STATEMENT OF NEED AND SIGNIFICANCE OF THE PROJECT

(i) Need for Project. By ***January 4, 2016, the official implementation date*** of the Unified English Braille (UEB) code, an estimated 286,000 working-age braille users, and the thousands of professionals who provide service and training to people who are blind and visually impaired, will need to learn UEB. An exhaustive review of current research and literature shows no explicit count of adult braille users in this country. However, the American Printing House for the Blind's Annual Report indicated that they served 5,117 braille readers in (APH Annual Report, 2013). This represents 8.5% of the total population of students identified as having visual impairments. According to data from the 2011 American Community Survey, 3,372,400 working age adults have a visual impairment (Erickson & von Schrader, 2011). Applying 8.5% that the APH found in the school age population to the American Community survey indicates that there are approximately 286,000 adults of working age who are potential braille readers in the United States. These 286,000 individuals will all need to learn UEB to stay competitive in the job market. The people who support braille learners, including service providers, braille instructors, and family members need to learn UEB. An estimated 6,100 professionals are teachers of students with visual impairments (TSBVIs) (Kirchner & Diamont, 1999) and 2,500 are vision rehabilitation specialists VRTs (BJ LeJeune, personal communication, May 20, 2014).

Despite much dedicated and excellent work in developing UEB transcriber manuals, webcasts, and a university level textbook, professionals developing braille instructional tools have not yet fully explored the importance of multi-modal approaches in teaching braille code. Neither has anyone harnessed the power and ubiquity of new mobile devices, interactive eLearning, educational gaming, and social networking for learning braille, nor has anyone developed a platform suitable for a wide range of adult learners.

Although research shows that acquisition of braille literacy skills has a positive impact on postsecondary outcomes (Wolffe & Kelly, 2011) and increases job opportunities (Ryles, 1996; Golub, 2006; Bengis, Izbirak, & Mackieh, 2008; Wolffe & Kelly, 2011) consumers who are blind and visually impaired often lack such skills (Crudden, Sansing, & Butler, 2005). A major contributing factor is that there are limited opportunities to receive high-quality vocational rehabilitation training in braille (Crudden, Sansing, & Butler, 2005). To further complicate the lack of opportunities to learn braille, professionals responsible for teaching braille often report feeling that they are not adequately trained to do so (DeMario, Lang, & Lian, 1998; Rosenblum & Amato, 2004).

By collaborating with consumers who are blind, a national panel of UEB and research experts, and users of braille learning technologies, ***Project UEB PREP will develop a web-based and mobile eLearning platform to train adult braille users, current and pre-service TSBVIs and VRTs, paraprofessionals, and parents of children with visual impairments in UEB—***with 500 active monthly users (AMUs) by the end of Year 1 and 10,000 by the end of Year 5, approximately 2,000 of whom will receive a certificate of completion. Refer to the **Logic Model in Appendix A** for an overview of Project UEB PREP.

Background on the Adoption of Unified English Braille Code

For tactile learners, braille access to text helps level the playing field and offers equal access to print information in school, college, and at work. In addition to the literary code for transcribing text, many other specialized braille codes exist—Nemeth code (mathematical braille), music braille, foreign language braille, and computer braille. While these codes increase access to information across various fields, the multiple code system has led to "complexity and disarray of the braille system" with "numerous conflicts among them in regards to symbols and

rules" (Cranmer & Nemeth, 1991). Furthermore, the literary braille code is not uniform among all English-speaking countries. Currently, the United States uses the Standard American English Braille (SAEB) for literary materials, which incorporates braille contractions with more than 400 braille rules. SAEB is now used for all literary braille materials published in the United States. Likewise, the Nemeth code is used exclusively for mathematic and scientific notation in braille.

From time to time, the braille code has been updated to reflect changes in English language conventions and trends in use of technology to access print with the goal of keeping braille "vital and contemporary" (Risjord, 2014). The Braille Authority of North America (BANA), an organization of and for those who are visually impaired oversees revisions to the rules and guidelines that govern the braille code in North America. Starting in the early 1990s, BANA embarked on an international project to revise the current code "to reduce the complexity and increase the accuracy of braille transcription" (Risjord, 2014), and to generate a common code for all English-speaking countries. As a result, they developed and field-tested the Unified English Braille (UEB) code, which includes both literary and mathematic components. All English-speaking countries have already accepted UEB. The United States is the last country to adopt UEB. In order to prepare for the January 4, 2016 implementation date, ***every braille user and all professionals who work with those who are visually impaired will need to learn UEB***. In a statement describing the major considerations for UEB implementation, BANA indicated that the development of ***new training materials*** was one of the most pressing issues for rehabilitation agencies and institutes of higher educational (BANA, n.d.). Learning UEB will require many types of training efforts. Numerous states are hosting professional workshops to address this need but not all service providers are able to attend. Another problem that arises is how to assess UEB competency for already trained professionals.

The population that will be served by UEB-PREP Project:

Project UEB PREP is designed to address the training needs of adults, specifically 1) ***adult braille users,*** particularly those who are beginning to learn UEB or developing their braille skills. Adults include transition age youth who are adventitiously visually impaired and working age adults; 2) ***parents of youth who are tactile learners;*** and 3) ***professionals*** who work with those who are visually impaired. Primarily, the professionals will be teachers of students with visual impairments (TSBVIs), paraprofessionals, vision rehabilitation specialists (VRTs), and braille instructors. The proposed eLearning platform incorporates evidence-based elements for adult learners, who for this project are familiar with the process of reading and writing in print. We will not include young children with visual impairment in this project because they could not learn braille using the proposed eLearning platform, as instructional methods are different for this group, having to focus on age and developmentally appropriate literacy skills, such as phonemic awareness, concept development, and vocabulary.

Needs Section:

There is a need, as Zuckerman (2004) explains, to provide adults who are blind with braille instruction. "Regardless of age, sex, education, and income, few blind adults receive the kinds of services that could presumably help them succeed in the work force and remain independent and productive (p. 8)." Historically, and at present, unemployment rates of people who are visually impaired are the high. Sixty-two percent of people who are visually impaired are unemployed (Cornell University, 2012), as compared to 6.3% of unemployed people who report no disability (United States Department of Labor, 2014).

Braille Literacy for Adults. Statistics show that 40% of adults who are blind do not have a high school diploma (Zuckerman, 2004). With high-stakes testing such as the high school exit

exams, students who are visually impaired must be equipped with skills to pass these exams. In a study exploring the perspective of 30 college students who were visually impaired, participants reported that literacy was one of the most important skills to have before entering college (Trief & Feeney, 2003). Ultimately, to be successful in a college or academic world, people who read braille need to know at a minimum contracted literary braille and Nemeth code. Therefore, imparting braille literacy and Nemeth code skills to students is imperative (Nagle, 2001).

A growing subset of braille users is wounded war veterans, many of whom have traumatic brain injury (TBI). Although most of these individuals maintain good visual acuity, a large percentage of them report problems with binocularity and reading, suggesting that braille should be considered a literacy option (Maa, Evans, Delaune, & Lynch, 2013). Some individuals experience significant TBI resulting in complete blindness. One case study describes the intensive rehabilitation process, which included braille instruction, of Staff Sergeant Jason Pepper, who survived the full force of an Improvised Explosive Device that exploded in a tree next to his armored personnel carrier in Karbala, Iraq (Okie, 2005). Adjustment to vision loss for young working-age adults and veterans has been cited as particularly challenging and many deal with depression, which can stall training progress and the desire to learn new skills (Zaborowski, 1997). In fact, research suggests that unemployment for veterans with visual impairment is 81%, which is particularly high (Bell, 2010).

Braille Instruction for Parents and Family Members. Parents act as the first teachers to their children and are uniquely motivated to foster development. A family-centered approach to literacy promotes emergent literacy, which is "defined as the developmental process beginning at birth in which children acquire the foundation for reading and writing" (Erikson, Hatton, Roy,

Fox, & Renne, 2007, p. 80). Research suggests that early shared-book reading experiences, written interactions, and conversations at home promote emergent literacy skills (Reese, Elaine, Sparks, & Leyva, 2010). In a study examining attitudes toward braille among young braille readers, parents were identified as being *more* likely to read to children with visual impairments than teachers (Sacks, Hannan, & Erin, 2011). Unfortunately, parents have expressed their "frustration and concern over their own knowledge of braille" (Avila, 2012, p. 21). Only a small percentage of parents of children who read braille master contracted braille. Although some free courses are available, such as the braille courses at the Hadley School for the Blind, none currently include UEB.

Need for Training for Professionals in UEB. Teachers of students with visual impairments (TSBVIs) have the unique role of providing instruction in disability-specific areas beyond the core academic curriculum to students with visual impairments. A key responsibility of the TSBVI is to teach braille literacy skills to tactile learners with visual impairment. This role is underscored in the *National Agenda for the Education of Children and Youths with Visual Impairments, Including Those with Multiple Disabilities* (Huebner, Merk-Adam, Stryker, & Wolffe, 2004) and the Individuals with Disabilities Education Improvement Act (IDEIA) [§300.324(2)(iii)]. For adults with visual impairment, the responsibility of teaching braille codes is placed upon vision rehabilitation therapists (VRTs) or braille instructors. Under the Rehabilitation Act of 1973, braille training is one of the many services available to adults with visual impairment.

Although accepted competency standards for literary (Lewis, D'Andrea & Rosenblum, 2012) and mathematics braille (Smith, & Rosenblum, 2013) exist for braille instruction in higher education, the level of braille knowledge varies tremendously among any one group of these

professionals. A major contributing factor is the variation in professional certification requirements across states. For example, most states offer alternate routes to teacher licensure. In some states individuals seeking TBVI certification *only* need to pass a state licensure test without taking a single class designed to address the compensatory skills of children with visual impairment. Furthermore, research suggests that instructors of braille courses at universities feel as though they do no have adequate time to promote mastery of the braille codes. Consequently, many graduating TSBVIs do not feel adequately prepared to teach braille (Kapperman & Sticken, 2003). Personnel preparation programs that train TSBVIs and VRTs must incorporate coursework that emphasizes learning the braille codes, and they must educate service providers about the unique learning needs of individuals who are blind or visually impaired, including the specialized set of skills required to access higher education curriculum.

Need for Innovative Flexible Braille Instructional Tools and Resources. In a presentation at the Braille Summit hosted by the National Library Services in January 2013, certified vision rehabilitation specialist, Lenore Dillon, described motivation as major barrier to teaching braille to adults with visual impairment. She also highlighted the need for engaging teaching methodologies and instruction, which focus on the intrinsic value of braille. Although several braille textbooks are available for personnel preparation programs, most are designed for braille transcribers, not TSBVIs or VRTs. Additionally, they primarily rely on *traditional* methods of learning such as skill and drill exercises, which may not be suited for all learners. Finally, graduate students in university training programs generally must wait several days for instructor feedback on braille homework assignments.

With the rapidly growing number of adults tapping into desktop and mobile learning, the body of scholarly work related to the needs of adult learners has increased. Adult learners have

diverse and unique learning styles. Thus, web-based learning environments must be suited to meet their needs (Cercone, 2008). While some valuable, accessible online braille resources are available, such as the Braille Through Remote Learning website (http://www.brl.org/), UEB training tools need to align with current and innovative e-tools and resources of the 21st century. We understand the need for rich, relevant, and evidence-based content in order to gain understanding and expertise of UEB subject matter. The Internet offers a variety of communication (e.g. social networking) and interactive (e.g. virtual practice, games) learning experiences, which can allow students to receive direct feedback and engage in authentic learning experiences (Garrison, 2011).

Need for Accessible UEB Training Tools. Distance education and use of the web-based platforms are ubiquitous in higher education and many educational agencies and organizations use Learning Content Management Systems (LCMS) and a variety of other online tools for teaching. Although there has been tremendous progress in developing guidelines for universal design, in particular the World Wide Web Consortium (W3C) Standards, many web-based products are not accessible to those who use screen readers or refreshable braille display (Dorigo, Harriehausen-Mühlbauer, Stengel, & Dowland, 2011). A web-based, multimedia approach *can* apply critical features of universal design and accommodate the needs and preferences of a range of learning styles. Project UEB PREP is dedicated to putting accessibility considerations at the forefront of project design and will adhere to ADA and 508 compliance standards, as well as accessible game design guidelines (http://gameaccessibilityguidelines.com).

Online access also appeals to the need for on-the-go availability of UEB training resources. Adults often have significant family and job responsibilities. Parents of children with visual impairments, in particular, have few opportunities to develop contracted braille skills.

Most often may attend a workshop aimed and learning Grade 1 braille and promoting braille literacy at home. The UEB PREP eLearning platform would allow trainees to learn UEB content and practice UEB skills while waiting sitting in the reception area at the doctor's office.

Need for Sustainable Training Tools. Considering that several online braille learning tools are outdated (e.g. Wes Braille, Braille Through Remote Learning), there is a need to develop an eLearning platform that is sustainable. One significant feature of Project UEB-Prep is the ability for contributors ***with expertise in UEB*** (e.g. UEB braille users, faculty from universities, UEB certified transcribers) to contribute content to the eLearning platform. This form of crowdsourcing or "smart" sourcing helps establish a community of professionals with a vested interest in supporting and maintaining UEB instruction. Several vision impairment specific projects have successfully implemented a contributor model, such as the Paths to Literacy website (http://www.pathstoliteracy.org/) and the ClickAndGo Wayfinding maps (http://www.clickandgomaps.com).

(ii) Importance or Magnitude of the Results or Outcomes. Each of the project objectives results in an important result or outcome that will support greater UEB skill acquisition and usage.

Objective 1: Result—*A consumer need-driven and accessible, user-friendly design of UEB PREP platform.* Not only are individuals who are blind and visually impaired entitled to full access of web-based resources, research suggests that consumers perceive products to be more valuable when then include user feedback into its design. Likewise, a meta-analysis of consumer satisfaction cites equity or fairness as a major determinant of customer satisfaction (Szymanski & Henard, 2001). Several studies support the finding that accessibility has a positive and significant influence on consumer satisfaction (Hackett and Parmanto, 2009, Ahmad and Al-

Zu'Bi, 2011). Through the collaborative efforts involving focus groups, field testing and guidance of the expert panel and advisory board, the result will be a product designed by numerous professionals and relevant to meet the varying needs of agencies or organizations serving those with visual impairments.

Objective 2: Result—*Increased motivation to learn UEB and increased knowledge of UEB.* Educational gaming has become a popular scholarly topic over the past decade. Serious Educational Games (SEGs) (Annetta, 2008) have the potential to play a critical role in learning at *all* ages. Military games – through funding from the Department of Defense—became mainstream learning tools through free products such as America's Army™. While studying the learning that takes place during America's Army™, Belanich (2004) found that participants recalled "procedures" better than facts. Research suggests that gaming can improve content understanding and presentation skills (Watts & Lloyd, 2000); practical reasoning skills (Wood & Stewart, 1987); and collaborative skills (Spikol & Milrad, 2008; Squire & Jan, 2007). Well-designed gaming has the properties of the most effective instructional situations: *experiential, inquiry-based, and providing continuous user feedback, while promoting self-efficacy, goal-setting, and team learning* (Halverson, 2005). Numerous researchers have observed that educational gaming improves student attitudes toward, motivation for, and engagement in learning content (Annetta, Cook, & Schultz. 2007; Annetta, Minogue, Holmes & Cheng, 2009).

Objective 3: Result—*Evidence-based practices related to online UEB training and vocational outcomes.* With the introduction of UEB, there is a rare opportunity to engage in a variety of research initiatives. In fact, BANA has established a research committee to develop a UEB research agenda. Research studies related to the proposed UEB eLearning platform include accessibility and usability of the e-training product, the use of technology as a means to learn

UEB, and the impact of the eLearning platform on UEB skills. Lastly, an important research question is whether or not UEB training leads to perceived vocational competence among those working age adults with visual impairments. With the aim of increasing UEB skills among those with visual impairments, the findings from these studies will lead to a better understanding of effective online UEB instructional practices for diverse learners and understanding of factors that lead to UEB acquisition.

Summary. Researchers have documented a need for better instructional materials and resources to teach braille codes to adventitiously blind adults, parents of children who are visually impaired and current and pre-service professionals who work with individuals who are blind or visually impaired. The introduction of UEB presents a unique opportunity to generate innovative instructional e-tools and resources, which would support BANA UEB implementation goals and training for family members and within university training programs and vocational rehabilitation agencies.

QUALITY OF THE PROJECT DESIGN

(i) Project Design. The purpose of Project UEB PREP is to design, develop, and evaluate an evidence-based, eLearning Unified English Braille (UEB) educational crowdsourcing platform for braille users, parents of children who are visually impaired, and professionals, both currently trained and pre-service, who work with individuals who are braille users. Our project has the following primary objectives:

Objective 1: Explore and evaluate the braille learning needs of the community through a high quality survey and focus groups.

Objective 2: Develop an evidenced-based braille learning platform that incorporates: a) eLearning experiences designed to be interactive, b) educational gaming designed to be engaging, and c) social networking designed to be connective and motivating.

Objective 3: Evaluate the UEB PREP learning platform and its impact on learner performance and outcomes, and on the community of braille learners.

Objective 1: Project UEB PREP will incorporate input from stakeholders during each step of development. In the first year a ***needs assessment*** will take place. This first step in the development process is critical to preparing UEB training materials that serve the needs of consumers and families, as well as agencies and organizations that serve individuals who are blind and visually impaired. Dr. Lawson will have major responsibility for this objective.

Activity 1.1. *Develop the focus group questions and recruit focus group participants.* In year one, two focus groups will be convened: 1) consumers who braille users and 2) parents of individuals who are tactile learners users. Eight to ten participants from each group and from a variety of backgrounds and experiences using braille will be targeted to provide a broad view of a web-based braille instructional platform. A *questioning route* will incorporate broad questions related to interest and motivation to learn UEB, accessibility features, as well as desired interactive features (Litosseliti, 2003). Participants will each be offered a $50 gift card and money for travel to focus group site, if necessary.

Activity 1.2. *Conduct focus groups, and analyze data*—During the interview sessions, which are intended to last for about an hour, the moderator will follow the questioning route but also allow for pauses and probes to solicit more information and clarify ideas. The goal is to encourage open discussion and help participants feel comfortable responding to the main topics. If necessary, the moderator will debrief with participants individually after the sessions. Data

collection will involve recording of the focus group sessions. At least one observer will participate to share insights into the themes that developed during the focus groups sessions. The graduate student will transcribe the recordings. Major themes that relate to the project goal will be conducted by initial review of the transcripts and using NVivo, a software tool for analyzing qualitative data (Litosseliti, 2003).

Activity 1.3. *Develop needs surveys for professionals, advertise survey, and recruit participants*—During the initial stages of development two groups will be surveyed: 1) TSBVIs and 2) adult service providers. Dr. Sennott will develop the survey questions, load the survey onto a website (e.g., Qualtrics), advertise the survey, recruit participants, and acquire consent as required by the IRB process. To encourage participation, two $100 gift cards will be randomly drawn and offered to two respondents. The interview schedule will include Likert scale, forced-choice, and open-ended questions (Sapsford, 2007) aimed at addressing the UEB needs and concerns of professionals, both current and pre-service.

Activity 1.4. *Collect survey data and analyze the results*—Descriptive statistics of participants (e.g. age, number of TSBVIs and VRTs, etc.) and pre-coded questions will be presented. The open-ended questions will be coded using a "representational approach" to explain the core themes or perspectives of participants (Sapsford, 2007). Data from the needs assessment surveys and focus groups will yield findings that will be used to guide the development of the project, including appropriate accessibility specification requirements for the UEB desktop and mobile accessible eLearning platform.

Objective 2: UEB PREP will be designed to be a student-adaptive platform and contain several features for learner use, including interactive recorded lessons using Adobe Captivate, games, and social networking capability. Adobe Captivate is a software tool that allows

individuals to prepare rich, interactive presentations. It includes accessibility features, such as closed captioning. Adobe Captivate presentations will include notes in both .pdf and braille ready, .brf, file formats. Content can easily be viewed on desktop and mobile devices and scoring, tracking and reporting of learner interaction with presentations are built into the Sharable Content Object Reference Model (SCORM) feature. All content will be hosted on both web-based and mobile platforms and include learning objectives and an overview of UEB rules. UEB PREP has two phases of design over the five-year period.

Within Phase 1 (Year 1), we will create two *levels*, 1) UEB content for adults who are already familiar with the Standard American English (SAEB) braille system and 2) uncontracted braille (Grade 1). Since most individuals who need to learn UEB are already familiar with SAEB, the goal of Phase 1 is to train individuals in the UEB changes through rich, multi-media content by November 2015 in anticipation of the January 2016 official UEB adoption. Beta testing of the Phase 1 content will occur three months prior to platform deployment. The primary reason for developing the Grade 1 module is to develop a foundation for additional UEB modules. We hope that it will also generate interest in braille among the general public prior to UEB implementation. In addition to the two levels, Phase 1 will include the creation of one game, a word game such as Scrabble or Word+ with braille interface. By the end of Phase 1, we will have a deployable two-level and one-game user interface. The second Phase includes user interface refinement based on Phase 1 field test findings, creation of additional 12 UEB modules and 4 games. Careful and ongoing review the Phase 1 design will determine the next steps in testing and development for Phase 2. Finally, we will develop coding of the full user interface and back end database. **Table 1** provides an overview of the key elements of UEB PREP.

Table 1: Overview of UEB PREP Elements, Description, and Benefits

PREP Element	Description	Benefits for PREP Users
eLearning (interact)	Interactive exercises on the computer that use principles of adaptive learning and intelligent tutoring	• Increased feedback during skill development • Built in assessment • Adaptive learning • Engaging content
Educational gaming (engage)	Fun and engaging activities that allow you to practice learner skills	• Increased time on task • Low pressure and enjoyable practice opportunities
Social networking (connect and motivate)	Social media posts to interact with other people using newly acquired skills	• Increased time on task • Meaningful practice opportunities • Social encouragement

Activity 2.1. *Develop UEB Curriculum.* Drawing from available UEB training materials and expertise from our consultant, Dr. Frances Mary D'Andrea, we will design an overall curricular structure for the UEB PREP platform. **Table 2** outlines the proposed content to be covered. Each module or level will contain several short lessons. The purpose of the lessons is to teach new braille code rules and contractions.

Table 2: Phase 2 UEB Modules (adapted from Howse, Riessen, & Holloway, 2013)

Module 3 Alphabet Word signs

Module 4 Punctuation Signs

Module 5 Strong word signs

Module 6 Whole-Word Signs

Module 7 Short-Form Words

Module 8 Part-Word Signs

Module 9 Numbers and Print Symbols

Module 10 Initial-Letter Contractions

Module 11 Lower Group Signs

Module 12 Lower Whole-Word Signs

Module 13 Final-Letter Contractions

Module 14 Braille Mode Indicators

Activity 2.2 *Recruit and Identify UEB Contributors.* An innovative aspect of Project UEB PREP is that it will incorporate content contributed by individuals who are proficient in UEB. Typically, crowdsourcing involves an unknown, diverse group of contributors. For this project, project staff will solicit contributions from UEB experts, including members of BANA, consumer organizations, and universities. Given the demand for UEB training and the fact that the final product will be free and accessible, we believe that professionals, in particular, university instructors, will be willing to contribute to the project. Through our expert consultant panel and advisory board, we will selectively invite contributors. All contributors will be required to pass a carefully designed and validated UEB pretest. Once a contributor has been deemed proficient in UEB, he or she will develop PowerPoint presentations that can be transferred into an Adobe Captivate file or practice sentences which focus on particular contractions. Dr. Lawson and the graduate assistant will check contributed content for accuracy.

Activity 2.3. *Develop Interactive eLearning Components.* Several features of UEB PREP will allow students to interact with content with the goal of making the UEB learning process *fun.* Within the Adobe Captivate recorded presentations, students will be prompted to respond to entertaining questions in a variety of formats. Each presentation will have associated reading and writing exercises that will be accessible through both a refreshable braille display and six-key entry using a QWERTY keyboard. We know this is possible since similar projects have successfully employed these features (e.g. Braille Tutor National Science Foundation funded project). The exercises, which incorporate "gamification" elements, will be tailored to user competence. To achieve this, we will draw upon research and development of Duolingo, a web-based and mobile eLearning platform designed to teach foreign language.

Duolingo uses a "student logic model" based on vocabulary that the learner has mastered. Using statistical analysis and program coding, an individualized "skill tree" is set. As the learner masters new vocabulary and grammar, the skill tree adjusts and each time the learner logs into the system, the student can resume where he or she last left the program (Hacker, 2014). This instructional design is especially feasible because unlike foreign language, which includes words and phrases with multiple meanings, UEB is code with one correct transcription answer for each probe. Students will receive immediate feedback on their performance in tactile and visual (simbraille) format. As students progress through different levels and exercises, they are rewarded with points (Hacker, 2014). The technical team, comprised of PSU graduate students in the computer science department mentored by Dr. Teuscher, will be responsible leading the software development of the web-based and mobile UEB platform.

Activity 2.4. *Develop UEB Games.* In addition to the gamified practice exercises and short and intense Adobe Captivate recordings, we will develop a total of five games over the 5-

year period designed to promote UEB skills. The time and coding required to develop online games has been significantly reduced with the availability of software specifically designed to streamline this process. Given the fact that games are the most reviewed type of iOS application by the AppleVis,, a group of iOS users who are visually impaired, we believe that UEB games will draw many users. Proposed games include UEB-like versions of Word+ or Seven Little Words, which are already accessible using VoiceOver. During the focus group sessions, we will request input from targeted end users to solicit their ideas for UEB games. Games will be designed following best practices for both learning (Gee, 2007) and accessibility (http://gameaccessibilityguidelines.com).

Activity 2.5. *Incorporate Social Media and Other Features.* The Project UEB PREP eLearning platform will allow UEB learners to connect with one another through social media. With the availability of application programming interfaces (APIs) for popular social media programs like Twitter and Facebook, adding this feature will be relatively simple. Social media features will allow learners to co-actively construct knowledge (Dabbagh & Kitsantas, 2012). For example, an end user may post a question related to specific UEB rules associated with a practice exercise and peers can respond with feedback through the social media interface. In addition, the social media feature offers learners opportunities to provide descriptions of how UEB is used in everyday, real world situations. For example, a parent may share that she helped her daughter bake a cake using a UEB recipe. Lastly, through social media, users can establish groups; members of the shared group may be students in the same braille course at a university.

Activity 2.6 *Create back-end database.* A major advantage to a web-based and mobile UEB learning platform is that we can integrate a robust, back-end database to assess UEB learning and *refine* the curriculum (Hacker, 2014). Building upon the learner tree model, we will

establish hypotheses or "tree experiments" to identify exercises that are more challenging than others. Tricky exercises may then be broken down into shorter ones. Through the database, we can also analyze the number of viewings of recorded sessions, exercise attempts, games most often played, and learner scores. Finally, the database will be used to determine the number of monthly active users and certificate completers.

Activity 2.7. *Conduct Beta Testing, Usability Studies and Field Testing Research.* We will field test the product extensively with input from the original focus group members, an expert panel of consultants, and advisory board and consumers across the United States. Field-testing will validate the effectiveness of the UEB web-based and mobile eLearning platform. Data will be collected on the extent to which participants learned UEB using the training materials and are able to access the content and online features. Additional data will be collected on participants' perceptions of their UEB skills upon completion of the UEB training program (See Evaluation Plan). In integral feature of the UEB PREP platform is a link for feedback submissions. The database will store user feedback and the graduate assistant will review feedback comments and communicate issues that need to be addressed/debugged with the technical team. Each technical problem will be assigned a number, coded by type of problem, and will include software notes (e.g. Mac or Windows Vista issue). Data from the field-testing will be analyzed, and revisions will be made to the UEB PREP training content, incorporating feedback into the final version of the braille-training platform.

Objective 3: Refer to *Quality of Program Evaluation* section starting on page 30.

(ii) Research and Effective Practice.

Evidence-based practices related to adults and eLearning. Drawing upon Cercone's (2008) framework of 13 characteristics of adult learners, Project UEB PREP incorporates

eLearning considerations that address the unique and multifaceted needs of its targeted audiences. Studies have shown that adults experience memory limitations. Therefore, presenting short UEB Adobe Captivate recordings allows for greater information retention and minimizes cognitive load. Adult learners need to be actively involved in their learning process. Our eLearning platform incorporates interactive tools with embedded UEB practice and instant feedback. Scaffolding, or specialized instructional support, has been identified in the literature as a method that promotes more self-directed learning among adult learners. Several strategies for infusing scaffolding are included in UEB PREP, including learner support tutorials and online tools for articulating questions or problems (e.g. contact us feature). Instructional content needs to be relevant to the lives of adult learners and the link between what they are learning and practical usage of knowledge needs to be clear. Playful exercises that encourage problem solving in groups and opportunities to share how learning can be applied in everyday situations are approaches to making eLearning a meaningful experience (Cercone, 2008). We present just a few attributes of adult learners we believe to be important. Through ongoing consumer feedback and review of the literature, we will continue to refine our pedagogical framework.

Serious Educational Gaming. The benefits of games include *experiential, inquiry-based learning* (Bransford, 1999) *and* positive student attitudes toward, motivation for, and engagement in learning content (Annetta et al., 2007; Annetta et al., 2009; Clark & Sheridan, 2010; Dunleavy, Dede, & Mitchell, 2009; Malouf, 1988; Squire & Jan, 2007; Watts & Lloyd, 2000; Wilson & Whitelock, 1997; Yu, 2001). Numerous studies provide best practices in designing educational games. Gredler (1996) recommends keeping a game easy to understand and stimulating without distorting the learning process. In additional learners should receive positive reinforcement for effort. Gee (2007) suggests allowing players to actively engage and

adjust the game to his or her learning level while providing levels of depth. Additionally, content should be challenging but achievable and include consistent and immediate feedback. Ongoing review of relevant research will help UEB PREP project staff develop games that incorporate evidence-based practices.

(iii) Procedures for Documenting Proposed Activities and Results. The project milestones and timeline for the project are depicted graphically in **Table 3** milestones for the project will be discussed at bi-annual videoconference UEB PREP meetings, reported at the annual advisory meeting, and included in the annual reports.

Table 3: Project Activities and Objectives by Key Personnel with Timeframe

Activity	Objectives			Persons Responsible	Time
	1	2	3		
Surveys of braille users, professionals, and family members	X			Sennott	Year 1
Coordination of focus groups	X			Lawson	Year 1
Coordination of Expert Consultants and Advisory Board	X	X	X	Lawson	Years 1-5
Coordination of Phase 1 Development		X		Teuscher & Sennott	Year 1 & 2
Coordination of Phase 2		X		Teuscher &	Year 3 & 4

Development				Sennott	
Coordination of Field Testing		X		Lawson & Sennott	Years, 2, 3 & 4
Dissemination Activities		X		Lawson & Sennott	Year 1-5
Coordination of Project Evaluation			X	Lawson	Year 3-5

(iv) Performance Feedback and Continuous Improvement. Project UEB PREP includes a variety of performance feedback methods integral to the project design. Ongoing formative data collection procedures are essential to understanding internal and external factors that are effective and those than need to be revised. As noted earlier, field-testing and input from UEB PREP users via the support feature will provide critical and ongoing information. Furthermore, our back-end database will offer rich data, which will allow us to adjust our curriculum and will support continuous product improvement. Through scheduled meetings and a shared Wiki, UEB PREP staff will communicate regular to review progress toward project objectives.

Regular Meetings.

Key personnel (Lawson, Sennott, and Teuscher) will meet monthly to discuss progress toward project milestones and deadlines. They will also discuss input and feedback from the expert panel and advisory board. ***Expert Panel of Consultant*** and ***Advisory Board*** meetings will be held bi-annually for each year of the project. The purpose of the expert panel meetings is to share ideas, expertise, and resources related to achievement of project objectives. In addition, each consultant will identify specific tasks that she will perform and deadlines for completion of these

will be delineated. The purpose of the advisory board meetings is to collaborate with and get program feedback from stakeholders, including usability input and review of project performance measure data. The advisory board includes braille users, family members, TSBVIs, VRTs, and pre-service personnel.

UEB PREP Wiki. Key personnel, expert panel, advisory board members, and technical team will have access to a shared Wiki page designed to serve as a collaborative tool and document repository. Meeting agendas and minutes will be drafted and stored on the Wiki. In addition, team members will use the Wiki to post project updates and feedback using the comments feature is encouraged. Project milestones, activities and deadlines will be tracked and accessible to the UEB PREP team.

(v) UEB PREP Dissemination. A variety of methods will be used to promote UEB PREP training and promote its use among targeted users. These include:

Web-Based Promotion of UEB PREP – PSU will host and maintain the UEB PREP website, which will be free and accessible over the 5 Year grant cycle. The platform will include ***online tutorials*** demonstrating how to use the eLearning platform. Examples of tutorials include how to use the QWERTY keyboard for six-key braille entry and how to use a refreshable braille display to input braille. Since ***social networking*** is an integral component of UEB PREP, we will create UEB PREP Facebook and Twitter accounts to share project updates and attract users. We will "Like" numerous consumer, professional and parent organizations, as well and allow users who access UEB PREP the option to follow our Facebook and Twitter feeds. ***Electronic promotional brochures*** will communicate information on UEB PREP to disability organizations (e.g., American Foundation for the Blind, the ADA National Network), school agencies, and rehabilitation providers. The brochures will provide an overview of the project and include a link

to the project's webpage for individuals seeking more information. Print and braille versions will be disseminated as appropriate (e.g., at conference presentations).

Webcast Series. A key means of disseminating this information will be a series of quarterly webcasts, starting in Year 2. The hour-long webcasts will alternate between targeting braille user, family member and professional audiences. We will use Adobe Connect, an accessible online conferencing platform. This program will allow us to include captions and transcripts of the webcasts and later to archive them on the project website. We will work with our participating professional organizations, such as the Association for the Education and Rehabilitation for the Blind and Visually Impaired (AERBVI), to provide continuing education credits when appropriate.

Workshops and Conference Presentations – In Years one through five, one conference presentation will be made annually rotating between different conferences to target a variety of stakeholders. Professionals will be reached through presentations at international AERBVI and Council for Exceptional Children conferences. Presentations aimed at sharing information with braille users will take place during conferences and conventions sponsored by consumer organizations, such as National Federation of the Blind and American Council of the Blind. Parents of children who are braille users will be addressed at National Association for Parents of Children with Visual Impairments conferences. The purpose of these presentations will be to share information about Project UEB PREP and to provide participants with valuable resources for how to use the eLearning platform.

Scholarly and Practice Publications – To reach a primary audience of TSBVI and VRT professionals and researchers, Lawson, Sennott, and Teuscher will publish their findings in journals such as *Journal of Visual Impairment and Blindness* and *Journal of Blindness*

Innovation and Research, and *British Journal of Visual Impairment.* They will also write articles and news bulletins that promote UEB PREP and highlight their findings about the effectiveness of online UEB training for publications and newsletters that go out to employment agencies serving people with disabilities, as well as consumer organizations (e.g. *Reflections* practice journal of the National Federation of the Blind).

QUALITY OF PROJECT SERVICES

(i) Equal Access.

Universal Design and Culturally Sensitive Training Materials. The project will adhere to the principles of universal design (Burgstahler, 2009; Connell, et al., 1997), ensuring equal access to individuals with disabilities and to people from culturally and linguistically diverse backgrounds. Concepts from universal design, originally a set of design principles for architecture, include assurances that individuals with disabilities have multiple ways of accessing, engaging with, and interacting with materials. It is of utmost importance that universal design principles be implemented with individuals who are braille users at the forefront of the design and that the materials are designed to appeal to individuals from varying cultures and/or minority backgrounds. Access to the eLearning platform must allow for the use of assistive technology devices such as screen access software, magnification devices, and portable refreshable braille displays.

Portland State University has policies in place to ensure equal access of curricula for individuals with disabilities. In particular, policies and support to create accessible websites and electronic materials are in place through the Office of Global Diversity and Inclusion. Additionally, the project's faculty members have experience in ensuring that individuals have access to the curriculum and opportunities for success. Dr. Holly Lawson is an expert in the

development of braille materials using variety of online learning technologies and cultural and linguistic diversity; Dr. Samuel Sennot is an expert in assistive technology and creation of iOS educational tools; and Dr. Christof Teuscher is an expert in innovative computer design. These three individuals are well aware of the principles of universal design and will guarantee that the materials can be accessed by individuals with varying disabilities and that they include culturally sensitive content. In addition, two of the expert consultant panel members have a visual impairment. One role of the consultant members will be to test the design of UEB PREP multimedia materials and website and mobile platform, ensuring that the materials can be accessed using a variety of low vision and screen access software.

Treatment of Individuals from Traditionally Under-Represented Groups. The project will actively recruit individuals from minority ethnic backgrounds and individuals with disabilities and encourage their participation in the development of the braille training materials. All research involving participants in needs assessment and the field tests phase will be cleared through the Institutional Review Boards of the University of Portland State University.

Forty-six percent of project staff, including key personnel, consultants, and advisory board members are from diverse backgrounds. Four individuals are from underrepresented minority groups and three have a visual impairment. In addition, Portland State University's teacher preparation program in visual impairment is a multi-state program, including Hawaii, Washington State, Oregon, Idaho and Montana, which attracts students from tribal groups and pacific islanders. Project staff members will actively recruit participants who are from under-represented groups to field test the materials. The project also ensures participation of universities by recruiting field-test sites in areas serving under-represented groups, such as North Carolina Central University, a historically black college (see McCarthy letter of support).

Last, the advisory board includes members who are from under-represented groups, including two individuals who are blind and work as assistive technology specialists for state Vocational Rehabilitation agencies.

(ii) Likely Results.

***Outcome*—Increased usage of UEB.** A primary goal of UEB PREP is to increase training in UEB and to make braille more *ubiquitous.* Our goal is to have 10,000 active monthly users (MUAs) by the end of Year 5. The number of MAUs is considered a standard measure of Internet growth. In addition, we aim to train 2,000 UEB PREP completers.

***Outcome*—Braille literacy leads to higher education and employability.** While a host of factors relate to employability, acquisition of braille literacy skills has a positive impact on postsecondary outcomes (Wolffe & Kelly, 2011) and increases job opportunities (Ryles, 1996; Golub, 2006; Bengis, Izbirak, & Mackieh, 2008; Wolffe & Kelly, 2011). For people with disabilities, education and training can offer meaningful opportunities to learn compensatory skills that foster economic independence. Several studies highlight the fact that graduation from a postsecondary educational institution is a predictor of competitive employment (Emener and Marion-Landais, 1995, Capella-McDonnall, 2005). Project UEB PREP is designed to help address the braille training needs of adults by offering a flexible and accessible interface. The use of distance education is particularly important for those who live in rural areas and have little or no access to training programs for the blind and visually impaired.

***Outcome*—Improved quality of life among braille users.** Another notable benefit of braille literacy is increased quality of life (QOL). As a construct, QOL is multifaceted and complex. A common, empirically validated approach to defining and measuring QOL consists of categorizing it into three main domains – well-being, independence, and social participation

(Claes, Van Hove, Vandevelde, van Loon, & Schalock, 2011). Studies have shown that improved outcomes for people with visual impairment are associated with such factors as economic stability, competence, and social integration (Pinquart & Pfeiffer, 2011). Braille reading and writing skills promote opportunities to earn competitive wages, perform activities of daily living (e.g. labeling clothing) and ultimately participate in society (Ryles, 1996, Bergeron & Wanet-Defalque, 2013)). Furthermore, many braille users report a preference for reading braille, particularly for activities such as reading books for pleasure or skimming recipes. Simply put, materials in audio format cannot offer the same connection to text as braille for many individuals (BANA Open Forum, Alexandria Virginia).

***Outcome*—Increased support of UEB instruction from parents at home.** Studies examining the social networks of children with visual impairment suggest that parent support has a significant and positive influence on well-being (Meeus, Raaijmakers, & Vollebergh, 1991, Meeus, 1994). Not only can support be emotional, but it can also be tangible or focus on assistance in daily living skills or homework (Chang & Schaller, 2000). Researchers who developed and provided a literary braille training intervention for parents in Arizona found that parents who completed the eight-sessions reported feeling more equipped to promote literacy skills at home. Unfortunately, this course only reached six families (Rosenblum & Greer, 2004). With the web-based and mobile UEB PREP platform, we will be able to reach many more participants and accommodate the learning needs of busy parents.

***Outcome*—Increased competency of TSBVIs and VRTs in teaching UEB to students and clients.** Research suggests that high-quality instruction in braille and braille instructional methods leads to positive attitudes about braille among professionals (Wittenstein, 1993). Furthermore, learning the UEB code is just *one of many skills* needed for professionals who

work with adults and students who are visually impaired. Learning assistive technology skills and tactile graphics are also critical. We feel that an online eLearning UEB platform would allow for ***greater student-directed learning of UEB*** among pre-service professionals, thus allowing faculty to focus greater attention on advanced braille skills and evidence-based literacy instruction, which has been identified as a major need, particularly among TSBVIs (Emerson, Holbrook, & D'Andrea, 2009).

(iii) Quality, Intensity, and Duration of Professional Development Services. The proposed UEB PREP eLearning platform is of high quality because the curricular design is evidence-based and includes input from both consumers and UEB experts. The UEB PREP training includes content for components of the UEB code as outlined in the Unified English Braille: Australian Training Manual (Howse et al., 2013). Furthermore, it will be free, accessible (WC3-compliant), user friendly, and SCORM-compliant. With the built-in, powerful data management system, ongoing assessment and refinement of the curriculum will be computerized. Participants will register for UEB PREP, create a user name and login, and have full access to the online learning platform. Since UEB PREP is a desktop and mobile platform, trainees have access to content as often and as long as needed. Research suggests that self-paced instruction has a significant and positive impact on learning (Tullis & Benjamin, 2011). Given the busy lives of many adult learners, UEB PREP provides just-in-time access to rich online UEB training. The adaptive skill tree design ensures that content is intense and challenging enough to result in effective learner progress. Upon completion of all skill exercises, participants will be awarded a certificate of completion that will be approved by our collaborating partner, the Association for the Rehabilitation and Education of the Blind and Visually Impaired (AERBVI) (See letter of support).

(iv) Likelihood of Improvements in Achievement. Given the high-quality design of the UEB PREP eLearning platform with its adaptable interface and interactive components, the likelihood of improvement in UEB skills is high. We anticipate 2,000 individuals will complete a UEB PREP certificate of completion. Professionals who work with braille users need to demonstrate mastery of UEB as measured by rigorous standards. Although no accepted standards for UEB proficiency exist, we draw upon established literary and Nemeth standards (Lewis & Rosenblum, 2012; Smith & Rosenblum, 2013). While UEB PREP users cannot be assessed brailling materials with a manual braillewriter nor with a slate and stylus, they will be offered a rich, evidence-based eLearning experience that will strongly support UEB knowledge and competence. To explore the impact of UEB PREP further, an in-depth discussion of the research questions and methods are presented in the following section, Quality of the Project Evaluation.

QUALITY OF THE PROJECT EVALUATION

(i) Thorough, feasible, and appropriate Evaluation Plan. The overall UEB PREP evaluation approach is focused on project outcomes that result in changes among trainees and organizations serving the blind and visually impaired. The evaluation process will begin by selecting an evaluation team. This team will consist of Dr. Lawson, Dr. Sennott, the graduate student, Dr. McCarthy as research consultant, and two adults who are braille users from our advisory and expert consultant panel. The inclusion of braille users on the evaluation team will ensure the data collection process is sensitive and responsive to the needs of braille users. Dr. McCarthy, an expert consultant will provide oversight of the methodology for the research agenda and assist with analysis of the data collected on the project's objectives (See McCarthy letter of support). Dr. McCarthy has extensive experience in evaluation related to the objectives of the Braille Tutor, a National Science Foundation funded project.

Project UEB PREP will utilize both formative and summative evaluation processes to measure progress toward objectives. The *formative* evaluation procedures allow for *ongoing performance feedback* and are implemented during the project design stage (Refer to Quality of Project Design section). Our *summative* evaluation procedures will examine overall achievement of project objectives and provide information on the value of the project in meeting the desired outcomes.

(ii) Valid And Reliable Performance Data. The *summative* evaluation plan will include rigorous methods for providing valid and reliable performance data. In addition, the methods will incorporate qualitative and quantitative objective measures to provide insight from various perspectives. For most of the proposed studies, we will work with our collaborating advisory board and expert panel members to recruit participants. Analysis of the results will involve use of appropriate descriptive and inferential statistical techniques. All aspects of the project will be documented and designed to address each of the major objectives. The evaluation procedures will clearly address the evaluation questions specific to the objectives of the project.

Objective 1: ***Explore and evaluate the braille learning needs of the community through high quality surveys and focus groups***. As described in the Quality of Project Design section, UEB PREP personnel will conduct focus groups and surveys to determine the needs of its intended trainees. During the evaluation phase of the project, questions will focus on perceptions of how well the UEB PREP platform meets the diverse and unique learning needs of its users.

(**Evaluation Methods are Clearly Related to the Intended Outcomes (iii)).**

Study 1.1: *Usability and satisfaction survey of currently active UEB PREP users.* By the end of Year 3, we will randomly select and offer $2, to 300 participants who logon to UEB PREP for participating in a short online survey. The survey will include Likert scale questions

with ratings of strongly disagree to strongly agree, such as "UEB PREP is fully accessible to me;" "The UEB PREP content is engaging." Other questions will relate to overall satisfaction with the UEB PREP training materials with questions related to different components of the platform (Adobe Captivate presentations, practice exercises, and games). Demographic questions will include age, gender, and purpose participating in UEB PREP training (e.g. parent of a child who is tactile learner interested in learning braille). The survey will include a few open-ended questions, such as "What do you like best about UEB PREP?" Participants will be asked to identify the purpose for learning UEB and the survey will include skip patterns to address the various ways that different end users are using UEB in their lives. For example, adult braille users and professionals will be asked questions about how they use braille at work.

Methods: We will report descriptive statistics on survey responses as well as code information from the open-ended questions. In particular, we are interested in understanding that is using UEB PREP, which aspects do end users like most, and which components need further improvement. The results from this study will help guide changes toward continuous improvement. The data will help us review the intended learning outcomes regularly to ensure clarity, utility, and appropriateness.

Study 1.2: *Case study of those who have engaged in UEB PREP training* (Year 4). Employing case study design as described by Stake (2006) we will explore the usability and satisfaction with UEB PREP training. Reliable data sources (Merriam, 2009) include a) the usability and satisfaction survey (Study 1.1) followed by b) interviews with participants. The survey will identify the level of UEB PREP engagement and which aspects of the platform participants find meaningful. The interview will include semi-structured and open-ended questions to provide us with a more in-depth understanding of the impact of UEB PREP. During

the interview process, the researcher may include additional questions to clarify unique experiences of individual cases. We will use a purposive sampling strategy to identify 8-10 participants, including braille users, parents, and professionals, with varying levels of experience using UEB PREP (e.g. continued users, completers, those who stopped using the program). All participants must have at least been introduced to UEB PREP and have used it to some degree.

Methods: Data analysis will include survey results and notes from the interviews. The data from the notes will be coded for themes and the descriptions of individual participants, as well as cross comparisons. The results of this study should give us a deeper understanding of braille users' level of satisfaction with the product.

Objective 2: ***Develop an evidence-based braille learning desktop and mobile platform that will incorporate a) eLearning experiences designed to be interactive, b) educational gaming designed to be engaging, and c) social networking meant to be connective and motivating.*** To report general outcome information we will pull analytics from the website database. The types of data will include:

- Number of UEB trainee completers each year
- Statistics on average amount of time using UEB PREP
- Duration and frequency that people engage with different types of eLearning features

Evaluation questions related to Objective 3 also focus on the extent users interacted with content, engaged in playing games, and connected with one another via social networking. **Table 4** provides an overview of qualitative and quantitative methodological approaches to assessing the different desired learning experiences. (**Evaluation Methods are Clearly Related to the Intended Outcomes (iii)).**

Table 4: Qualitative and Quantitative Methods for Assessing UEB PREP Features

Desired Learning Experience	Data Sources	Methods
Interactive *To what extent did users interact with content?*	• SCORM generated data from Adobe Captivate presentations • Analytics of frequency and duration using eLearning tools	• Descriptive statistics of frequency and duration using eLearning tools • Appropriate statistical analysis to compare categorical data across groups
Engaging *Were the games engaging and did they help the learner gain knowledge?*	Data from EGameFlow (Fu, Su, & Yu, 2009) an evidence-based survey assessing 8 scales of eLearning game engagement	• Descriptive statistics and comparison of scale scores • Appropriate statistical analysis to compare categorical data across groups
Connective and Motivating *To what extent, and for what purpose did learners use the social media features?*	Membership (e.g. group or individual) and user-generated social media content	• Content analysis (Krippendorff, 2012) of membership characteristics, coding of themes • Appropriate statistical analysis to compare categorical data across groups

Objective 3: ***Evaluate the UEB PREP learning platform and its impact on learner performance and on the community of braille learners.*** The primary question of this objective is, did participants learn UEB. (**Evaluation Methods are Clearly Related to the Intended**

Outcomes (iii)). In addition to the data on the UEB PREP completers, we will also conduct two studies to further explore the impact of UEB PREP on learning.

Study 3.1: *Quasi-experimental pre-posttest group study analyzing impact of UEB PREP on pre-service teachers of the visually impaired* (Gersten, Fuchs, Compton, Coyne, Greenwood, & Innocenti, 2005). Through our collaborations with expert panel members, many of whom work in personnel preparation, we will randomly select two online UEB university level courses (<15 students per class). The dependent variable is UEB test scores. We hypothesize that UEB PREP will lead to a statistically significant increase in the test performance. One classroom will be randomly assigned to a treatment of traditional braille instruction. The second classroom will receive traditional online instruction plus UEB PREP. Both university instructors will be advised to teach their classes using similar materials, such as PowerPoints, in-class writing exercises, and braille readings. Since both courses will be taught online, recordings of live class instruction will take place using web-conferencing (e.g. Blackboard Elluminate). Students who receive the UEB PREP treatment will be required to complete weekly exercises using UEB PREP that align with the course content. Students in the treatment group will be asked to maintain a log of UEB PREP usage, including number of days per week. Online engagement with UEB PREP will be verified by examining user activity through the backend database.

Data Sources: Multiple choice question test, transcription assignment, and satisfaction survey from Study 1.1 for treatment group. At the beginning and end of the term, all study participants will take two similar, multiple-choice tests. At the end of the term, all participants will complete a braille transcription assignment. These are commonly used assessment measures on state certification exams. All students will be required to complete a course evaluation and the UEB

PREP group will be asked to take the satisfaction survey from Study 1.1. Descriptive data will be reported and appropriate statistical analyses will be employed (Gersten, et al., 2005).

Study 3.2: *Single-subject multiple baseline study across adult braille learners with pre-posttest* (Gast, 2010). This study will employ single-subject multiple baseline methodology and explore the impact of UEB PREP on study habits of adult braille learners. The primary dependent variable will be the total minutes of braille study per day. The independent variable will be the use of UEB PREP. Since motivation to learn braille has been cited as a barrier, we hypothesize that UEB PREP will lead to an increase in the amount of time spent practicing braille. Through our connections with state rehabilitation agencies, we will identify 6 participants who are starting to learn braille with direct instruction from a braille teacher or VRT at an adult rehabilitation center. Three conditions will be employed: baseline, intervention, and maintenance. Current Institute of Educational Sciences (IES) recommendations for single subject research will be used including a minimum of five data points will be obtained in each phase of the study per participant (Kratochwill et al. 2010).

Baseline. We will start by collecting baseline data on the total minutes of braille study per day and three secondary variables, 1) frequency of independent braille study per week, 2) duration of braille study sessions and 3) braille knowledge using the same pretest in Study 3.1. The braille instructor will ask the participants to maintain a study log and record data every day.

Intervention. Once a stable trend is established for at least one participant, the braille instructor will introduce UEB PREP and ask the adult learner to continue to track study behaviors. Prior to introducing UEB PREP to the adult learner, a researcher from the UEB PREP team will train the braille instructor in how UEB PREP can be used to provide engaging and motivating braille exercises. “Systematic and sequential introduction” of UEB PREP “will

continue until all participants have reached criterion" (Gast, 2010, p. 278). The posttest will be conducted one week after criterion is achieved. Maintenance probes will be conducted at approximately 1 and 2 months after the participant completes the intervention phase. Treatment fidelity will be conducted by phone with the braille instructor. UEB PREP usage data will be used to test reliability of the participant study log. Data analysis will include analysis of plotted data and descriptive statistics.

(iv) Performance Feedback and Periodic Assessment. Procedures for ensuring feedback and continuous improvement in this project will be based on: (a) user satisfaction and opinions regarding the importance and appropriateness of the UEB PREP training, (b) number of MAUs and completers each year of the project, (c) data on numbers of completers who use UEB in their work setting, (d) research data from our outcome studies and (e) input from expert panel and advisory board members. The procedures referred to above will be implemented on a yearly basis and the process will be continued throughout the project. As required by the Secretary under 34 CFR 75.118, we will submit annual performance reports at the end of Years 1-4 on progress toward targeted goals and financial expenditure information. In Year 5, we will submit a final performance report for the entire project.

QUALITY AND ADEQUACY OF PERSONNEL AND RESOURCES

Equal Opportunity. Portland State University supports equal opportunity in admissions, education, employment, housing, and use of facilities by prohibiting discrimination in those areas based on age, color, disability, marital status, national origin, race, religion or creed, sex or gender, gender identity or gender expression, sexual orientation, veteran status, or any other basis in law. This policy implements state and federal laws. This project will meet all equal opportunity campus mandates for the hiring and retention of faculty and staff during the project

period. As proposed, the project already represents a very diverse group of faculty, project staff, and advisory board. **See GEPA Assurances Statement for additional information.**

Project UEB PRPE Personnel at Portland State University are well qualified to conduct project activities. Their vita can be found in **Appendix B**.

(i) Principal Investigators.

Holly Lawson, Ph.D. Principal Investigator, is Hispanic. She is an assistant professor at Portland State University and program coordinator of the Visually Impaired Learner (VIL) teacher preparation program a multi-state program between Oregon, Washington State, Hawaii, Idaho, and Montana. She has worked in the field of visual impairment for twenty years as a teacher of students with visual impairment and orientation and mobility specialist. She has broad expertise in developing distance education materials and teaching braille in higher education. She has served in several administrative roles, including director of a Vocational Rehabilitation funded summer program (2005-2009) at the Arizona State School for the Deaf and Blind aimed at preparing transition aged youth for college and work. She completed her doctorate at the University of Arizona in 2010 and her dissertation focused on postsecondary and employment outcomes for young adults with visual impairments. In addition to transition, her research has examined the use of braille assistive technology on the writing process and perceptions of faculty who teach distance education courses.

Samuel Sennott, Ph.D. Co-Principal Investigator is an Assistant Professor of Special Education at Portland State University. His work focuses on universal design for learning and assistive technologies. He co-created the popular Augmentative and Alternative Communication (AAC) app, the original Proloquo2Go for the iPhone, iPod Touch, and iPad. This AAC system has helped tens of thousands of individuals gain access to communication. This invaluable

experience provided him with executive leadership, design, technology, and advocacy experience. Dr. Sennott has solid experience with single subject research and mixed methods research. During his research training, he conducted a meta-analysis of single subject research and two case studies in preparation for two separate single subject design studies. He is currently conducting three single subject design studies and a survey study.

Christof Teuscher, Ph.D. Co-Principal Investigator is an Assistant Professor in the Electrical and Computer Engineering Department at PSU. His research focuses on computer architecture and computer science, including nano, bio, and neurosciences as well as innovative approaches to adaptive learning. At the Maseeh College, Teuscher pursues his highly interdisciplinary research interests and oversees a leading research team and lab in future and emerging computing machines and paradigms. He is the recipient of many honors and prestigious awards, such as the Cor Baayen award, which recognizes the most promising young researcher in computer science and applied mathematics in Europe. Teuscher has also published multiple books and over 90 scientific publications.

(ii) Key Personnel.

Expert Panel of Consultants

Frances Mary D'Andrea, Ph.D. is a national expert on UEB and has provided numerous trainings on the topic within numerous states. She has extensive in developing braille curricula and is the author of numerous books and resources on the topic, including the *Ashcroft's Programmed Instruction in Braille*, 5th Edition (2014), which has been updated to include the UEB changes, the *Braille Trail Parent/Teacher Guide* (2002), and *Instructional Strategies for Braille Literacy* (1997). She is currently serving as a consultant and co-leader of curriculum on *Braille Challenge Mobile Application* project. She completed her dissertation at the University of

Pittsburg in 2010 and research focused on preferences among students who read braille and use assistive technology. She is the Chair of BANA and has served as the American Foundation for the Blind's representative since 1998 in various capacities.

Michael Fish, MA is blind and works as a computer and technology instructor at the Virginia Rehabilitation Center for the Blind and Vision Impaired. He has been a braille reader from early childhood. He has extensive knowledge of a variety of assistive technology tools designed for those who are visually impaired, including JAWS for Windows, Window-eyes, NVDA, OpenBook, Voiceover, iOS and Mac products, braille displays and braille notetakers. He holds a Masters in Special Education with specialization in vision impairment and worked for several years in Arlington Public Schools as a teacher of the blind and visually impaired. One of his primary responsibilities was teaching braille and assistive technology to school aged children with visual impairment.

Cheryl Kamei-Hannan, Ph.D. is a professor at California State University, Los Angeles and program coordinator for the Education Specialist Credential in Visual Impairments. At CSULA, Dr. Kamei-Hannan has served as the principal investigator of a federally funded personnel-preparation grant through which she has developed distance learning modules using multi-media for distance learning modules and web-based learning environments. Her research agenda has focused on assistive technology, assessment, literacy, and the impact of a visual impairment on English language learning and cultural linguistic diversity. She is currently the principal investigator of an Office of Special Education Programs' Stepping Up Technology Competition grant, *Improving Literacy and Technology Skills Using the Braille Challenge Mobile Application* (BCMA). The goal of the Braille Challenge Mobile App project is to increase technology and braille literacy skills of children who are visually impaired through the development, evaluation,

validation, and widespread dissemination of the BCMA. She completed her doctorate at the University of Arizona in 2008. Her dissertation focused on the impact of word processing typesets such as bold, italics, and colored words on braille production.

Penny Rosenblum, Ph.D. has low vision and brings to the project both her professional and personal experiences. She is an Associate Professor of Practice at The University of Arizona in the Department of Disability and Psychoeducational Studies where she joined the faculty in 1999. Dr. Rosenblum earned her doctorate from The University of Arizona. She is the Project Director for AnimalWatch Vi Suite a US Department of Education, Institute of Education Sciences 3 Year project, U.S. Department of Education Institute of Education Sciences project. The app focuses on building the math competence of youth with visual impairments who solve authentic word problems about endangered species. She recently completed her role as evaluator the Braille Tutor (Quantum Technologies), a National Science Foundation and the US Department of Education funded project which used artificial intelligence to students learning the braille code learn sets of contractions through an on-line totter. Dr. Rosenblum has authored more than 25 articles several book chapters and curricula. She was part of a group that examined the competencies beginning professionals should demonstrate in literary braille code and another group that examined beginning competencies for Nemeth code.

Tessa McCarthy, Ph.D. is an Assistant Professor and Coordinator of the Visual Impairment Training Program at North Carolina. She has worked in the field of Visual Impairments for 12 years as professor, a teacher of students with visual impairments, and orientation and mobility specialist. Dr. McCarthy has demonstrated expertise is in the area of analyzing and designing rigorous research methodologies that can be used with low-incidence populations. As a result of her strong statistical background and skills, she has worked as a methodologist and evaluator on

a number of federally funded grants related to braille. She also just finished working as an evaluator on the above-mentioned Braille Tutor project. She is currently serving as the methodologist and evaluator on the Braille Challenge Mobile App project.

Graduate Assistant. A graduate assistant will be hired to assist with coordination of project. Job duties include providing administrative support to Project UEB PREP, coordinating regularly scheduled meetings among key personnel as well as bi-annual meetings with the consultants and advisory board, taking meeting minutes, preparing dissemination brochures, managing the database and participant records, and assisting with analysis outcome data.

Technical Team. The technical team will be comprised of graduate students in the computer science department and will be mentored and supervised by Dr. Teuscher. With ongoing and consistent guidance from Dr. Teuscher, the technical team will be responsible for designing and coding the web-based and mobile UEB PREP platform as well as refining the platform based on user feedback and usability testing. We will target hiring students from an underrepresented groups by advertising these positions within the Office of Disability Resources and through students groups affiliated with Portland State University.

In summary the project staff have a unique set of skills and extensive expertise in assistive technology, braille curriculum and design, and research. Finally, the principal investigator (Lawson) and two members of the expert panel are *National Center for Leadership in Visual Impairment* (McCarthy and D'Andrea) fellow recipients.

(iii) Adequacy of Resources. U.S. News & World Report's "Best Colleges 2013" named Portland State University a "Top 10 Up-and-Coming National University," and for the last 12 years, PSU has ranked among the top universities nationally in categories of service learning and learning communities (U.S. News and World Report, 2014). As the largest university in Oregon,

and the state's only public, urban research university (reaching $69.5 million in research expenditures in 2013), Portland State University (PSU) has the facilities and resources needed to administer the *UEB-PREP*.

These and all other externally funded grants and contracts at PSU are managed by the department of *Research and Strategic Partnerships (RSP)* and the office of *Research Accounting (RA)*. Each PI at PSU works closely with the RA and is assigned a team of accountants, administrative professionals, contract officers, and other specialists to maintain research integrity and compliance with the project budget, contracts, sub awards and subcontracts, and other expenditures. PSU's *Human Subjects Research Review Committee (HSRRC)* provides independent determinations on methods, risks, benefits, and rights involved in research involving human subjects.

The *UEB PREP* will be situated within the *Graduate School of Education (GSE),* in the *Department of Special Education.* The GSE had approximately $3 million in research expenditures in 2012-13. Working in tandem with RA, the GSE employs a number of research administration professionals who cover budget reconciliation, purchasing, personal service contracts, hiring-practices, labor reporting, and annual reporting. In addition to administration, the GSE will provide office space and meeting facilities on campus for project staff and activities, computers for faculty and intranetworking with a wide range of up-to-date software, technical support for hardware and software issues, office supplies, routine printing and copying, instructional material production, secretarial support, and other important services.

(iv) Appropriate Time Commitments. The ***personnel loading chart*** included as **Table 5** illustrates the projected number of days allocated for project personnel according to major project objectives and activities based on an annual academic calendar. The major tasks and

objectives for the overall project are listed on the left side, while the estimated number of days for completing those tasks are listed under the initials of those staff who will be working on those components. The chart includes the FTE allocated for the proposed project. Each major task will be further subdivided among project staff upon notification of funding.

Table 5: Personnel Loading Chart by Average Days per Year by Objective

	HL	**SS**	**CT**	**GA**	**Tech Team**
Project FTE	.22 @ 9 mos .11 @ summer	.22 @ 9 mos	.11 @ 9 mos	30 days/yr	~ 131 hrs/year
Project Objectives					
Obj. 1: Needs assessment	15	10		5	
Obj. 2: Develop UEB PREP Design	7	15	21.5	7	131
Obj. 3: Evaluate	25	18		7	
Ongoing: Project Management	8			11	
Total Project Days	**55**	**43**	**21.5**	**30**	**131**

(v) Reasonableness of Costs. This project is designed to have national, and potentially international, impact for designing and creating an eLearning platform that will result in successful acquisition of the UEB skills among countless diverse users. By leveraging internal resources through PSU's Maseeh College Computer Science Department, costs associated with technology design and platform development are significantly lower than if an external company were contracted for this work. Since PSU is already committed to developing UEB training materials as part of the VIL teacher preparation program, costs are low for UEB PREP faculty support. By crowdsourcing curricular content, we reduce costs associated with hiring a full time person to develop curricular exercises and recordings. Funds are requested for faculty support, graduate and undergraduate student pay, honorarium for the expert consultant panel, advisory board members and participants, technology, and travel to assist with the project dissemination. The requested funds for this project will allow project staff to complete all objectives and benchmarks. Salaries for all project staff and consultants are adequate. Several collaborating agencies have offered to loan us refreshable braille displays and other assistive technologies, which reduce overall technology costs (See American Printing House for the Blind, Humanware, and Freedom Scientific Letters of Support in Appendix C). Use of common braille technologies will make the UEB PREP eLearning platform cost effective for braille users, as these tools are affordable and often available to clients through vocational rehabilitation. Further, the eLearning platform's compatibility on desktop and mobile platforms makes it useful to learners seeking solutions at home or work. Only minimal costs associated with software and distance education supplies are necessary to maintain and enhance the quality of the learning opportunities available for scholars.