

Using Storytelling to Support the Education of Deaf Children: A Systematic Literature Review

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Abstract. Education of deaf children has always been a challenge due to communication problems, that's why different teaching and learning strategies must be taken into account in order to address language issues and make use of the visual input to overcome the loss of the auditory one. Storytelling is one of such strategies that's been proven to be effective in teaching and learning processes of hearing children. Therefore, a systematic literature review was conducted to identify how this technique has been used in the education of deaf children and how could interactive storytelling engage children with learning processes in different areas of knowledge. A total of 623 studies were found in different databases but just 24 of them were selected for this review.

Keywords: Storytelling · Deaf · Children · Sign language · Education · Learning · Systematic review

1 Introduction

Deaf children learn at different paces compared to their hearing peers [1] and this has aroused interest among researchers and teachers who are constantly looking for new and different ways to improve education processes of these children. As technology advances and teaching strategies changes, new tools can be implemented to support the education of people with disabilities. In this study, we want to know how a teaching strategy like storytelling has helped deaf children in their education and how the inclusion of ICT could improve these teaching and learning processes through interactive storytelling.

This paper is structured as follows. In Sect. 2 we give an overview about storytelling and how Human-Computer Interaction (HCI) is involved in interactive storytelling. In Sect. 3, the methodology to conduct the systematic review is presented. Section 4 shows the results obtained after data extraction and analysis. Finally, Sect. 5 concludes this study.

2 Background

In this section, we present a short overview of storytelling, and how it can be enriched by means of technology and HCI. Moreover, education of deaf children is also introduced in this section.

2.1 Storytelling + HCI

Storytelling is known as a social and cultural activity of creating or sharing stories and it has lately being a topic of interest in fields like HCI and Artificial Intelligence (AI) [2, 3] Storytelling is pervasive in different aspects of children's life such as the development of skills in communication or to enforce the relationships with peers and adults [4]. In the field of education, storytelling has demonstrated to be a great resource to work in different areas like natural sciences [5], foreign language teaching [6], sign language [7, 8], programming [9] and literacy [10–14].

According to the National Storytelling Network (NSN) high-quality storytelling must be interactive [15] and nowadays technology provides new opportunities for children not just to have fun but also to learn. Interactive storytelling is an interdisciplinary field in which the humanities meet artificial intelligence [16] where stories are told by combining personal narratives with technology and this is essential in order to engage the new generation of digital natives [17]. Therefore, Human-Computer Interaction (HCI) plays a key role in the design and development of interactive environments for children, especially for those with disabilities who present specific problems and incorporate unusual forms of interaction [18].

2.2 Education of Deaf Children

The Salamanca statement [19] is a document that is informed by the principle of inclusion and proposes that education systems should be designed in order to consider the wide diversity of children and their unique characteristics, interest, abilities and learning needs [20]. Unfortunately, deaf children are facing difficulties in different areas of knowledge mainly due to the late acquisition of a first language which should be a sign language (SL). Some SL are legally recognized in national laws or constitutions, or are mentioned in the laws of different countries [21]. Children must be exposed to an accessible language during the first five years of age [22] and for deaf children it should be the SL used or accepted in their countries but unfortunately for some of them this language is not acquired properly at home due to 90% of them are born to non-deaf parents [22, 23] who do not use this language.

It is then clear that in order to acquire any kind of knowledge, it's necessary to have a proper communication channel and that's why a bilingual education should be adopted [24] where SL is seen as primary language in order to start developing skills in a second language (written language) and other areas like math. One of the main reasons deaf children don't finish higher education is poor literacy skills according to [25]. Literacy problems may affect the development of other skills and learning of other

areas such as math and science [26] and this leaves deaf people in a disadvantage compared to their hearing peers.

Taking into account that sign language is the primary communication channel of deaf children, different educational strategies must be implemented in order guarantee the fundamental right to education for these children as stated in [19].

3 Research Method

This study was carried out by following Kitchenham and Charters [27] guidelines to perform a systematic literature review in software engineering. These guidelines define the procedures to be followed in order to identify and summarize existing data about a particular subject. In subsequent sections, the steps followed to perform the review are presented.

3.1 Research Questions

The main objective of this study is to answer the following research questions.

RQ1: How is storytelling being used to support education of deaf children?

RQ2: How could interactive storytelling support education of deaf children?

3.2 Data Sources and Search Strategies

We searched for papers that are written in English and Spanish. The search was made in electronic databases with very specific keywords and filtering criteria. The following electronic databases were used.

English search:

- IEEE Xplore (<http://ieeexplore.ieee.org>)
- ACM Digital library (<http://dl.acm.org>)
- SCOPUS (<https://www.scopus.com/home.uri>)
- Springer (<http://link.springer.com>)
- ProQuest (<http://search.proquest.com>)

Spanish search:

- ProQuest (<http://search.proquest.com>)
- Dialnet (<https://dialnet.unirioja.es>)
- Redalyc (<http://www.redalyc.org>)

The keywords to address the search in order to find relevant studies in English and answer the research question were: *Storytelling, deaf, children, learning or education, sign language*. The same words were used in Spanish: *Cuentos, niños, sordos, aprendizaje o educación, lengua de señas o lenguaje de señas*.

From this group of keywords, it is mandatory that the words *storytelling* (*cuentos*), *deaf* (*sordos*) and at least one of the other ones are included in all the results, that is how we came up with the following strings in each of the databases:

IEEE Xplore. It has an advanced search that allows to find articles where the keywords are found just in the title and abstract. After applying a full string with all the words, we obtained more than 80000 articles irrelevant for the search, that is why we decided to perform individual searches where the words *storytelling* and *deaf* were combined with each one of the others, getting as a result that only three words (*storytelling*, *deaf* and *children*) were necessary to get the only relevant paper this database offers to help answer the research questions.

("Document Title":storytelling AND "Document Title":deaf AND "Document Title":children OR "Abstract":storytelling AND "Abstract":deaf AND "Abstract":children)

ACM Digital Library. It also has an advanced search where keywords can be found only in the title and abstract. The structure of the string is the same used in IEEE Xplore but with all the keywords included.

acmdlTitle:(+"storytelling" +deaf +(learning children education "sign language")) OR recordAbstract:(+"storytelling" +deaf +(learning children education "sign language"))

SCOPUS. It lets perform a search where the words can be found not just in the title and abstract but also in the keywords of the document. In this database all the words were included.

(TITLE-ABS-KEY (storytelling AND deaf) AND TITLE-ABS-KEY (learn OR child* OR education* OR "sign language"))*

Springer. It does not allow to find the keywords just in the title and abstract, instead, it performs the search finding the words in the whole document. Since Springer could offer relevant results in chapters of books, these ones were also included in the search.

storytelling AND deaf AND (learning OR children OR education OR "sign OR language")

ProQuest (English and Spanish). ProQuest was used to find papers in English and Spanish. The same structure of the string used in the previous databases was used for both searches.

(storytelling deaf) AND (children OR "sign language" OR education OR learning)

(cuentos sordos) AND (niños OR "lenguaje de señas" OR "lengua de señas" OR educación OR aprendizaje)

Dialnet. It does not have an advanced search where operators like AND/OR can be used. This is why the search had to be done using the 2 most important keywords in order to find enough results to be filtered by us.

cuentos sordos

Redalyc. It has a poor engine to perform searches, even though it is one of the most relevant databases for literature in Spanish, so we decided to perform the search using Google where we can filter a search by site and filetype. All the words could be used here.

cuentos sordos niños OR "lengua de señas" OR "lenguaje de señas" OR educación OR aprendizaje site:redalyc.org filetype:pdf

3.3 Management of Studies and Inclusion/Exclusion Criteria

The exclusion criteria (EC) are all the reasons why some studies found are not included into the systematic review.

- EC 1: Document not available to download
- EC 2: Document not in English or Spanish
- EC 3: Document not related to storytelling and deaf people

On the other hand, the inclusion criteria (IC) show the factors to consider a paper as relevant to answer the research questions. In our case, there is only one reason to include a paper in the systematic review.

- IC: Document related to the use of storytelling with deaf people.

3.4 Data Extraction

We developed a template to register all the results given by each database. On this template, we were able to record relevant information of every paper such as: (a) Name of database, (b) String used, (c) Inclusion or exclusion criteria, (d) ID of paper, (e) Authors, (f) Paper Title, (g) Keywords, (h) DOI, (i) Year of publication, (j) Name of conference or journal where the study was published, (k) Type of publication. The search of this systematic review was performed in September 2016. We obtained 623 studies from all databases. Once the inclusion and exclusion criteria was applied, only 24 studies were selected for the review process. Table 1 shows detailed data about the number papers found on each database and relevant studies selected from them.

Table 1. Summary of search results

Database name	Search results	Duplicated papers	Relevant papers
IEEE Xplore	1	–	1
ACM	3	–	3
SCOPUS	14	5	6
Springer	269	9	1
ProQuest (English)	233	26	9
ProQuest (Spanish)	11	–	0
Dialnet	18	–	1
Redalyc	74	–	3
Total	623	40	24

4 Data Analysis and Results

In order to determine how storytelling is being used to support the education of deaf children, the selected papers were classified into different categories:

Skill. Research that clearly shows the support to a specific skill to be developed.

ICT. Research that makes use of any kind of technology to support learning.

Development. Research that proposes the development of a tool, app or platform to support learning.

Strategies/Activities. Research focused on presenting strategies or activities developed to support learning with or without ICT.

Figure 1 shows the number of papers that fitted in each category.

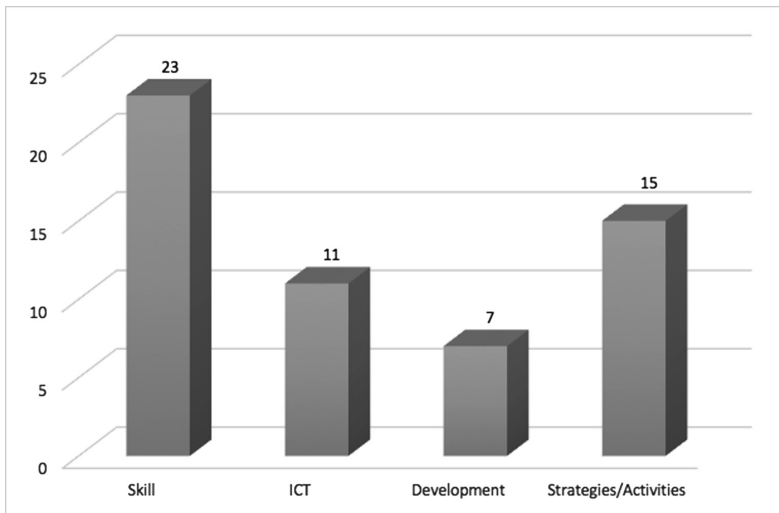


Fig. 1. Classification of articles

96% of the papers aimed to develop or strengthen a particular skill [S1–S20, S22–S24], 46% showed the use of ICT as a resource [S1–S5, S11, S18, S19, S21, S23, S24], 29% had an app, tool or platform as a result to support teaching/learning [S1–S5, S18, S21] and 62,5% presented activities or strategies as part of the educational process [S5, S6, S8–S17, S20, S22, S23]. Some papers matched more than 1 category.

The category *skill* was divided into 3 subcategories identified in the papers in order to know what are the target areas of knowledge.

Figure 2 shows that 65% of the researches aim to support literacy in deaf children skill [S1–S3, S5–S8, S10, S11, S14, S15, S17, S18, S22, S24], 26% sign language [S4, S5, S8, S11, S14, S19] and 43% narrative [S4, S9, S10, S12–S14, S16, S17, S20, S23].

From the strategies/activities category, we identified that 33% of the papers involved a collaborative work of children with peers [S5, S6, S8, S10, S15] (Fig. 3).

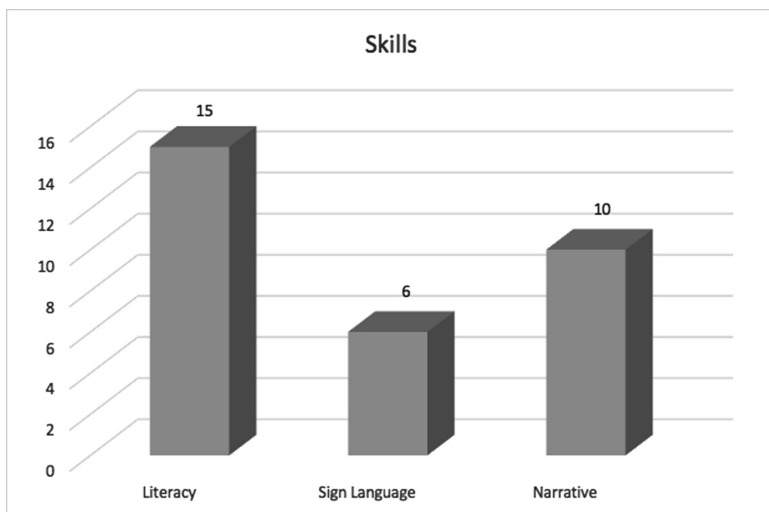


Fig. 2. Skills aimed to be developed or strengthened



Fig. 3. Papers with collaborative or individual strategies/activities

Finally, we wanted to know which sign languages were used by users in the different researches in order to identify if these were used as primary communication channel (Fig. 4).

From all the papers, 33% of them did not mention the use of any sign language [S3, S6, S7, S10, S13, S18, S20, S21], while 29% made use of American Sign Language (ASL) [S1, S8, S9, S11, S14, S19, S22], 12,5% made use of Brazilian Sign Language (BSL) [S5, S8, S24] and 8% used Chilean Sign Language (ChSL) [S15, S16]. Arabian Sign Language (ArSL) [S2], Spanish Sign Language (SSL) [S4], Hong Kong Sign

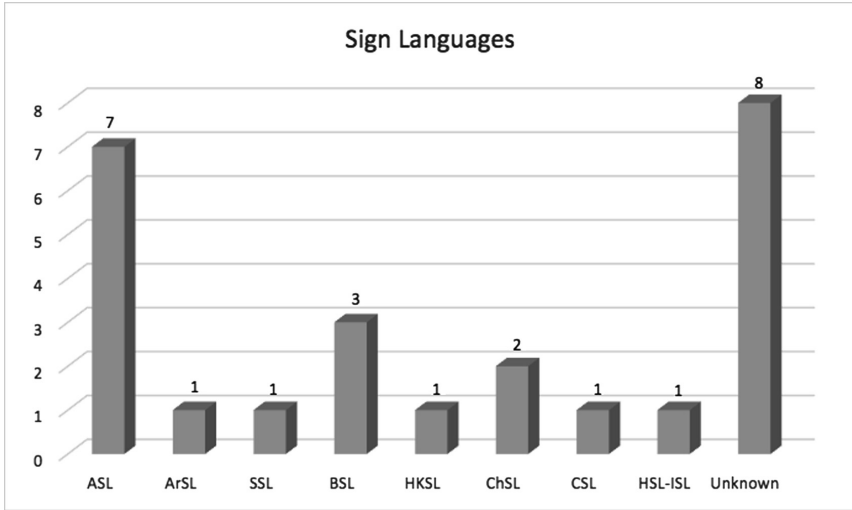


Fig. 4. Sign languages used as primary communication channel in researches

Language (HKSL) [S12], Colombian Sign Language (CSL) [S17], Hebrew and Israeli Sign Language (HSL-ISL) [S23] were each mentioned in one different paper. In some researches, more than one sign language was used.

4.1 Findings About Research Questions

In this section, we discuss how the data extracted from reviewed papers address our two research questions.

RQ1. How is storytelling being used to support education of deaf children?

We identified that there is not much information from the last five years about the use of storytelling in order to support the education of deaf children, but the 24 studies reviewed showed the great impact that storytelling has on deaf children, mainly in the development of skills related to communication and language such as literacy, narrative and the use of sign languages. We also found that different strategies are being implemented in the classroom in order to address this issues related to communication and that almost half of the studies showed the implementation of technology not just to be used in the classroom, but also at home. Finally, some studies show the use of collaborative strategies with great results.

RQ2. How could interactive storytelling support education of deaf children?

The studies reviewed showed that the inclusion of ICT engages children and allow them to take the education process outside the classroom. Through interactive storytelling, children will not be restricted to a fixed story, instead, they will be direct authors of it and this could improve not just skills like sign language, literacy and narrative but also imagination. Unfortunately, there is even less efforts made in order to

use interactive storytelling, since just a small part of the reviewed papers show the inclusion of interactive stories, but this is also an opportunity to propose a methodology that could motivate researchers to start working towards the inclusion of deaf children in society through education.

5 Conclusions and Future Work

We have conducted a systematic review where 24 out of 623 papers were selected to answer the research questions. After data extraction and analysis, we can determine that skills related to language and communication are the most common among researches that involve the use of storytelling as an educational resource for deaf children. Storytelling has been used for a long time with this community but according to the last five years there is not much research around the use of this strategy to educate deaf people and we think there should be made more efforts taking into account that new technologies such as smartphones and tablets open a new set of opportunities to impact positively in the lives of these children through a well-known strategy such as storytelling.

Nowadays, deaf children are also considered digital natives and this could make interactive storytelling an even more effective strategy for them, but unfortunately, we noticed that there is not an established methodology to make use of interactive storytelling through the use of ICT.

According to the results of this study, for future work we identified a great opportunity to propose a methodology to design interactive storytelling where researchers can integrate technology and education in order to remove barriers in the way of deaf children by letting them tell their own stories. The findings of this systematic review will be enhanced by including studies where interactive storytelling supports education in general without restricting the search to just deaf children.

Appendix: Papers Included in the Review

- S1. M. Malzkuhn and M. Herzig, "Bilingual Storybook App Designed for Deaf Children Based on Research Principles," in *Interaction Design and Children*, 2013, pp. 499–502.
- S2. A. Alsumait, M. Faisal, and S. Banian, "Improving Literacy for Deaf Arab Children Using Interactive Storytelling," in *iiWAS '15 Proceedings of the 17th International Conference on Information Integration and Web-based Applications & Services*, 2015, p. 5.
- S3. K. Hart and R. Ahmed, "Using Demibooks Composer to Create Remedial Learning Apps for the Profoundly Deaf," in *Proceedings of the 13th International Conference on Interaction Design and Children*, 2013, pp. 573–576.
- S4. S. Peix Cruz, "Carambuco : cuentos y actividades en lengua de signos," *Boletín de la asociación andaluza de bibliotecarios*, no. 107, pp. 50–59, 2014.

- S5. C. Guimarães, D.R. Antunes, L.S. García, A.L. Pires Guedes, and S. Fernandes, "Conceptual meta-environment for deaf children literacy challenge: How to design effective artifacts for bilingualism construction," *Proceedings - International Conference on Research Challenges in Information Science*, p. 12, 2012.
- S6. H.P. Karasu, "Group Activities for Literacy Preparation during the Pre-School Period of Hearing-Impaired Children," *Education and Science*, vol. 39, no. 173, pp. 297–312, 2014.
- S7. L.K. Entwisle, K. Brouwer, E. Hanson, and J. Messersmith, "A Systematic Review of Emergent Literacy Interventions for Preschool- Age Children With Cochlear Implants," *Contemporary Issues in Communication Science and Disorders*, vol. 43, pp. 64–76, 2016.
- S8. D. Chen Pichler, J.A. Hochgesang, D. Lillo-Martin, R. Müller de Quadros, and W. Reynolds, "Best Practices for Building a Bimodal/Bilingual Child Language Corpus," *Sign Language Studies*, no. January, pp. 361–388, 2016.
- S9. J.S. Beal-Alvarez and J.W. Trussell, "Depicting Verbs and Constructed Action: Necessary Narrative Components in Deaf Adults' Storybook Renditions," *Sign Language Studies*, pp. 5–29, 2015.
- S10. L. a Pakulski and J.N. Kaderavek, "Reading intervention to improve narrative production, narrative comprehension, and motivation and interest of children with hearing loss," *The Volta Review*, vol. 112, no. 2, pp. 87–112, 2012.
- S11. D. Golos and A. Moses, "Supplementing an Educational Video Series with Video-Related Classroom Activities and Materials," *Sign Language Studies*, no. January, pp. 103–125, 2016.
- S12. F. Sze, G. Tang, T. Lau, E. Lam, and C. Yiu, "The development of discourse referencing in Cantoneseof deaf/hard-of-hearing children.," *Journal of child language*, vol. 42, pp. 351–393, 2015.
- S13. A.N. Asad, L. Hand, L. Fairgray, and S.C. Purdy, "The use of dynamic assessment to evaluate narrative language learning in children with hearing loss: Three case studies," *Child Language Teaching and Therapy*, vol. 29, no. 3, pp. 319–342, 2013.
- S14. K. Snoddon, "Ways of taking from books in ASL book sharing," *Sign Language Studies*, vol. 14, no. 3, pp. 338–359, 2014.
- S15. M.R. Lissi, K. Svartholm, and M. González, "El Enfoque Bilingüe en la Educación de Sordos : sus implicancias para la enseñanza y aprendizaje de la lengua escrita," *Estudios Pedagógicos*, vol. 38, no. 2, pp. 299–320, 2012.
- S16. X. Acuña Robertson, D. Adamo Quintela, I. Cabrera Ramírez, and M.R. Lissi, "Estudio descriptivo del desarrollo de la competencia narrativa en lengua de señas chilena," *Onomázein*, vol. 26, pp. 193–219, 2012.
- S17. L.S. Prieto Soriano, "La Pedagogía por Proyectos de Aula: una alternativa para enseñar castellano escrito a niños y niñas de primer ciclo," *Educação & Realidade*, vol. 41, no. 3, pp. 789–806, 2016.
- S18. P. Bottoni, D. Capuano, M. de Marsico, and A. Labella, "DELE framework: An innovative sight on didactics for deaf people," *Journal of E-Learning and Knowledge Society*, vol. 8, no. 3, pp. 165–174, 2012.

- S19. J.S. Beal-Alvarez and S.G. Huston, “Emerging Evidence for Instructional Practice: Repeated Viewings of Sign Language Models,” *Communication Disorders Quarterly*, vol. 35, no. 2, pp. 93–102, 2013.
- S20. T. Boons, L. De Raeve, M. Langereis, L. Peeraer, J. Wouters, and A. van Wieringen, “Narrative spoken language skills in severely hearing impaired school-aged children with cochlear implants,” *Research in Developmental Disabilities*, vol. 34, no. 11, pp. 3833–3846, 2013.
- S21. P. Bottoni, F. Borgia, D. Buccarella, D. Capuano, M. De Marsico, and A. Labella, “Stories and signs in an e-learning environment for deaf people,” *Universal Access in the Information Society*, vol. 12, no. 4, pp. 369–386, 2013.
- S22. B.K. Strassman and K.O’Dell, “Using open captions to revise writing in digital stories composed by D/deaf and hard of hearing students,” *American Annals of the Deaf*, vol. 157, no. 4, pp. 340–357, 2012.
- S23. S. Eden, “Virtual intervention to improve storytelling ability among deaf and hard-of-hearing children,” *European Journal of Special Needs Education*, vol. 29, no. 3, pp. 370–386, 2014.
- S24. R.I. Busarello, V.R. Ulbricht, P. Biegling, and V. Villarouco, “Deaf students and comic hypermedia: Proposal of accessible learning object,” *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, vol. 8011 LNCS, no. PART 3, pp. 133–142, 2013.

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