

VOLUME 8 ISSUE 4

The International Journal of

Health, Wellness, and Society

Evaluation of an Oral Health Literacy Curriculum

Design Feedback from Three Audiences

VALERIE A. UBBES, JAMES R. COYLE, AND ELIAS TZOC

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THE INTERNATIONAL JOURNAL OF HEALTH, WELLNESS, AND SOCIETY

<http://healthandsociety.com/>

ISSN: 2156-8960 (Print)

ISSN: 2156-9053 (Online)

<http://doi.org/10.18848/2156-8960/CGP> (Journal)

First published by Common Ground Research Networks in 2018
University of Illinois Research Park
2001 South First Street, Suite 202
Champaign, IL 61820 USA
Ph: +1-217-328-0405
<http://cgnetworks.org>

The International Journal of Health, Wellness, and Society is a peer-reviewed, scholarly journal.

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Evaluation of an Oral Health Literacy Curriculum: Design Feedback from Three Audiences

Valerie A. Ubbes,¹ Miami University, USA
James R. Coyle, Miami University, USA
Elias Tzoc, Miami University, USA

Abstract: Our primary goal was to evaluate the usability of a curriculum prototype for improving oral health literacy. We conducted two phases of usability testing on three different target audiences (university students, preK-12 teachers, and parents) by collecting eye tracking data and written feedback from participants after they experienced the digital curriculum under testing conditions. Although a collection of E-Texts will comprise twelve chapters in an online eBook for Oral Health Literacy, our two-phase pilot study describes user interactions and experiences on one E-Text chapter prototype by Amer and Ubbes entitled "Decisions to Keep My Teeth Health and Strong" located as an open source document at <https://dlp.lib.miamioh.edu/new-etexts/03/index.html>. Findings are organized by three design principles: multigenre, multisensory, and multidisciplinary. A practical bridge is made between functional literacy and functional health literacy with connections to interactive health literacy.

Keywords: Curriculum Design, Oral Health, Health Literacy, Evaluation, Eye Tracking

Introduction

The project involved an evaluation of digital materials called Electronic Texts for Health Literacy[®], to be abbreviated as E-Texts in this article. Health literacy is the number one predictor of health status and a social determinant of health (WHO Europe 2013). Health literacy has been conceptualized as functional, interactive, and critical (Nutbeam 2000). The current study focuses on functional health literacy for school-age children, although emergent literacy remains an important precursor for younger children during well-child checkups as described in Reach Out and Read programming in pediatric clinics (Ubbes and Ausherman 2001).

E-Texts are chapters in a digital curriculum that combines narrative story and expository information about children's health habits and daily living routines. The design depicts authentic accounts of children's lives through visual, textual, and gestural compositions as modeled in action photographs supported by declarative sentences about health. Participants experience E-Texts by viewing ten sequential positive-frame images and sentences that promote health. Each frame includes a photo with a written message and an audio narration of that message.

Positive-framed message design in health communication provides a visual-textual medium for promoting health behaviors through disease prevention strategies and cognitive skill development, while negative-framed message design focuses on behavioral risks and disease management (O'Keefe 2012). E-Texts focus on positive role models depicting daily routines and healthful habits of children with their families, friends, and health providers at home, school, and health clinics. Examples of E-Texts can be found on the Digital Literacy Partnership (DLP) website². We sought to determine the effectiveness of one E-Text from the eBook for Oral Health Literacy Curriculum at Miami University within the DLP.

¹ Corresponding Author: Valerie A. Ubbes, 501 E. High St., Department of Kinesiology and Health, Miami University, Oxford, OH, 45056, USA. email: ubbesva@miamioh.edu

² <https://dlp.lib.miamioh.edu>

We chose oral health hygiene as our first health literacy theme from our collection of E-Texts based on the national Healthy People 2020 health indicators. One of the top seven needs (health determinants) in the United States is oral health behaviors (USDHHS n.d.).

To date, we have conducted pilot studies to observe children and their parents viewing an E-Text with music in a dental office waiting room (Ubbes 2014b) and to assess the design of spoken narratives to educate consumers on oral health and medicine safety via tablets to be used in pharmacies and dental clinics (Ubbes 2015). However, visual processing of the E-Text has not been studied. This study employs eye tracking to evaluate the E-Text user experience.

The Design Solution

E-Texts use a narrative of reasoned actions to demonstrate health habits in different situations. Each photograph demonstrates the motivations of individuals to reason out their actions in the form of belief statements. The belief statements are called salient beliefs from the Integrative Model of Behavioral Prediction (Yzer 2012; Fishbein and Ajzen 2011) and include outcome beliefs, normative beliefs, and self-efficacy beliefs regarding health behaviors. These salient beliefs are divided among ten pages of an E-Text.

An E-Text begins with a title page and an opening self-efficacy belief statement on page two, followed by three pages of outcome belief statements, three pages of normative belief statements, one page of another self-efficacy belief statement, and one interactive summary page that invites the reader to perform the health behavior too. The design of the intervention includes the declarative belief statements integrated with human photographs showing the visual and gestural actions demonstrating that behavior on each page. A lexical verb pattern emphasizes the cognitive skill needed to move one's salient beliefs into action. Hence the body language in the photographs and the written language in the captions are woven together to demonstrate visual-textual-gestural messages that encourage healthy behaviors. By using visual-textual-gestural pages turned at the reader's pace, there is adaptability and functionality that is tailor-made to the individual. A slower image-by-image sequence allows for reflection—and reinforces what the individual can do when observing role models for one Habit of Health (behavior) and one Habit of Mind (cognitive skill) (Ubbes 2008).

We were interested in the user's multisensory experience from a gestural, visual, auditory, and kinesthetic perspective. Ultimately, information processing through the human senses has the potential to engage the user for enhanced learning outcomes. One prototype of an E-Text was evaluated to gain feedback regarding two research questions: 1) What design changes will be suggested by college students after experiencing our digital prototype? and 2) How do two important target audiences, parents and teachers, differ in how they process the health literacy messages found in the images and text?

Methodology

Eye tracking methodology "records the position and fixations of the eyes as readers move across visual stimuli" in the form of text and graphics (Jian 2015, 96). Eye tracking technology allows usability researchers to go beyond self-reported attitudinal data to better understand how users visually process interface content. Specifically, eye tracking can help researchers determine what users are looking at, for how long, and the visual paths taken. An important underlying assumption made in eye tracking research is the mind-eye hypothesis, which suggests that people will cognitively process what they visually attend to (Just and Carpenter 1984).

Previous eye tracking research has looked at the effectiveness of different processing strategies when text and pictures are presented together as stimuli. In these contexts, much learning occurs via textual processing (Hannus and Hyona 1999; Schmidt-Weigand et al. 2010), and people tend to attend more to the text than pictures (Rayner et al. 2001). However,

integration of information gathered from text and pictures tends to lead to the best learning outcomes (Koc-Januchta et al. 2017).

Procedures

We conducted a pilot study involving six college students enrolled in a public health communications course. Student feedback assisted us in improving the design of the E-Text. Based on this feedback we revised the E-Text and recruited three parents and three public school educators to review the revision. Two educators teach third graders and one teaches ninth graders. The parents have children who ranged in age from two years to nine years. Informed consent was obtained per Institutional Review Board standards. After reviewing the E-Text, each participant completed a written evaluation of that experience. The written evaluation is shown below for educators and for parents.

Questionnaire for Educators

1. Please give your honest impression of our E-Text on Oral Health Literacy.
2. As an educator, to what extent will our E-Text narrative in “pictures and words” convince students to do something about their health?
3. How could our E-Text design be improved based on your teaching experiences with students who are both average and above average readers?
4. Please reflect on the body language, oral language, and written language that you experienced while interacting with our E-Text design. What do you remember thinking as you moved from page to page?
5. Speculate how different students would interact with our E-Text in your classroom. If you don’t think your students would use the materials, please suggest where the material might be used in a school setting and for what purpose.
6. In the design of the E-Text, we purposely thought about “visual-textual-gestural interactions” with the message. What do you think about the body language sequence of the 10 slides? Specifically, what thoughts do you have about the sensory sequence used for each slide: seeing the picture, tracking the declarative sentence with the eyes, reading the sentence, clicking on the icon, listening to the sentence being read, then clicking to move to the next slide.
7. Based on question 6 above, what connections to literacy and linguistic development are fostered by our E-Text design?
8. What connections to language principles (or theories) are fostered by our E-Text design?
9. Finally, we are planning to implement our E-Text for Oral Health Literacy in two settings. Please give your ideas and honest feedback on implementing our E-Text in each setting:
 - a. School Curricula or Educational Programs
 - b. School-Based Health Clinic with a Dental Practice

Questionnaire for Parents

1. Please give your honest impression of the E-Text on Oral Health Literacy. What were some of your first thoughts on the E-Text when it began?
2. Do you feel that your interaction with the E-Text on Oral Health Literacy was too simple or too complex? Please explain. Give your adult perspective first from your own experience then speculate how your own children would interact with the E-Text. If you have more than one child, please give the gender and age of each child with a brief reflection on how they would do with the material.

3. What do you remember the most about the messages you experienced on the 10 slides?
4. What seemed distracting or frustrating?
5. What suggestions do you have for improving our E-Text for Oral Health Literacy?
6. Finally, we are planning to implement our E-Text for Oral Health Literacy in two locations. Please give your feedback and ideas on each:
 - a. Pediatric Dental Clinic Waiting Rooms
 - b. School-Based Health Clinic with a Dental Office

Results

When asked what improvements were needed for the prototype, the students suggested the following: larger photographs, audio narration to accompany the text, especially if a child's voice could be used, and some kind of animation on the page. As a result of this feedback from college students, the look and feel of the Electronic Text for Health Literacy© changed. Figure 1 shows these design changes.

Figure 1: Comparison of Slide from Pilot Study (left) and from Revised Prototype (right)



Source: <https://dlp.lib.miamioh.edu/new-etexts/03/index.html> within <https://dlp.lib.miamioh.edu>

Eye-Tracking Results

Participants needed to learn how to interact with the content, especially the audio narration. This typically took one to two slides. For that reason, the eye tracking results discussed below focus on slides three to eight. We also do not include data taken from the last slide, because the picture on that slide was identical to the picture on the first slide.

Each page of the E-Text was designed so that participants would visually process the large picture that appears first, orient to the text (sentence) that moves across the page from the left to the right to land on the left margin, then click on the audio icon to activate the audio narrative. This is exactly what was observed. With one exception, participants' visual orientation to the text when it first appeared on each slide occurred in under one second.

We found significant differences in how the two groups, parents and teachers, visually processed slide content. When the text and picture both appeared on the slides, teachers spent 63 percent of their time looking at the text and 13 percent of their time looking at the picture. In comparison, parents spent 57 percent of their time looking at the text and 21 percent of their time looking at the picture.

Based on our instructions, participants were free to look wherever they wanted while they listened to the narration. However, the teachers were more likely than the parents to focus on the text during this time rather than the picture. After the audio icon was clicked for narration, teachers spent 62 percent of their time looking at the text and 15 percent of their time looking at the picture, while parents spent 55 percent of their time looking at the text and 26 percent of their time looking at the picture. Teachers tended to read the text word for word as it was being

narrated without looking at the picture much or at all. They would then immediately click the arrow in the top right corner to move onto the next page. Parents, on the other hand, would spend time looking at the picture during the narration. This is not to say that they never looked at the text during the narration. They did, but they tended to bounce back and forth between the text and the picture during the narration. Once the narration was completed, parents tended to linger on the picture longer than the teachers did before moving onto the next page. Heatmaps of the parents' visual processing and the teachers' visual processing of one slide depict these differences (Figure 2). On the heat maps, red indicates where most visual attention was spent, then orange, then yellow, and then green.

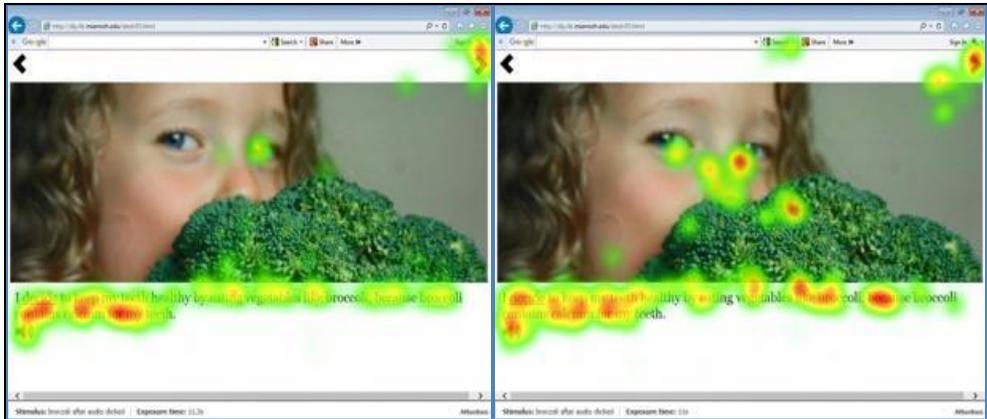


Figure 2: Comparison of Parents' Eye Tracking Processing of Electronic Text Slide (left) with Teachers' Eye Tracking Processing of Electronic Text Slide (right)

Source: <https://dlp.lib.miamioh.edu/new-etexts/03/index.html>

Feedback Themes from Parents

Three important themes emerged from the written feedback that parents wrote in the post-test questionnaire. One, parents discussed how demonstrated behaviors on the slides would affect them and their children in positive ways:

In terms of behavior change, I feel the eBook provided sound justification for adopting healthy oral hygiene behaviors. For example, I prefer water, but I never fully appreciated the role drinking water has in cleaning our teeth. (Parent 1)

My 9-year old daughter would probably understand the “why” of the statements better than my 6-year old daughter (calcium, rinse your teeth with water, etc.). I think both children would easily understand the emphasis on it being a decision they have to make to take care of their teeth. I am not sure the 6-year old would be able to read the text without the audio, so she would probably click on the audio right away. (Parent 2)

Two, regarding the E-Text design, parents discussed benefits of the self-paced interaction:

I feel that the interaction was just right. It was easy to advance the slides and the person reading the text did so at a great pace. The pictures were very inviting, colorful and attractive. I also like that it linked nutrition with oral care and didn't focus on brushing teeth but rather everything else that you put into your mouth. (Parent 3)

Three, parents discussed ways in which E-Text access in dental clinic waiting rooms might include conversations with dental hygienists.

Pediatric Dental Clinic Waiting Rooms: Wonderful idea! If the children interact with the eBook prior to their appointment, it might be helpful if the hygienist could ask some follow up questions during the visit to ensure understanding. (Parent 2)

Feedback Themes from Teachers

Two important themes emerged from the written feedback that teachers wrote in the post-test questionnaire. One, teachers envisioned in a detailed way how the E-Text would facilitate classroom learning:

I like the sequence of the slides. I looked at the picture, made a prediction and read the sentence. Then, I listened to the sentence after. I think having a delay before the listening button pops up may be beneficial. This would give students more time to read the sentence before jumping ahead and listening to it. (Teacher 1)

I could have the eBook set up as an intervention center in my classroom. I can have the link set up to my google classroom so that students can easily get on and access it. After going through the eBook, I would have follow up questions they could answer on the google classroom. I try to have a center that relates to health and sciences. We do an oral health center in my room at the start of the year. (Teacher 2)

Two, teachers reflected on ways students would process the E-Text information, including what is needed to “know and do” regarding the subject of health:

Literacy and linguistic development are directly related. So having the option of reading a text, and then listening to it, allows students to hear the way the text is supposed to be read. This will help students identify mistakes in reading they make. This can also help students learning to decode. Sometimes decodable words are pronounced differently when they are decoded. Giving the students the opportunity to listen to the word, after decoding it, is a great way to reinforce the proper pronunciation. (Teacher 3)

I think that this gives students a more relatable and realistic take on their health. Seeing the images of kids and families may make the students realize that health is something that people need to be aware of, and they need to take the proper steps to maintain it. Having the text read aloud to them gives those students who are struggling readers more of an opportunity to understand the text. (Teacher 1)

Discussion

This study focused on the evaluation of an Oral Health Literacy Curriculum using eye tracking methodology. The health literacy curriculum is written to combine narrative story and expository information about children’s oral health habits and daily hygiene routines. Three design principles (multigenre, multisensory, and multidisciplinary) were used when writing the curriculum and are explained below in the context of our results.

Multigenre refers to the written composition of an E-Text as both narrative and expository. In an E-Text, large colorful photographs sequence across ten slides to depict the desired health behavior shown by a happy and healthy role model who practices cognitive thinking skills, e.g., decision making or goal setting. Photographs are reinforced by a title page and nine declarative sentences describing what skill-based intention the role model has toward performing a health

behavior. The last slide invites the reader to act on the encouraging phrase: How about you? Will you make a decision too?

Throughout the narrative, a repeating verb pattern helps to prime the reader of what action is required. For example, “I decide to...” focuses the reader on establishing a habitual pattern to one’s thinking by intentionally acting on one’s decisions. This lexical verb pattern may encourage the reader to initiate physical actions and gestural body language in real time. Our results show that teachers attended to sentence cues more often and parents focused more on photographs when reading and listening to the E-Text. This finding highlights the importance of preparing preK-12 teachers to know the concept and skills of health literacy. Teacher health literacy has been defined as “the capacity of teachers to obtain, interpret, and understand basic health information and services, with the competence to use such information and services in ways that enhance the learning of health concepts and skills by school students” (Peterson et al. 2001). The fact that E-Texts employ and weave together written language, body language, and oral language to teach health literacy means that the oral health literacy curricula could have multiple benefits as a school health curriculum as well as practical applications in the home environment where health-related habits become routinized with the support of parents.

Multisensory refers to the design principle of using the human senses in an explicit way when learning. In the current study, multisensory content was explicitly sequenced to be reviewed by participants as a visual, auditory, and kinesthetic processing experience. After the title page, participants experienced each page as a visual cue, followed by visual tracking of the eyes to follow and read a moving sentence from left to right. Then participants made a kinesthetic click of the mouse on an icon that triggered an auditory cue to listen to a sentence being read, followed by another kinesthetic cue to click and advance the page. Research on reading through a multisensory approach helps every reader, but especially those with special needs and disabilities (Myers 2017). The design of an E-Text specifically engages and trains participants to a patterned multisensory response to build functional health literacy through information processing.

Multidisciplinary refers to the conceptual focus on literacy and health to form functional health literacy. Health literacy is defined as “the ability to read, write, and talk about health habits in a variety of life situations and environments” (Ubbes 2014a online). Although related, oral health literacy is defined differently, as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate oral health decisions” (American Dental Association 2006 online).

The disciplinary crossover between health education and dental education is challenging because of the differences in how early childhood teachers, health education specialists, dental hygienists, and dentists are prepared as professionals to work with and support children in a variety of classroom, community, and clinical settings. Not only is the literature diverse and scattered across hundreds of disciplinary journals, such research covers multiple topics including curriculum, pedagogy, technology, assessment, and the diverse needs of students, parents, teachers, and health care providers. Our multidisciplinary research adds an integrative dimension to the literature because we designed an innovative oral health curriculum to be used by children across different settings supported by multiple adults.

Implications

Nearly one in three Americans is functionally illiterate (Foulk et al. 2001) with an inability to use reading, listening, speaking, writing, and critical thinking to participate in society (Kefalides 1999). Literacy skills impact an individual’s health more than age, income, employment status, education level, and racial or ethnic group (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs 1999).

Our E-Text design specifically uses visual material as an aid to literacy (U.S.CDC n.d.) and includes a prompting sentence with a verb that highlights a critical thinking skill, e.g., decision

making, from slide to slide. This sentence prompt cues users “to turn their thinking into action” so they know how to perform the health behavior by thinking about a variety of belief statements (e.g., efficacy, outcome, and normative) for why, when, and with whom they can do the action. If the users are not able to read (see), listen (hear), track their eyes effectively to read from left to right or navigate the computer mouse (tactile or kinesthetic movements), then the users will not be able to process the information that is necessary for functional literacy to occur. Functional literacy is an important bridge to functional health literacy, which is one’s ability to read, write, and speak about health. Functional health literacy is conceptualized as the first of three types of health literacy, followed by interactive and critical health literacy (Nutbeam 2000). Our digital project addresses both functional health literacy and interactive health literacy, the latter requiring ongoing research in usability of our digital interface with parents, educators, and health professionals who will care for their own oral health in tandem with children.

Limitations and Future Research

In our eye tracking research, we only interviewed three parents and three public school teachers. Future research will need a much larger sample size to investigate the effect of eye tracking on the improvement of functional health literacy and oral health behaviors. Future evaluation studies will incorporate feedback from dental professionals. We also will expand user feedback with children of different ages and different literacy backgrounds to determine developmental changes in oral health content knowledge gained by users who read and listen to the digital curriculum. Children’s beliefs about oral health, including their intentions to do oral health behaviors, could also be studied in the context of oral health data, e.g., children with decayed, missing, and/or filled teeth versus children without these oral health conditions.

Conclusion

Pre-testing of digital health literacy materials is a key step in process evaluation in health education. Our E-Text prototype is an innovative digital approach to health curricula because users practice functional literacy skills of reading, listening, and thinking as developmental steps toward practicing functional health literacy skills in a variety of life situations and environments (Ubbes 2014a). Traditional definitions of health literacy, defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (USDHHS 2000), makes assumptions by not naming the functional reading, writing, listening, thinking, and speaking skills that are foundational to the practice of functional health literacy. Therefore, our digital oral health literacy curriculum bridges the practice gap between functional literacy skills and functional health literacy skills by using E-Texts as compositions of written language, oral language, and body language to educate for health.

Our research is also an example of interactive health literacy, because it explores usability and functionality of a digital curriculum while inviting feedback from future health professionals (college students), parents, and teachers relative to their technology interface and health literacy competencies. Teachers and parents provided mostly positive feedback and offered suggestions for implementing the curriculum in school classrooms, school-based health clinics, dental clinic waiting rooms, and home environments.

Acknowledgement

This project was funded by an \$4025.00 interdisciplinary grant from the College of Education, Health, and Society at Miami University, Oxford, OH. The Center for Digital Scholarship of Miami University Libraries and the Center for Research in User Experience (CRUX) in the Armstrong Institute for Media Studies were key partners in the project. Photographs are from open source Google Images with the first photo approved for sharing at the end of the document @ <https://dlp.lib.miamioh.edu/healthliteracy/items/show/288>.

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ABOUT THE AUTHORS

Valerie A. Ubbes: Associate Professor, Department of Kinesiology and Health, Miami University, Oxford, OH, USA

James R. Coyle: Associate Professor, Interactive Media Studies Program and Department of Marketing, Miami University, Oxford, OH, USA

Elias Tzoc: Principal Librarian, Miami University, Oxford, OH, USA

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