC (Tecnologie Cognitive e della Comunicazione) dell'ITC-Irst di Trento esclusivamente per fini di ricerca e non saranno divulgati. Il trattamento dei dati avviene mediante strumenti manuali / informatici comunque idonei a garantire la sicurezza e la riservatezza. Titolare del trattamento e' il Presidente dell'Istituto Trentino di Cultura, domiciliato per la carica in Trento, via S. Croce n. 77. Voi avete tutti i diritti previsti dalla legge per garantire la qualita' dei dati, l'aggiornamento, l'integrazione, la cancellazione e l'opposizione al loro trattamento per legittimi motivi."

Firma____________________

English Translation

Parental consent to participation

Dear Sir/Madam, we invite your child to participate in this research as part of a project (called Peach) which ITC-irst is involved in as a main research partner.

The aim of this research is to evaluate the potential benefits of a new multimedia tool to support storytelling. Each child will be invited to use the technology and the process will be videotaped.

We would be grateful if you were to give your consent to your child's participation in this research and we invite you to fill in the form below, and return it to our team.

I (name and surname)

____

Authorise my child (name and surname)

____

To take part in this research project. I take responsibility for accompanying him/her to and from the lab. (Any incident the child may incur into will be covered by our Third Party insurance policy. However, the parent will have the specific responsibility of taking care of the child while s/he is on the institute premises). I authorise researchers to use the data resulting from this research for analysis and publication purposes.

YES **NO**

Signature____________________

According to Law 675 of 31.12.1996, that the recordings and the data obtained from this study will be used exclusively by researchers of the TCC Division at ITC-irst in Trento, and only for research purposes. The data will be protected and locked away. The data will be handled and analysed through manual and IT tools which guarantee privacy protection. You are entitled to demand updating, integration and deletion of your data at any time and without the need to provide a reason for this.

Signature____________________

Appendix II

Transcripts for the third set of observations in the StoryTable Case Study

Session 1

Facilitator: When is this taking place: is it day or night time?

Alessandro: It's night time

[Alessandro selects the night version of Duckburg and Alina also selects it]

[Alessandro opens the Characters LadyBug, selects Scrooge McDuck and positions it near the money depot]

Facilitator: So what is Scrooge McDuck doing?

Alessandro: He is counting his money

Facilitator: His face looks angry, why do you think this is?

[No answer from Alessandro or Alina]

Facilitator: He might have had his money stolen, what do you think?

Alessandro: Yes, he is angry and he calls for help.

Facilitator: Who might help him?

Alina: Donald Duck!

Facilitator: Why?

Alessandro: Because Donald Duck is smart.

[Alessandro records an Audio LadyBug: "*Donald Duck is investigating*" and plays it back]

[Alina records an Audio LadyBug: "*Scrooge McDuck is counting his money in the depot*" and plays it back]

Facilitator: Did we say it is night or day time?

Alina: Night time.

[Alina records the Audio LadyBug: "*It's night time, Scrooge McDuck is counting his money in the depot*"]

Facilitator: And he realises that...

[Alina records another Audio LadyBug: "*Scrooge McDuck realises that some of his money is missing*" and plays it back]

[Alina positions her Audio LadyBugs in the first and second slots of the PlayList, then Alessandro positions the Audio LadyBug he had recorded in the third slot of the PlayList]

Facilitator: So before Donald Duck can investigate, Scrooge McDuck needs to call him, right?

Alina: We could say that Scrooge McDuck is patrolling his depot.

Alessandro: But now it's my turn!

[Alina records an Audio LadyBug: "*Scrooge McDuck is patrolling the depot and he calls Donald Duck*", plays it back]

Alessandro: The next two bits are mine!

Facilitator: Alina, do you want to put that in the third slot? Then Alessandro can record the next one.

[Alina replaces Alessandro's Audio LadyBug in the third slot with hers there]

Alina: You could say that he calls lots of friends so they all look in different places.

Facilitator: We could select the other story setting, as there are more characters in there that you could use?

[Alessandro and Alina select the day version of Duckburg and Alina selects Mickey Mouse]

Alessandro: Wait, it's my turn. You must put it there!

Alina: Ok, you do it, you could put it on the window

[Alessandro selects the Beagle Boys]

Facilitator: So who is helping Donald Duck with his investigations?

Alina: Mickey Mouse, in his car

[Alessandro re-records the Audio LadyBug he had recorded about Donald Duck investigating: "*Donald Duck calls Mickey Mouse and asks him for help with the investigations*", plays it back and pots it in the forth slot o the PlayList]

Facilitator: Mickey Mouse is carrying a magnifying glass, isn't he?

[Alessandro records another Audio LadyBug: "*Mickey Mouse finds the Beagle Boy's fingerprints*", plays it back and puts it in the fifth slot of the PlayList]

Facilitator: So how could the story end?

Alessandro: Donald Duck and Mickey Mouse find the Beagle Boys.

Facilitator: And Scrooge McDuck should be happy to have his money returned to him, right?

Alessandro: They catch the Beagle Boys!

[Alessandro records the last Audio LadyBug: "*The Beagle boys are caught and Scrooge McDuck is happy*", plays it back and puts it in the sixth slot of the PlayList]

Facilitator: Very good, shall we play the story back?

[Alessandro and Alina play the story back:

"It's night time, Scrooge McDuck is counting his money in the depot"

"Scrooge McDuck realises that some of his money is missing"

"Scrooge McDuck is patrolling the depot and he calls Donald Duck"

"Donald Duck calls Mickey Mouse and asks him for help with the investigations"

"Mickey Mouse finds the Beagle Boy's fingerprints"

"The Beagle boys are caught and Scrooge McDuck is happy"]

Session 2

[Alessandro and Alina select the night time version of the forest setting]

[Alessandro selects an eagle and positions it in the sky]

[Alessandro records an Audio LadyBug: "*The eagle is flying in the sky*", plays it back and positions it in the first slot of PlayList]

[Alina records an Audio LadyBug: "*The bobcat is hunting for prey*", plays it back and positions it in the third slot of the PlayList]

[Alina records an Audio LadyBug: "*The cheetah is teasing the animals*", plays it back and positions it in the second slot of the PlayList]

Alessandro: It was my turn to record.

Facilitator: How is the cheetah teasing the animals?

[Alessandro records an Audio LadyBug: "*The cheetah is catching prey*" and plays it back]

Facilitator: But how is he teasing the animals?

Alessandro: It is stealing them.

[Alessandro re-records the Audio LadyBug: "*The cheetah is stealing the prey from the bobcat*", plays it back and positions it in the fourth slot of the PlayList]

Facilitator: What is the bobcat's reaction?

Alessandro: It bites it...it has a fight with the cheetah.

Alina: The bobcat bites the cheetah...you could say that the bobcat is having a fight with the cheetah and it bites it.

[Alessandro records an Audio LadyBug: "*The bobcat is having a fight with the cheetah and it bites it*", plays it back and positions it in the fifth slot of the PlayList]

Alessandro: Now, the eagle grabs a rock. You could say that while the bobcat and the cheetah are having a fight, the eagle catches a sparrow.

[Alina records an Audio LadyBug: "*While the bobcat and the cheetah are having a fight, the eagle catches a sparrow*", plays it back and positions it in the sixth slot of the PlayList]

Facilitator: Ok, so do you think the story would be better if we swapped the second and third Audio LadyBugs around, so the bobcat is hunting the prey first, and then the cheetah is teasing it? Alina, that is the order you recorded them in, isn't it? Did you want them in this order?

[Alina nods and swaps the Audio LadyBugs around without discussing]

Facilitator: Let's play the whole story back again, shall we?

[Alessandro and Alina play the whole story back:

"*The eagle is flying in the sky*"

"*The bobcat is hunting for prey*"

"*The cheetah is teasing the animals*"

"*The cheetah is stealing the prey from the bobcat*"

"*The bobcat is having a fight with the cheetah and it bites it*"

"*While the bobcat and the cheetah are having a fight, the eagle catches a sparrow*"]

Facilitator: Is this how you want your story to end? How is the fight between the bobcat and the cheetah going to end?

Alina: The cheetah gives in

Alessandro: No, the cheetah is stronger than the bobcat!

Alina: The bobcat gives in

Alessandro: no

Facilitator: So what happens? Do they make peace?

Alessandro: Yes, they do.

Alina: Yes, they do. The cheetah and the bobcat make peace.

Facilitator: And...anything else?

Alina: They split the prey.

[Alina re-records the last Audio LadyBug: "*The cheetah and the bobcat make peace and they split the prey*", plays it back and positions it in the sixth slot of the PlayList]

Session 3

[Alessandro and Alina select the night time version of the castle scene]

[Alessandro selects Obelix and positions it on the grass]

Alessandro: I am putting it here with the chickens.

Facilitator: Obelix is always hungry, isn't he?

Alessandro: Oh, look who's here, what's his name?

[Alina remains silent]

Facilitator: I think his name is Panoramix? He's holding a magic potion...

Alessandro: To make them stronger!

Alessandro: My cousin has a book, but in the book he gets some sort of skin rash – Panoramix

[Alessandro takes another character out]

Alessandro: I can't remember what this one's name is...He is the...the person who gives messages to Caesar.

Facilitator: The ambassador? What is he holding under his arm?

Alessandro: That is his head cover. He is running.

[Alessandro moves the character across the setting]

Alina: He could be holding a treasure.

[Alessandro takes another character out]

Alessandro: This one is the chief.

Facilitator: Is he good or bad?

Alessandro: He is good.

Alina: He is bad.

[Alessandro crawls away from StoryTable and starts telling a story about when he hurt his knee]

[Alina takes another character out]

Facilitator: Alessandro, come back here, we are making a story together. This is called Ideafix, right? Is he a clever dog or a silly dog? Is he nice?

Alessandro: Usually he is stupid. I have a tape with a story where he is in the woods and he tries to catch all the ostriches.

[Alessandro rolls himself on the floor, distracted]

Facilitator: Come back Alessandro, Alina is waiting for you to make a story together. Do you want to have a look at the other story setting and its characters?

[Alessandro comes back to StoryTable, Alessandro and Alina select the day time story setting]

Alessandro: I'll put Obelix here so he is falling down.

[Alina selects another character and positions it]

Facilitator: The lady with blond hair – isn't Obelix in love with her? Can I leave you to make a story together without my help?

Alessandro and Alina: Yes.

Facilitator: Ok, I'll be just over there if you need help using StoryTable. Remember, you are making this story together.

[Alessandro records an Audio LadyBug: "*There is a nice castle*", plays it back and re-records "*Once upon a time there was a nice castle*", plays it back and positions it in the first slot of the PlayList]

[long pause where nobody does or says anything]

[Alina moves Obelix around]

Alessandro: You could say that Obelix is squashing one of the guards.

[Alina records an Audio LadyBug: "*Obelix is squashing a one of the guards*", plays it back and positions it in the second slot of the PlayList]

Alessandro: Or wait wait we could say that Asterix is going into the castle. Or that Asterix attacks one of the guards.

[Alessandro records an Audio LadyBug: "*Obelix is keeping the guards occupied*", plays it back and positions it in the third slot of the PlayList]

[Alina records an Audio LadyBug: "*The woman falls off the castle and Asterix ...Asterix saves her*", plays it back]

Alessandro: You said Asterix twice

[Alina re-records the Audio LadyBug "*The woman falls off the castle and Asterix saves her*", plays it back and positions it in the fourth slot of the PlayList]

[long pause where nobody does or says anything]

Alina: Let's listen to the story again.

["*Once upon a time there was a nice castle*"

"*Obelix is squashing a one of the guards*"

"*Obelix is keeping the guards occupied*"

"*The woman falls off the castle and Asterix saves her*"]

[Alina tries to record the Audio LadyBug that Alessandro had previously placed on the microphone]

Alessandro: Leave it - that is my ladybird!

[Alessandro records an Audio LadyBug: "*The guards are falling asleep*", plays it back and positions it in the fifth slot of the PlayList]

[Alina records an Audio LadyBug: "*In the castle everybody is happy*", plays it back and positions it in the sixth slot of the PlayList]

[the children mention some characters, inaudible]

[Alessandro and Alina call the facilitator]

Facilitator: Is your story ready? Do you want to play it for me?

[Alessandro and Alina play the story back

["*Once upon a time there was a nice castle*"

"*Obelix is squashing a one of the guards*"

"*Obelix is keeping the guards occupied*"

"*The woman falls off the castle and Asterix saves her*"

"*The guards are falling asleep*"

"*In the castle everybody is happy*"]

Facilitator: Very nice. But I don't understand why the guards fall asleep?

Alessandro: Because Obelix goes bang bang! Play yours Alina...

[Alina plays the next Audio LadyBug "*The woman falls off the castle and Asterix saves her*"]

Facilitator: So why is Obelix punching the guards?

Alessandro: So Asterix can go into the castle.

Facilitator: But does it make sense that the guards fall asleep after Asterix saves the woman?

Alina: Asterix had seen her.

Facilitator: Oh so Asterix sees she is about to fall, and rushes into the castle; and in the meantime, Obelix keeps the guards busy – is that right?

[Alina takes all the Audio LadyBugs out of the PlayList]

Alessandro: What have you done?

Alina: We need to rearrange them.

[Alessandro plays them back until he finds the first one "*Once upon a time there was a nice castle*", and positions it in the first slot of the PlayList;

[Alina finds "*Obelix is squashing a one of the guards*" and positions it on the microphone]

[Alina re-records: "*Asterix goes into the castle to save the woman*", plays it back and positions it in the second slot of the PlayList.]

[Alessandro and Alina play back the remaining Audio LadyBugs until they find the right sequence:

"*Once upon a time there was a nice castle*"

"*Asterix goes into the castle to save the woman*"

"*Obelix is keeping the guards occupied*"

"*The guards are falling asleep*"

"*The woman falls off the castle and Asterix saves her*"

"*In the castle everybody is happy*"]

Session 4

[Alessandro selects the night time version of the jungle and Alina also selects it]

[Alessandro opens the Characters LadyBug, selects Baloo and positions it.]

[Alina selects Mowgli and positions it.]

Alessandro: No, put it here on the tree, it's better.

[Alessandro moves Mowgli near the tree]

[Alina attempts to select another character]

Alessandro: No, wait, it's my turn to take it.

[Alessandro selects King Louie and positions it]

[Alina selects Hathi and positions it]

[Alina positions an Audio LadyBug on the microphone]

Alina: One day Mowgli went into the woods.

Alessandro: It's the jungle!

Alina: ...into the jungle to see his friends...his animals. Then he notices that an elephant is coming out of the bush who...

Alessandro: ...whose name is Hathi.

[Alessandro moves Hathi into a different position, but Alina places it back where it was]

Alina: Hathi the elephant came out and Mowgli got scared, so he told Baloo to go and fight him.

Alessandro: I disagree.

Alessandro: I think...one day, Mowgli went into the jungle, and he climbed on a tree so he could watch the sky.

[Alessandro records the Audio LadyBug "*One day Mowgli went into the jungle, and he climbed on a tree so he could watch the sky*", plays it back and positions it in the first slot of the PlayList]

Alina: He could have been checking to see if it was sunny. He saw an elephant...

Alessandro: ...called Hathi

Alina: ...called Hathi, who was in the bush...and he was playing with his friends.

[Alina repeats this twice]

Alessandro: So...Mowgli is watching the sky and he sees the elephant.

Alina: Mowgli could be playing with his friends and Baloo.

[Alessandro records the Audio LadyBug "*King Louie is spying on Mowgli*", plays it back and positions it on the second slot of the PlayList]

[Alina records the Audio LadyBug "*Baloo realises that King Louie is spying on Mowgli and he gets angry*", plays it back and positions it in the third slot of the PlayList]

Alessandro selects a monkey character and positions it.

Alina: You could say that...

Alessandro: Wait.

[Alessandro records the Audio LadyBug "*The monkeys attack Mowgli*", plays it back and positions it in the fourth slot of the PlayList]

[Alina records the Audio LadyBug "*Mowgli asks the elephant is they could all play hide and seek with him, and everybody had a great time together*"]

Alessandro: It doesn't work: if the monkeys had attacked Mowgli, how can he be free to play now?

[Alina re-records the Audio LadyBug "*Baloo saw that Mowgli was trapped and he went to rescue him*", plays it back and positions it in the fifth slot of the PlayList]

Facilitator: Is your story ready? Do you want to play it back for me?

"One day Mowgli went into the jungle, and he climbed on a tree so he could watch the sky."

"King Louie is spying on Mowgli."

"Baloo realises that King Louie is spying on Mowgli and he gets angry."

"The monkeys attack Mowgli."

"Baloo saw that Mowgli was trapped and he went to rescue him."

Appendix III

Parental consent form for Experimental Studies 1 and 2

Giulia Gelmini

School of Psychology

University of Nottingham

University Park

Nottingham

NG7 2RD

Tel. 0115/ 9515281

E-mail: gg@psychology.nottingham.ac.uk

Dear Parent/Guardian,

I am a PhD student at the University of Nottingham, investigating how technology can support collaboration and storytelling in the classroom.

I have been pleased to work with Albany Infant School in the past. Mrs. Bates has seen many advantages for the children and she is happy for the school to become involved in a new project.

I am writing to request consent for your child to be involved in this study, where children will be making stories with the computer, in small groups. This will take about an hour altogether.

If you are happy for your child to participate in this study could you please complete the consent form and return it to the school by **...**

You are also very welcome to attend. Many thanks for your help!

Yours faithfully,

Giulia Gelmini

Learning Sciences Research Institute

1) Child's Name: ________________________

2) Date of birth: __________________

I NEVER put pictures of the children on the Internet, so be reassured that this will NOT be the case with the children involved in this study. However, it would be extremely helpful if I could (every now and then) use a few pictures in university publications (such as conference articles). If you would like me to, I can obscure your child's face in the pictures.

3) Are you happy with your child being video recorded/taken pictures of whilst participating in the activities? Yes/No

It is likely that your child will enjoy the storytelling activity – however, (s)he will be given the option to withdraw from it at any time.

If you require any further information on the study, or its results, please feel free to contact me using the details given above.

I understand the purpose of the study and give my consent for my child to be involved in it.

Parent / Guardian name: _______________________

Signature: ______________________

Date: _________________________

Appendix IV

Table 27. *WASI scores for children in Experimental Study 1. The results are the sum of the Vocabulary and Similaritiy scores.*

Child name	WASI score
Clive	118
Sue	116
Rachel	119
Danni	105
Karen	100
Steve	90
James	98
Leo	93
Lizzy	93
Olga	122
Diane	122
Melanie	122
Meg	116
Jane	114
Tyler	112
Abbi	122
Frank	133
Lea	123
Bart	103
Charles	122
Jenna	114
Nick	125
Tyler	124
Eleonor	128
Rob	109
Zed	93
Susanne	101
Tara	67
Melissa	75
Rita	86
Rose	118
Brittany	122
Sam	123
Simon	120
Ciara	118
Leonore	125

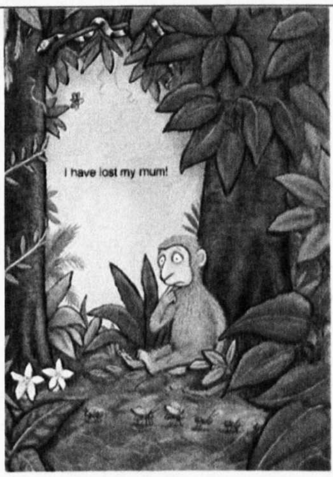
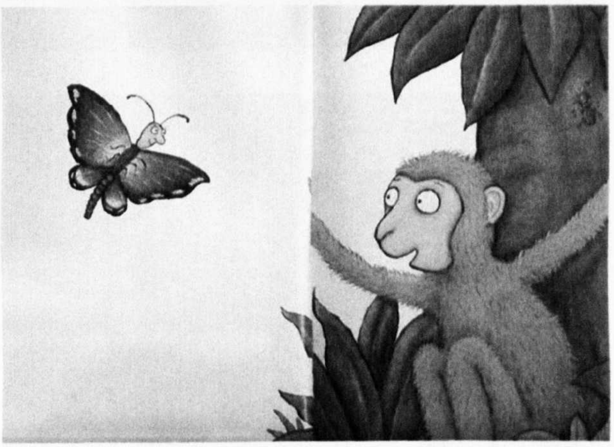
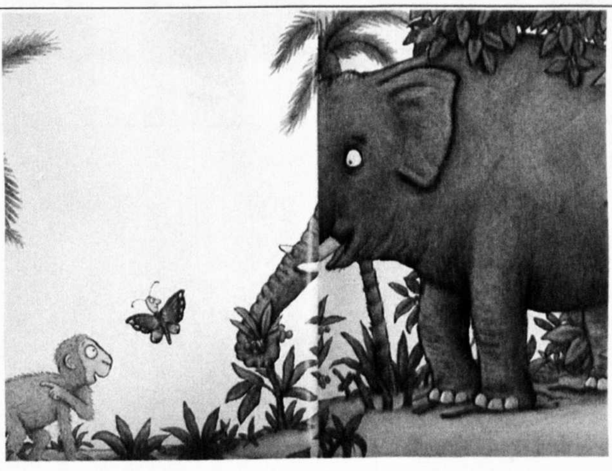
Table 28 *WASI scores for children in Experimental Study 2. The results are the sum of the Vocabulary and Similarity scores.*

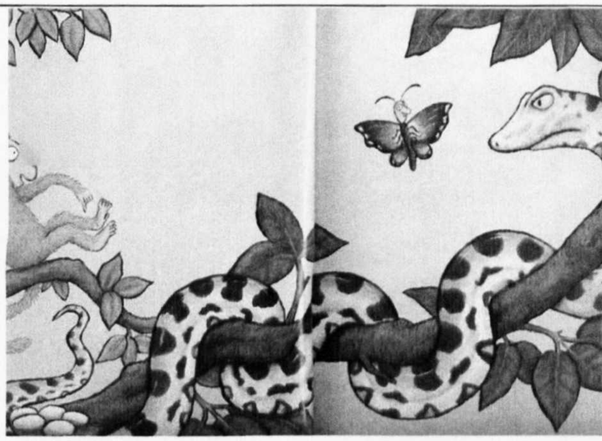
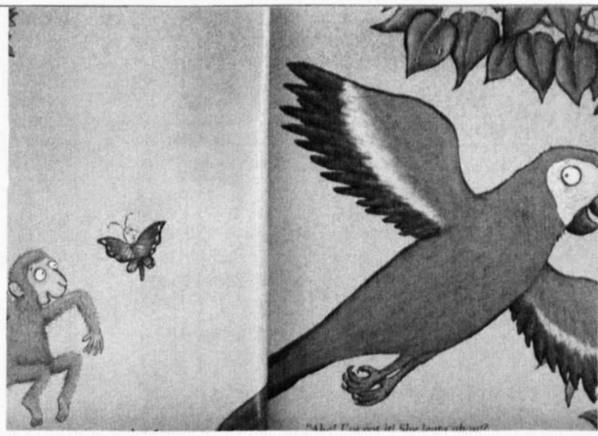
Child name	WASI score
Joseph	107
Jane	121
Paula	141
Brandon	142
Mike	157
Joanna	154
Ed	120
John	143
Gina	155
Mike	125
Kris	155
Maddy	154
Liam	141
Gina	157
Tom	132
Ciara	134
Bob	139
Simone	158
Ellie	147
Rob	116
Sharon	139
Emily	108
Vivian	159
Joe	120
James	147
Zoe	141
Stan	133
Oliver	122
Tom	142
Gavin	144
Oliver	122
Ethan	125

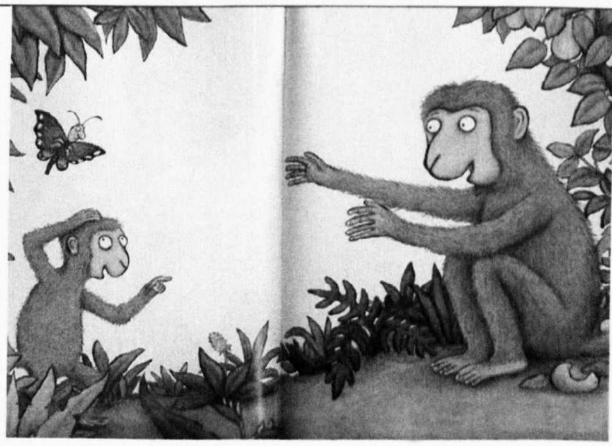
Appendix V

Coding scheme for Story Referential Complexity

Table 29 *The monkey story*

<table>
<tr><th>Scene</th><th>Monkey story</th><th>Picture</th></tr>
<tr><td rowspan="3">Scene 1</td><td>There is a monkey
SCORE: 1</td><td rowspan="3">
</td></tr>
<tr><td>Monkey has lost his mum
SCORE: 1</td></tr>
<tr><td>Monkey states that he will look for his mum
SCORE: 1</td></tr>
<tr><td>Scene 2</td><td>Monkey meets butterfly
SCORE: 1</td><td></td></tr>
<tr><td rowspan="2">Scene 3</td><td>Monkey meets elephant
SCORE: 0.5</td><td rowspan="2"></td></tr>
<tr><td>Butterfly is with monkey
SCORE: 0.5</td></tr>
</table>

Scene 4	Monkey meets snake SCORE: 0.5	
	Butterfly is with monkey SCORE: 0.5	
Scene 5	Monkey meets spider SCORE: 0.5	
	Butterfly is with monkey SCORE: 0.5	
Scene 6	Monkey meets parrot SCORE: 0.5	
	Butterfly is with monkey SCORE: 0.5	

Scene 7	Monkey meets bat SCORE: 0.5	
	Butterfly is with monkey SCORE: 0.5	
Scene 8	Monkey meets frog SCORE: 0.5	
	Butterfly is with monkey SCORE: 0.5	
Scene 9	Monkey sees his dad/mum SCORE: 0.5	
	Butterfly is there too SCORE: 0.5	

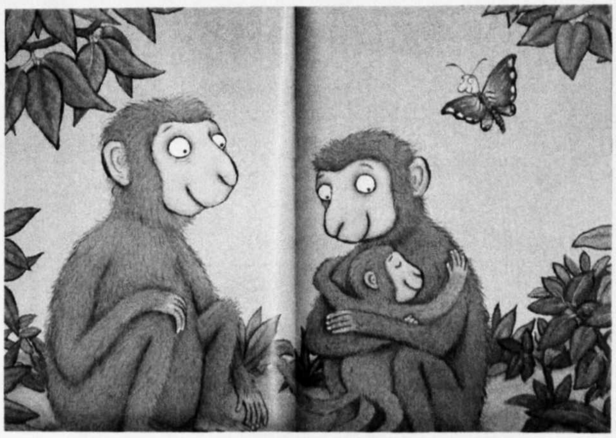
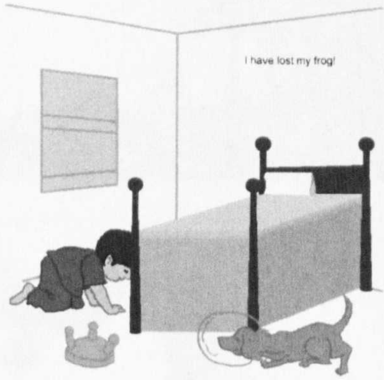
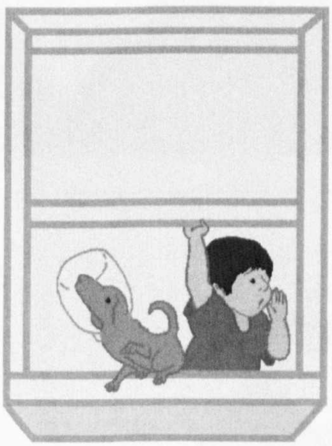
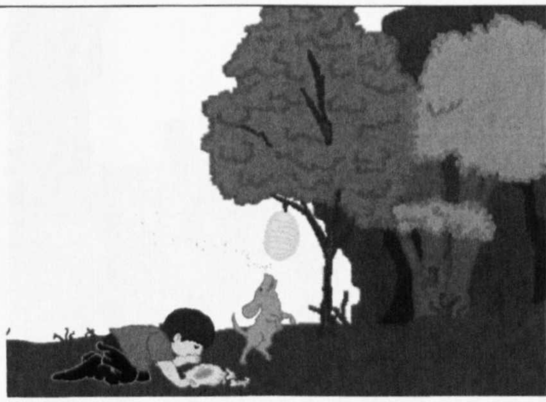
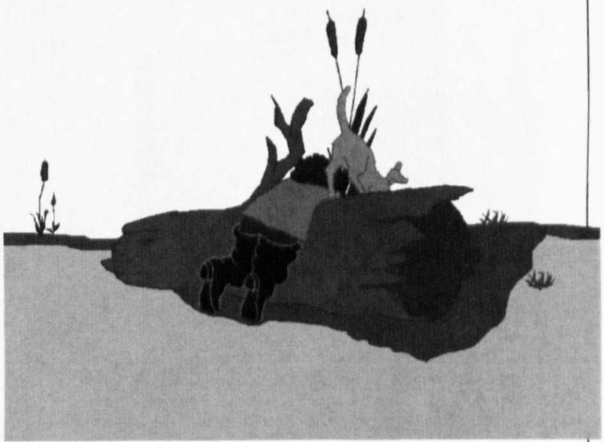
Scene 10	Monkey finds his mum/dad SCORE: 0.5	
	Butterfly is there too SCORE: 0.5	

Table 30 *The frog story*

Scene n.	Frog story	Picture
Scene 1	There is a boy SCORE: 1	
	Boy has lost his frog SCORE: 1	
	Boy states that he will look for his frog SCORE: 1	
	Boy looks for frog under bed SCORE: 0.5	
	Dog looks for frog in jar SCORE: 0.5	
Scene 2	Boy calls for his frog outside the window SCORE: 0.5	
	Dog also calls for frog outside the window SCORE: 0.5	
Scene 3	Boy calls for his frog in the field SCORE: 0.5	
	Dog also calls for frog in the fields/where the bees are SCORE: 0.5	

Scene 4	Boy calls for his frog in mole hole SCORE: 0.5	
	Dog looks in the bee hive SCORE: 0.5	
Scene 5	Boy calls for his frog from what looks like a rock SCORE: 0.5	
	Dog sniffs the ground SCORE: 0.5	
Scene 6	Boy gets picked up by deer SCORE: 0.5	
	Dog hides behind a rock SCORE: 0.5	
Scene 7	Boy gets thrown off cliff by deer SCORE: 0.5	
	Dog is with boy SCORE: 0.5	

Scene 8	Boy falls into pond SCORE: 0.5	
	Dog is with boy SCORE: 0.5	
Scene 9	Boy finds a log SCORE: 0.5	
	Dog is with boy SCORE: 0.5	
Scene 10	Boy finds his frog SCORE: 0.5	
	Dog is with boy SCORE: 0.5	

Appendix V

Training material

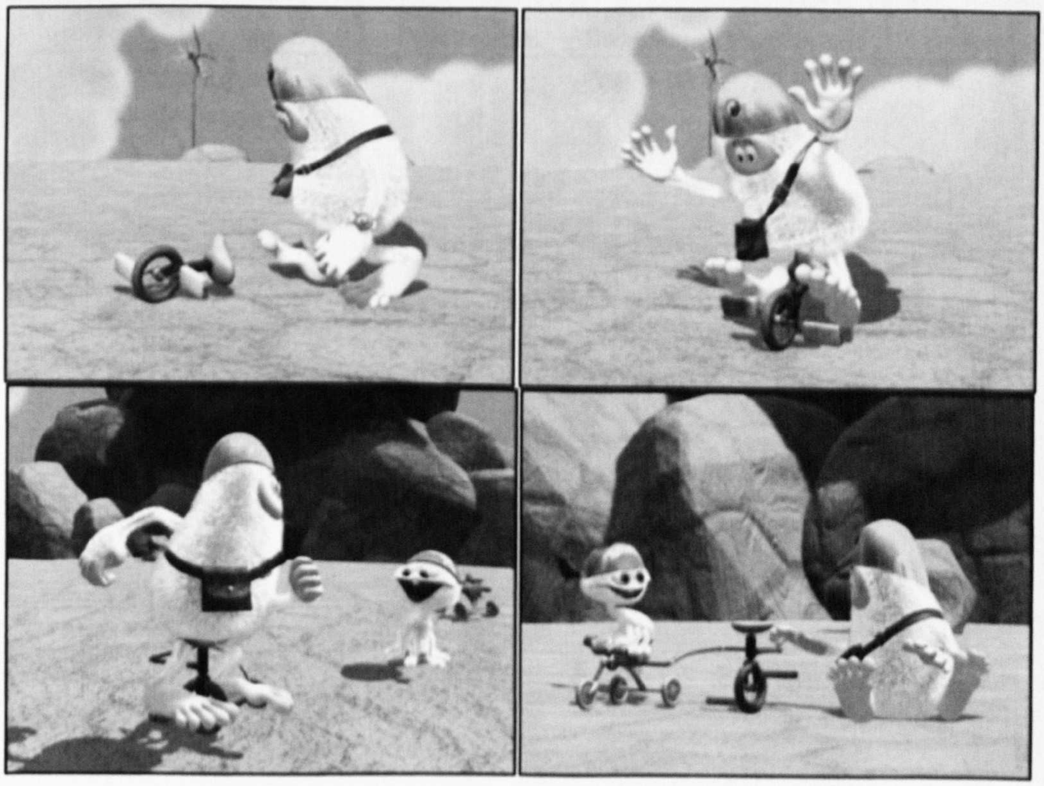


Figure 41. The pictures used in the KidPad and Question training task.

Appendix VI

Table 31 *Total number of On Task Turns and Off Task Turns in the No Prompts and Prompts tasks, during story-making*

	ON Task		OFF Task	
	No Prompts	Prompts	No Prompts	Prompts
Joseph Jane	76	114	8	4
Paula Brandon	69	146	6	6
Mike Joanna	57	159	1	6
Ed John	122	182	18	22
Gina Mike	23	143	0	1
Kris Maddy	78	155	6	2
Liam Gina	76	106	23	17
Tom Ciara	8	146	0	3
Bob Simone	159	263	9	2
Ellie Rob	33	35	0	0
Sharon Emily	195	311	59	30
Vivian Joe	182	262	29	11
James Zoe	50	170	3	4
Stan Oliver	205	345	10	43
Tom Gavin	147	135	27	15
Oliver Ethan	101	159	20	20