Interactive Storytelling Books for Fostering Inclusion of Children with Special Needs

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Abstract. Children with Special Needs may have difficulty understanding the content of a book or associating words and sentences with their meaning. Teachers use the storytelling as a powerful literacy tool which engage children in making connections between academic content and pedagogy. This strategy is also useful to integrate the diversity of the classroom. Increasing or varying the types of materials available to children is another way to make the classroom more inclusive. This paper proposes a new approach for fostering interaction and inclusion development during shared reading. We sought to increase the interactivity of traditional tale books by incorporating elements of technology and storytelling. To develop prototypes we recruited 30 teachers divided into six groups. Each group worked with two challenges: (1) to incorporate technology into a traditional storybook and (2) create an interactive storytelling book for left-handed children. During five work sessions each group developed two proposals: The first proposal was designed with QR codes and the second with NFC tags and augmented reality patterns to facilitate left-handed activities among teachers and children. The proposals were evaluated in the classroom and with experts' reviews, finding interesting results.

Keywords: Interactive storytelling books · Inclusion · Children with special needs · Left-handed children

1   Introduction

There are many challenges and issues to be solved regarding the inclusion and development of social and academic skills of Children with Special Educational Needs and Disabilities (SEND). Among them, education and training of teachers, the participation of parents in the learning process, educative resources adaptation or physical environment adjustments in classrooms, for instance, many students need classroom reading material to be adapted for their individual needs [1]. In the current study, we propose a new approach for fostering interaction and inclusion development during shared reading. We sought to increase the interactivity of traditional tales books by incorporating elements of technology and storytelling. By combining these elements, interactive books can provide more direct feedback and narrative possibilities for children. Interactive storytelling books can also engage children through sensory stimuli such as digital sounds, videos and augmented reality. The effects of engaging children as storytellers on vocabulary development have been less well studied [2]. We believe the interaction between children with special educational needs with others is potentially important to their social development and inclusion.

Considering this motivation, the present study recruited 30 teachers divided into six groups. Our protocol began with the presentation of several interactive storytelling technologies on the market, for example, LeapFrog, an interactive learning system which includes a stylus that reads invisible dots on compatible books and activity sets, triggering vocabulary, songs, questions and challenges; TOK - A tangible interface for storytelling to allow children and teachers build their own digital enhanced learning activities and OSMO - A system that uses the iPad's camera to enable tangible interaction for children. OSMO provides a mixed-reality storytelling app while encouraging kids' creativity. With this experience, two challenges were designed: (1) to incorporate technology into a traditional storybook and (2) create an interactive storytelling book for left-handed children. During five work sessions each group developed two proposals.

The first proposal was designed with QR codes, which link an audio file with a narration of tales, songs, questions or challenges. Each group selected a storybook to develop learning strategies for inclusion of SEND children. The participants recorded the voices of actors of the tale, as well as the activities through their smartphones or tablets. For the second group challenge, participants had to design an innovation with NFC (Near Field Connection) tags and augmented reality patterns to facilitate left-handed activities among teachers and children. It is important to mention that many unpredicted strategies were developed during working with teachers, for example, the way the book is opened, the way to encapsulate QR codes and how to present the story in 3D pop-up scenarios. Modern day technology possesses a wide range of smart elements and devices that can still be better explored in new book designs. We are sure that these innovations will foster children's learning, cooperation and inclusion. However, further studies are necessary to investigate both immediate and longitudinal effects of specific interactive storytelling books on children's social development and their inclusion in learning activities.

The rest of this article is structured as follows: Sect. 2 details the background and related work, Sect. 3 presents the method used, Sect. 4 presents the results of designing

Interactive Storytelling books, and finally, Sect. 5 presents the conclusions and future work of this research.

2 Background

Children with special educational needs and disabilities face difficult challenges in the educational, social and even family environment. SEND children have to face their own deficiencies in social interaction, but also the social exclusion by other members of their environment [3]. For instance, at classroom many teachers pull SEND children out of the literacy hour or block because they believe that these learners, as a rule, need special instruction and content. Actually, many children including those with learning disabilities, cognitive disabilities, autism or ADHD can participate quite successfully in the general education classroom with appropriate supports such as adapted materials, individualized goals or objectives, and co-teaching [4].

There are some studies on children that suggest that unstructured outside play can be very helpful for some SEND children. The unstructured, fast-paced nature of play in these setting necessitates using teacher-mediated interventions to enhance inclusion of children with special needs in cooperative interactions with their typically developing peers [5]. On the other hand, within the classroom the technologies become an element that can help the inclusion. Computers, tablets or smartphones are able to engage in didactic collaborative storytelling. Storytelling is one of the oldest methods of communication and learning. Digital storytelling is the combination of traditional, oral narration with multimedia and communication tools [6].

In our study we integrate these two elements to create interactive books in order to develop reading skills and inclusion [7]. Through storybooks children develop critical early literacy skills by linking concepts with corresponding physical actions to establish the foundation or reading comprehension. Digital storytelling is particularly conductive to create novel interactions [8, 9]. The effects of engaging children as storytellers on vocabulary development have been less well studied. Positive effects of shared reading for children's language development are boosted by including instruction of word meanings and by increasing interactivity [10]. This research seeks to understand how interactive books can be implemented with SEND children for fostering inclusion and reading skills.

3 Method

The study used a descriptive qualitative method that focused in the analysis of the data obtained from Design Thinking methodology, that provides a solution-based approach to solving problems.

3.1 Participants

We recruited 30 teachers who are studying a Master in Education, mention Innovation and Leadership at Universidad Tecnológica Indoamérica. They are teachers of public

and private elementary and middle schools. The participants were divided into six groups of 5 each in the Educational Infopedagogy module. The average age of the students was 38.6 years. In relation to gender 80% corresponded to female.

3.2   Materials

The materials used in the research are grouped into two categories: classroom materials and technology. In the first category we used physical storybooks, paper, cardboard, colors, markers, adhesive tape, glue and foamy. In the second category we used hardware, such as laptops, tablets and smartphone. We also used a QR Generator web site (https://www.codigos-qr.com/), MIT AppInventor Platform and some Apps: Hi-Q MP3, Animal 4D+, Space 4D+, Humanoid 4D+ and QuiverVision 3D Augmented Reality.

3.3   Procedure

Following the Design Thinking methodology, five sessions of eight hours each one were perfomed. In the first session we conducted a series of brainstorming to create as many solutions as possible that might make children fostering reading. We began with the presentation of several interactive storytelling technologies on the market. In the second session, we challenged to incorporate technology into a traditional storybook with QR codes. Teachers worked in six groups, The results were presented and the learning strategies registered in a forum of a Moodle Platform.

The groups defined the problem and needs according their experience.

In the empathise stage, teachers used the platform in six groups. Afterwards, they ideate the design of the pedagogical strategy according to the storybook used in class. After teachers designed an original storybook with the materials and technology studied.

Finally, in the test stage each group test their interactive storybook with their students at classroom.

After that, the combination and filtering of the ideas were done to select the final solution, which was evaluated with the help of two pedagogues.

4   Design of Interactive Storytelling Books

This section shows some results designed by the groups of teachers. We have divided into two categories: Interactive books with QR codes and Storytelling books for left-handed children.

4.1   Interactive Books with QR Codes

Within the category of interactive book, teachers created innovative learning strategies for children. The participation and interaction by the reader was made with QR codes. The main idea of this interface was to introduce narrative an questions throught QR codes. First with the Hi-Q app recorded audio in MP3 format. Subsequently teachers

generated QR codes of different sizes, which were pasted them in a physical book or they designed a sheet of cardboard with their own story as the Fig. 1 shows. The audio files and pictures were integrated in App Inventor application. In this interface children can use a smartphone to listen a story or answer a question that generates the QR code.

Fig. 1. Storybooks with QR codes.

Teachers evaluated these storybooks with their students achieving interest and motivation in the learning process. With this technology teachers could design their own educational technology resources to create multimedia reading experience [9].

4.2 Storytelling Books for Left-Handed Children

The challenge was to create an interactive storytelling book for left-handed children. To simulate teachers in this work we introduce NFC (Near Field Connection) tags in the same way of QR codes, which generates a sound, narrative or question throughout history. In addition, we introduce augmented reality.

One of the strategies developed by teachers is that books open upwards to make it easier for a left-handed child in the reading process. Teachers also developed an interactive pop-up storybooks. Teachers realized that the QR codes could also help children with visual impairment or children who can not read yet. Many of these stories were also designed with high relief to help develop tactile stimulation.

Importantly, teachers developed interesting stories to engage the child in reading. In the evaluations we can observe that the storytelling were not flat, these had some elements that made it interesting.

Some of the interactive storytelling books included multimedia contents or activities for left-handed children in each QR or NFC code. Other storytelling books had activities designed within the same book.

The use of augmented reality also contributed to the interaction and inclusion of children. Figure 2 shows an example of the interactive storytelling book.

Fig. 2. Interactive book with QR codes, NFC and Augmented Reality AR.

The use of NFC tags facilitated the interaction of children with special needs, unlike the QR codes that need more precision with the camera of the smartphone.

We believe that it is an innovative idea that uses disruptive technology rarely seen in our environment and applicable to a vulnerable and little forgotten population.

5   Conclusions

The aim of this research work was to demonstrate to participants that everyone can create educational resources, everyone can tell stories. In consequence, the results reflect that storytelling can enhance visualization skills, providing a scaffold for reading comprehension.

From the experience gained during the design process and the final evaluation of interactive storytelling books, teachers were motivated to design their own educational resources. This experience can help teachers in using interactive features in a meaningful manner.

Technology is an essential factor in motivating children to collaborate with other in the learning process. Positive effects of shared reading for children's language development are boosted by including multimedia and by increasing interactivity with the integration with technology.

We noticed that teachers developed novel learning strategies in the Storytelling books for left-handed children. The study was substantive and thoughtful, giving impetus for further researches in varied directions. For future research, we are planning testing the interactive books in a real environment, in order to measure the impact on children learning.

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