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	Particle	
	Given Name	Riley
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	Division	
	Organization	Swarthmore College
	Address	Swarthmore, PA, USA
	Email	rcollin4@swarthmore.com
Author	Family Name	Mirus
	Particle	
	Given Name	Gene
	Prefix	
	Suffix	
	Division	
	Organization	Gallaudet University
	Address	Washington, D.C., USA
	Email	gene.mirus@gallaudet.edu
Corresponding Author	Family Name	Napoli
	Particle	
	Given Name	Donna Jo
	Prefix	
	Suffix	
	Division	
	Organization	Swarthmore College
	Address	Swarthmore, PA, USA
	Email	dnapoli1@swarthmore.edu
Abstract	<p>The RISE bimodal-bilingual eBooks project is a joint initiative of Gallaudet University and Swarthmore College in the United States aimed to promote shared reading activities between hearing adults and their deaf children, although the format may welcome users from a broader spectrum. It produces ebooks, typically using published picture books as a base, and adding sign language videos, where the countries and languages involved right now number a dozen, but the global interest is growing steadily. The project has developed a workflow that is easily implementable using commercial off-the-shelf software, or open source alternatives, with an aim of making the production of bimodal-bilingual ebooks both readily accessible and efficient.</p>	
Keywords (separated by '-')	Deaf children - Literacy - ebooks - Sign languages	

RISE eBooks: Leveraging Off-the-Shelf Software Components in Support of Deaf Literacy

Riley Collins¹, Gene Mirus², and Donna Jo Napoli^{1(✉)}

¹ Swarthmore College, Swarthmore, PA, USA
rcollin4@swarthmore.com, dnapoli1@swarthmore.edu

² Gallaudet University, Washington, D.C., USA
gene.mirus@gallaudet.edu

Abstract. The RISE bimodal-bilingual eBooks project is a joint initiative of Gallaudet University and Swarthmore College in the United States aimed to promote shared reading activities between hearing adults and their deaf children, although the format may welcome users from a broader spectrum. It produces ebooks, typically using published picture books as a base, and adding sign language videos, where the countries and languages involved right now number a dozen, but the global interest is growing steadily. The project has developed a workflow that is easily implementable using commercial off-the-shelf software, or open source alternatives, with an aim of making the production of bimodal-bilingual ebooks both readily accessible and efficient.

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1 Introduction: Background and Rationale

Literacy allows us to process a complex of knowledge in a variety of media: oral, manual-visual, or print. When we listen to a story (told ritualistically, so that it is (nearly) the same every time, or more individualistically), or watch one (signed ritualistically or individualistically), or read one, we process multiple things. First, there is the primary information of who did what to whom, when, where, why, and how. But second, is more subtle information, what we here call secondary, such as what the unstated motives were for this behavior and what the likely impact is on the affected parties. Secondary information enriches primary information, allowing us to feel empathy, make inferences and, therefore, predictions, and comprehend the story's relevance to our own lives, which may be distant from the lives of the story characters. Secondary information is what makes us care about stories.

In a sense, all information that is imparted from one person to another forms a story, though the majority of these stories are of a minimal sort. This is why journalists talk about the “feature story” of the day, whether it be about a scientific discovery, a medical alert, a military debacle. We organize information, fiction or nonfiction, around that set of primary information factors, and we rely on our audience understanding the secondary information factors to get the full import of what we are trying to convey. Again, it is

the secondary information that makes the audience care about the news; it clarifies the import of the news and makes it profound for them.

All this means that literacy is essential to people partaking fully of their own humanity. Further, print literacy is necessary to gaining information beyond that conveyed by those people we have immediate access to orally or visually, thus being print-literate is critical in modern society. Gaining print literacy, however, can be difficult. For hearing people of ordinary intelligence and without relevant disabilities, difficulty in gaining print literacy may be relative to the deep (i.e., opaque) or shallow (i.e., transparent) nature of the orthography: learning to read in character systems that have little to no correspondence between symbol and sound (for example, Chinese characters as used for Mandarin and many other languages) is far more difficult than learning to read in alphabetic systems, particularly those with a close correspondence between symbol and sound (for example, the Roman alphabet as used for Spanish and Italian, which have close to one-to-one correspondences across-the-board, in contrast to its use for French and English, which have multiple many-to-one correspondences).

For deaf people, difficulty in gaining print literacy has more sources. For one, all orthographies are deep to the deaf. This is obviously true for the deaf person who has little to no access to sound (although signing deaf people use phonological information from sign in reading alphabetic script [1]). However, even deaf people with assistive technology that allows some access to sound have difficulties learning to read (where the child with a hearing aid fares better than one with a cochlear implant [2]). For another, the majority of deaf children do not acquire a first language in the ordinary way – i.e., simply by being surrounded by users of an accessible language, without explicit instruction. Instead, they may be surrounded by spoken language they find inaccessible and not have adequate exposure to a sign language to acquire it well. Researchers point to lack of a firm foundation in a first language as a culprit in the fact that deaf children lag behind hearing peers in print literacy [3].

A third possible contributor to difficulty in gaining print literacy may lie in lack of early exposure to stories. Repeatedly, research on print literacy concludes that shared reading activities (SRAs) when a child is small are important to whether that child will become skilled at reading ([4] and many earlier works). Enjoyable language interaction and play over a story (such as open-ended questions like “What would you do next if you were that bunny?”) are critical to understanding not just the primary information, but, especially, the secondary information of the story. Through this language interaction, children come to see books as fun and worth the effort of learning to read. This is why scholars strongly recommend SRAs for deaf children [5].

But it is also why we should strongly recommend visual storytelling. Deaf children learn best when their visual attention is captured [6]. Deaf parents know this instinctively, and when they engage in SRAs with their deaf children, they retell (parts of) the story in sign, often embellishing or orienting the story to entice their own child, as well as employ a range of methods to focus the child’s attention [7].

Given all the above, it should come as no surprise that deaf children who sign well have superior print literacy achievement to those who don’t [8–14].

Therefore, in an effort to enhance deaf children’s literacy skills, we set out to produce materials to encourage SRAs at home with preschoolers, helping to develop the needed

visual literacy skills to support later print literacy skills through spurring language interaction that supports understanding of primary and secondary information. Since the huge majority of deaf children are born to hearing parents, many face challenges in acquiring the shared experiences that provide developmental advantages.

2 RISE eBooks

The RISE (Reading Involves Shared Experience) eBooks project was founded as a joint venture between Swarthmore College and Gallaudet University. RISE produces entertaining bilingual-bimodal ebooks, in a sign language and in the text of the ambient spoken language, that are accessible to both deaf children and their (typically hearing) parents, with an aim towards encouraging enjoyable SRAs. The books are drawn from a variety of sources including the public domain (mostly classic books but also a few newer books), and agreements involving the kind permission of Penguin Random House and National Geographic Books (NG), as well as the kind permission of individual children's authors and illustrators. The association with NG has allowed the inclusion of nonfiction ebooks. All the ebooks are prepared for publication through the project's workflow and then published for free on the Internet [15].

2.1 Characteristics of Other Digital Products with Similar Aims

Gallaudet University's Science of Learning Center's project "Visual Language and Visual Learning" (VL2) has produced six ebooks, with original stories in commercial application form [16], using an in-house developed framework [17]. The aim is explicit reading instruction – so the SRA has a pedagogical focus. They use ASL, are marketed for the 5 year old and up, and sold at a reasonable price.

The SMARTSign Center for Accessible Technology in Sign produces a collection of tools that allow readers to access in ASL videos of words, phrases, sentences, and whole pages from popular books. The videos are provided by members of the public, and reviewed by an editorial board to ensure quality. While their tools are free, they are intended to be used in tandem with a copy of the physical book [18].

Additionally, videobooks in various sign languages have been appearing on the Internet increasingly over the past decade [19]. Typically, the stories are original and offered at minor cost. They include text, illustrations, and signing.

2.2 Characteristics of RISE eBooks

RISE ebooks are not explicitly pedagogical. While the sign video on a given page corresponds to the text, the correspondence is loose. Signers cover the information in the text in a manner appropriate to the visual-learning needs of the deaf child; it makes use of the visual vernacular common to sign stories [20], thus giving the children a tradition that is their heritage by virtue of being deaf. The signers, thus, have considerable creative freedom. All are deaf students and signing is their most comfortable means of communication. They are guided by two professors: Gene Mirus, a former member of the

National Theater of the Deaf, and Donna Jo Napoli, a children's author. The signing is energetic and enthusiastic, allowing many points from which parent and child can initiate conversation of a factual and an inferential nature.

The signers' creative energy may have an effect on the children. In observations of children using the ebooks in a school setting in autumns 2013 and 2014 [21], and in a pilot study of their use in school and home in autumn 2014 [22], deaf children mimicked the videos starting as early as the second viewing. Then they re-told the stories to others, varying them to make their feelings about the plot obvious and to add details that personalized the stories. Most important, they had fun, claiming ownership of the ability to tell the stories in a sign language. Thus the ebooks led to complex language interactions about both the primary and secondary information in the stories.

Further, because almost all our ebooks use a picture book produced by a publishing house, the stories and illustrations have been "vetted" for quality. With respect to books for which the copyright has expired, this means the children are introduced to classics that are part of their heritage by virtue of living in a given country. It further means that parents might well be faced with stories they loved as a child and want to share with their children. So parent interest is a given, and that means parents might watch the videos with more concentration, so that their own signing skills improve. This is important, since everyone in the family needs signing skills to interact with the deaf child in a way that promotes the child's overall linguistic abilities and supports the child's psychological needs of being accepted as a deaf person who can interact with family members in all the ordinary ways that family members interact [23].

3 Work Flow

The RISE project's workflow keeps two constraints in mind: ease of use by nontechnical project members, and assurance of clear, accessible representation of text and sign within ebooks. The software in each step is usually interchangeable with at least one other, and the project has utilized commercial software and open-source alternatives. This makes production feasible for groups without access to funds for traditional commercial solutions to the different tasks required by the workflow. In the following workflow description, closed and open-source options are represented. A large part of the workflow is parallelizable, as the signing and text portions of the ebooks can be prepared separately until late in the process. This is convenient as it allows for remote collaboration between teams of producers and signers, a quality that has allowed the RISE project to collaborate with individuals and teams from around the world.

3.1 Text and Video Preparation, and Audio Narration

Ebooks begin the process as a PDF document provided by the book's publishing house or, for older public-domain books, from high quality scans of the physical texts. The PDF is then broken into pages and the pages are reduced to their constituent stylistic

elements (text, illustrations) using a standard photo editing suite, either Adobe Photoshop or the GNU Image Manipulation Program (GIMP). Once the PDF has been processed, the resulting files are ready to be used to construct the ebook template.

For each page in the book, a video is prepared on a green screen by a signer. The files are then edited with a video editing suite, Adobe Premiere, Apple's Final Cut Pro, or the open-source Blender, and prepared for the ebook template by replacing the green screen with an appropriate background to match the aesthetic of a given book.

Although the primary audience of the RISE project is deaf children and their hearing parents, each page has associated audio narration in order to make the ebooks accessible to the largest audience possible. This way a deaf person (adult or child) can share the book with a non-reading hearing person. Further, this makes the ebooks more useful to hearing children with special needs who can benefit from exposure to sign languages, including children with autism.

3.2 Template Construction

Once the text and sign files are processed, if this is the first time a particular PDF has been used to make an ebook, we build a template in two formats, ebook and online book. The template is a standardized layout for the placement of text and videos that can be used for any subsequent languages the story will be prepared in.

The ebook template is built in Apple's iBooks Author program, the only available and free program when the RISE project began. It abstracts much of the technical challenge of incorporating videos into an ebook format. The downside to this format is that ebooks made with iBooks Author can be viewed only on certain devices with the Apple family – a regrettable limitation, given expense and availability.

In contrast, the online template is a Google Drive Presentation (GDP), which offers two benefits. First, stories can play on devices beyond the Apple family; anyone with Internet access (at home, or in libraries, schools, or other institutions) can view them. Second, this format allows sharing stories with groups, including classroom settings utilizing modern teaching aids such as a Smart Board. This means that children in a deaf school can enjoy the experience together. Most deaf children in developed countries, however, are mainstreamed, and for the mainstreamed child, the GDP has two additional advantages. First, deaf children can use the same educational material as hearing peers, enjoying the contents together. This is significant in that it removes from the teacher the responsibility of finding materials that include the deaf child – a responsibility not all teachers reliably assume [24]. Second, deaf children can delight at finding themselves in the far too atypical position of having a linguistic advantage over their hearing classmates in that they can teach signs to hearing children who take an interest in the book. Both advantages can help with social integration, one of the major problems for deaf children in mainstream settings [25].

Layout of the template is influenced by two main factors: respect for the original layout, and attention to making visually prominent both languages (sign and text).

For books not in the public domain, templates adhere strictly to the layout of the print book. This adherence required the development of several strategies for inserting videos into pages. The first is utilizing existing blank space in the original layout – a

simple if there is enough space. A more labor-intensive strategy is to insert the signer into an illustration on the page. The green screen behind the signer is edited so that the signer appears as part of the illustration. When there is not enough blank space or insertion of a video would compromise illustrations and/or text, we utilize a “push button.” This is a widget at the top of a page; when pressed it expands to a page-sized video of the signers with the full page (text and illustrations) mapped behind them. Thus readers can enjoy the text and illustration before seeing the video superimposed.

For books in the public domain, liberties can be taken with design, allowing showcasing the signer to enhance narrative and/or telling. One ebook has experimented with a different format. Instead of static text with a video that requires a click to play, both video and text require a button to be pressed for viewing, whether together or independently. Other books have enhancements to original illustrations in the form of animation, while still others have signers interacting with illustrations.

Once a template is set, a video version of the text is prepared as a final alternate format. The video is produced from the iBooks version of the text, and is made accessible over the Internet. In addition, the video format has been used to experiment with an alternative approach to designing the books. Instead of fitting the video inside pre-existing text and illustrations of a traditional book layout, the alternate format fits text and illustrations into a video of the signer. While this requires more time to produce, it provides another engaging reading experience for deaf children and their parents.

3.3 Revisions and Publishing

The first draft of the ebook is produced in the iBooks format, through collaboration between student signer and student producer/editor. The signer is responsible for the telling of the content. The producer is responsible for formatting and film editing. Both collaborate on every decision. Each pair is coupled with another pair, into teams of 4 people. All four people give feedback on the first draft. The professors also give feedback at every stage, as do other people involved in the education of deaf children.

The second draft is tested on families with deaf children and deaf schools, where observation and feedback lead to further improvements. The third drafts are published and distributed free. Ebooks are available in the iBooks store through Apple, and the GDP and video formats can be downloaded from our website at Gallaudet University.

For legal reasons, books under copyright are not available on the iBooks store, and are instead provided through a content delivery system implemented using Google Drive’s API. This provides RISE an easy method for sharing templates with teams, domestic and abroad, interested in producing an ebook and allows partial tracking of how many downloads are done by families or classrooms that have a deaf individual.

4 Reach

Over the three years that the RISE project has been active, more than 6,000 copies of the ebooks have been downloaded through the iTunes store. Since January 2016, a website hosted at Gallaudet University has made available our full range of stories so

far (and announces several in progress). The project has produced ebooks in American, Korean, Nepali, Fiji, Japanese, and Brazilian sign languages with the appropriate written text; additional ones in German, Irish, Greek, Saudi Arabian, Swedish, and Italian sign languages with the appropriate written text are in production.

5 Future Work

The project will continue to provide ebooks with stories and non-fiction works for deaf children of all signing abilities. There are presently hundreds of thousands of picture books for hearing children in the USA and only dozens of bilingual-bimodal ebooks for deaf children. The disparity in other countries is also drastic. We hope to change this not simply by adding more stories, but by making available an online manual for producing these ebooks and by teaching deaf children how to tell stories in the visual vernacular, so that we help create new generations of ebook producers.

With respect to more technical aspects, our next step is deployment of a framework to automate the RISE workflow to the greatest possible degree. Optimally we will be able to input edited video along with the appropriate template to automatically produce ebooks on all our supported platforms with no additional work. We also hope to offer an application on Android devices, as they represent a large portion of the market share globally and are more prevalent than Apple devices in developing markets.

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