Contents lists available at ScienceDirect

International Journal of Child-Computer Interaction

Investigating the use of digital manipulatives for storytelling in pre-school

Cristina Sylla [a,*], Clara Coutinho [a], Pedro Branco [b], Wolfgang Müller [c]

[a] Ciec/engageLab, University of Minho, 4710-057 Braga, Portugal
[b] engageLab/Algoritmi, University of Minho, 4800-058 Guimarães, Portugal
[c] Media Education and Visualization (MEVIS), University of Education, 88250 Weingarten, Germany

ARTICLE INFO

ABSTRACT

Research has identified a need for design of interactive products for children, as well as long-term studies that investigate the effects of its use in the classroom environment. Following the design and development of a digital manipulative system for storytelling, which involved preschool children and teachers, the investigation presented here reports findings from a four-month evaluation of the system that was carried in a Portuguese preschool involving 24 pairs of children. During the four months the researchers were able to observe children's interaction with the digital manipulative system that was not biased by the novelty of the system or by time constrains. The gathered data showed that children used the digital manipulative system to create stories and play language games, which are activities that foster the development of oral language and emergent literacy, and are formally targeted in the preschool curriculum. The system provided challenge and adventure, motivating children to collaboratively explore and create narratives, empowering each child to actively participate in the task.

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1. Introduction

The work presented here is part of a broader study that was carried for a period of four years in a Portuguese preschool.[1] The overall aim of the study was to design and evaluate a digital manipulative system[2] that stimulates storytelling and oral language development in preschool children.

The study was structured in two main phases: the first one was dedicated to the design and implementation of the interface, and extended for a period of three years, involving six pre-school classes (ages five) and six preschool teachers [3]. Following the implementation, the researchers carried out three interventions at preschool for a period of around one year. The first one, (which we report here) was performed with 24 pairs of children from two preschool classes, who interacted with the interface during free-play time for a period of four months, and aimed at investigating how children used the system and the kind of activities in which they involved during free-play time. The second intervention was carried out in collaboration with a preschool teacher with a group of 20 children during three months, and investigated to which extent the use of the digital manipulative system promoted the development of language abilities that are relevant for formal literacy learning. Finally, the last intervention studied the narratives created by 27 pairs of pre-schoolers, while using the interface for a period of six months [4].

The motivation to develop digital manipulatives for preschoolers emerged out of:

– The need expressed by leading researchers in the field of Child Computer Interaction "for research in the design of interactive products for children, related methodology, as well as a scientific account of the interaction between children and technology" [5]:2.
– The need expressed by educational professionals and researchers for learning materials that meet children's physical and cognitive needs [6];

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[1] This work returns to a study presented in the doctoral dissertation of the first author [1].

[2] The term digital manipulatives has been coined by Resnick to designate a new generation of computationally enhanced manipulative materials that enable children to interact with digital information [2]. In the scope of this work we will use the terms digital manipulatives, tangible interfaces (TUIs), or tangible systems as synonyms.

- The need for more long-term evaluations, including evaluations in the classroom [7,8];
- The potential of digital manipulatives to involve children in expressive and exploratory learning activities [2,9].

The intervention reported in this article had an exploratory nature, and aimed at investigating if the interface was intuitive to use for the children, if they would choose to play with it among the other activities they could do during free-play time, and if yes, whether it was capable of involving children in meaningful activities, or on the other hand if children would lose interest after the initial use. Overall we wanted to investigate the extent to which the use of digital manipulatives can support the development of oral language and emergent literacy [10]. These competencies play a major role in the learning of reading and writing, and are essential for the development of children's personal, social and academic skills. Three research questions were formulated: Is the interface attractive and intuitive to use for the children? In what kind of activities do the children engage, and is their involvement long lasting, or merely a result from the new digital artefact? Can digital manipulatives contribute to the development of early literacy, promoting creative thinking and the construction of narratives?

Before presenting the digital manipulative system and the study, we will briefly highlight the importance of oral language development in the pre-school years and then provide a short overview of the design process explaining the choices we have made.

2. Background and related work

2.1. Language development and early literacy

The development of oral language is among the major challenges that children face during the preschool years; this is also the 'best' learning period to formally learn the language [11]. Language develops primarily to communicate with others, and through the interaction with others, in a process that is essentially social and interactive [12]:103. At the same time language mediates learning, and is a tool to organize the world [13]:6 empowering children to express themselves, to communicate with others and to participate actively in educational activities ([13]; [14]:8 and [15]).

Yet, the acquisition and development of oral language is a long and particularly complex process, which reaches its critical development during the preschool years, a period of rapid conceptual and lexical acquisition.

During this period children begin to develop "emergent literacy skills", which are "developmental precursors to conventional reading and writing skills" [16]:21. The variety of rich literacy experiences is fundamental for the development of emergent literacy, and is directly related with children's degree of exposure and active participation in literacy environments, where they interact with meaningful materials, within social contexts that scaffold and encourage emergent literacy attitudes [17–20].

Storytelling is a creative and playful way of linguistic exploration [21,22] that promotes the development of oral language [23,24,21], providing opportunities for creative thinking and social interaction [22,25], helping children learn to express themselves and communicate with others, gradually acquiring the discourse rules [26]. Stories help children to "develop more sophisticated language structures, accumulate more background information and have more interest in learning to read. In addition active participation in literary experiences enhances the development of comprehension, oral language and a sense of story structure" [24]:646.

2.2. Storytelling technology in school

The use of technology in school may play an important role in supporting the development of oral language and emergent literacy in a collaborative peer context, however such potential has been "under-explored" [27]:81. Well-designed interactive technology has the potential to offer four key characteristics of effective learning environments: active engagement, collaborative learning, frequent and immediate feedback, and connections to real world contexts [28,29].

Yet, the use of technology in preschool is still uncommon [30,31] even though a significant number of teachers consider it useful as preparation for school [32]. The use of technology to support literacy development is even more infrequent, as stated by Yarosh and collegesYaroshetal2011. In an extensive examination of 137 long papers presented at the Interaction Design and Children Conference (IDC) for the period between 2002 and 2010 the authors reported that technology to support literacy development was the focus of merely 8% of all papers (with a decreasing trend).

As opportunities for IDC, the authors expressed the need for more long-term evaluations, and the need to investigate whether the technologies remain compelling for the children after the novelty effect is gone [7]:143. They also challenged researchers to design for a larger variety of ages, as the majority of IDC papers targeted children between six and twelve. These results confirm findings from previous reports, which concluded that the great part of research on technology and children over the last two decades addresses mostly older children with a pick around ten years of age, [33–35].

Just a few years before the development of tangible technology [36], examples of desktop computer applications that target the development of collaborative storytelling for children were created by [37], who first included young children, technologists, and educators in the design of the technology [38]. One of these projects the KidStory [39] involved around 100 children aged between five and seven from two schools in England and Sweden. The project resulted in the development of a collaborative environment for storytelling (by using a Single Display Groupware system that supports several mice plugged into the computer), which allowed children to create non-linear structured stories.

The PictoPal [40] is a more recent example of an application for desktop computers designed to foster the development of emergent reading and writing skills in four and five years old children, which was carried at preschool involving children and teachers.

2.3. Touch and tangible technology

More recent projects such as Fiabot, Castor, or VisMo are applications for tablet devices. The Fiabot [41] explores the creation of interactive and multimedia stories. Similar to our study, but involving two primary school classes (instead of preschoolers), this project extended for a period of four years, and investigated the development of technology that supports existing teaching and learning practices. Castor [42], a project carried out at primary school with the collaboration of teachers, consists of a tablet application in which children can create and edit stories outdoors, exploring the role of the environment and the potential of mobile technology for connecting outdoors structured learning and experience. VisMo [43] is a set of playful applications for preschoolers that run on multi-touch tabletops to promote creativity and collaboration. Other projects, such as Scratch Junior [44] or the Interactive Sticker Book [45], use storytelling to introduce programming concepts for children.

Developments that use tangible technologies for storytelling vary widely, some approaches use books enhanced with embedded sensors and electronics, thus extending the experience provided by traditional books. Some relevant examples here are the *MagicBook* [46], Telescrapbooks [47], or the Bridging Book [48].

Tangible *Story Listening Systems*, which according to Cassel may play a unique role in supporting emergent literacy [27]:81,