Implementation of Unified English Braille by Teachers of Students with Visual Impairments in the United States

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Structured abstract: *Introduction:* This study analyzed survey responses from 141 teachers of students with visual impairments who shared their experiences about the implementation of Unified English Braille (UEB). *Methods:* Teachers of students with visual impairments in the United States completed an online survey during spring 2016. *Results:* Although most respondents knew if their state had a UEB transition plan, few participated in its development. Half attended workshops to learn about word-based UEB, but few attended workshops about math-based UEB. They believed their students would be successful in transitioning to word-based UEB but were less sure about their transition to math-based UEB. *Discussion:* The teachers believed they were more confident in their own skills and their students' future success with word-based UEB compared to math-based UEB. Additional clarification on the relationship between math-based UEB and the Nemeth Braille Code for Mathematics and Science Notation (hereafter, Nemeth code), an increased capacity of math-based UEB training, and clear instruction for high-stakes testing were considered to be urgent issues among these teachers. *Implications for practitioners:* Issues concerning the implementation of UEB in the United States will continue to challenge the field of visual impairment for the next several years. Although many teachers of visually impaired students had knowledge of word-based UEB and resources for its implementation, as of January 4, 2016, few were prepared to teach math-based UEB. As the United States is maintaining the Nemeth code, future studies, workshops, and the development of resources are needed to ensure braille users have the knowledge and materials they need in order to be literate in all aspects of UEB.

Since the initial use of braille in the United States in the late 1800s, ease of its use, different levels of contractions, and adoption of codes have long been discussed and sometimes debated (Irwin, 1955; Lorimer, 1996). The country's literary code has undergone various revisions due to its "living language" nature of keeping pace with standards of print (D'Andrea, Wormsley, & Savaiano, 2014; Jolley, 2005). Likewise, expressing mathematical and scientific notations in

braille has also evolved from initially using the Braille Mathematical Notation code (also known as Taylor code) in the early 1900s to the Nemeth Braille Code for Mathematics and Science Notation (referred to as "Nemeth code" for the remainder of this article) by mid-century (Navy, 1991). Although the Nemeth code adopted fewer changes compared to literary braille, by the 1980s discussions about ambiguity among various codes used in the United States were beginning to emerge (Cranmer & Nemeth, 1991; Jackson, Bogart, & Caton, 1993).

The concept of a unified braille code was first discussed by the Braille Authority of North America (BANA) (Bogart, Cranmer, & Sullivan, 2000). The intent for a unified braille code was to allow for continuity among English-speaking countries and to accommodate the use of technology in the production of braille. The added complexity of reading and writing braille due to changes in the English language and access technology were also contributing factors (BANA, 2011–2012).

In response to this challenge, a group of experts composed of braille users, transcribers, researchers, and teachers, through the leadership of the International Council on English Braille (ICEB), began work to develop a unified braille code (Bogart et al., 2000). This code, later known as Unified English Braille (UEB), was adopted in 2004 by the ICEB. English-speaking countries each determined if they would adopt UEB and then set an implementation date (D'Andrea, 2015). After close examination, Canada determined that UEB was "useful" for mathematics and technical materials and adopted it (Marshall & Holbrook, 2015). In 2012 the United States adopted UEB and set an implementation date of January 4, 2016 (D'Andrea, 2013). Although the ICEB Fifth General Assembly—which took place in Johannesburg, South Africa, in May 2012—resolved to continue studying worldwide outcomes of UEB implementation, research on this topic remains limited (D'Andrea et al., 2014). To date, only Australia and New Zealand have reported implementation outcomes that showed that UEB was logical and understandable for students (White, 2011).

It is ironic that the United States was one of the last ICEB countries to adopt UEB, since initial discussion of a unified code originated within this country. Reasons behind the lengthy debate are rooted in academic approaches as well as in perceptions. D'Andrea et al. (2014) noted that the process for adopting UEB in the United States was widely debated due to lack of agreement on using the new code for mathematics and science (Gerber & Smith, 2006; Nemeth, 2004). Proponents of Nemeth code remained concerned that UEB was not suitable for easy computer translation and that it was not capable of rendering mathematics equations and technical materials into tactual format effectively (Nemeth, 2004). Those in favor of no longer using Nemeth code and using only UEB suggested that UEB allows seamless integration of literary and mathematics symbols. UEB eliminates ambiguity of symbol use: for example, dots 3-4-5-6 is only a numeric indicator in UEB (Holbrook & MacCuspie, 2010).

Although efforts have been made to summarize the process of developing UEB (D'Andrea, 2015), advantages and disadvantages of UEB (Bogart et al., 2000; Cranmer & Nemeth, 1991; Nemeth, 2004), and changes of rules and

symbols from English Braille, American Edition (EBAE) to UEB (Holbrook & D'Andrea, 2014), the perception of teachers of visually impaired students about the transition from EBAE to UEB has not been documented. Furthermore, ways in which these teachers were supported through the transition process and what resources were provided to them have not been studied.

The present study sought to gather information about the experiences of teachers of visually impaired students in preparing for and carrying out the implementation of UEB in the United States. Data about their involvement in their state implementation plans, training in UEB, resources for teaching UEB, availability of transcribers to prepare materials in UEB, and personal beliefs were gathered.

Methods

An online survey containing 17 sections and 126 questions was administered through Survey Monkey. The survey items were reviewed by four expert teachers of visually impaired students, two of whom also taught university-level braille courses. The study was approved by the Human Subjects Protection Program at The University of Arizona. The survey was open for six weeks in the spring of 2016. E-mails advertising the study were posted on electronic mailing lists in the field of visual impairment and placed on Facebook group pages that pertained to visual impairment. Informed consent was obtained from all study participants who chose to complete the online survey.

The terms *word-based UEB* and *math-based UEB* were used throughout the survey and the following definitions, developed by the authors, were provided to the study participants. Word-based UEB was defined as "the UEB code components such as contractions, punctuation, and typeform indicators one typically uses when preparing written material students use in classes other than mathematics and science. This material is 'non-technical.'" Math-based UEB was defined as "the UEB components such as signs of operation and comparison, algebraic expressions, and symbols used in geometry. These symbols are typically used when preparing written material for students in mathematics and science classes. This material is 'technical material.'"

Results

This section reports the results from the survey of teachers of visually impaired students, which received responses from 141 participants. Frequencies were calculated for each question. Not all participants answered each question.

Demographic data

Table 1 reports the demographic data of the teachers of students with visual impairments. The teachers were from 28 U.S. states, with the most being from Arizona ($n = 14$), Colorado ($n = 14$), and California ($n = 13$). They had attended 36 universities, with the highest number attending the University of Northern Colorado ($n = 14$), the University of Arizona ($n = 13$), Northern Illinois University ($n = 10$), Illinois State University ($n = 9$), Florida State University ($n = 7$), and California State University, Los Angeles ($n = 7$).

UEB state transition plan

Teachers of visually impaired students were asked if their state had a UEB

Table 1
Teachers of visually impaired students' demographic data ($N = 141$).

Variable	*n*(%)
Gender ($n = 141$)	
Female	132 (93.6)
Male	9 (6.4)
Ethnicity ($n = 139$)	
White	130 (93.5)
American Indian/Alaskan Native	2 (1.5)
Asian or Pacific Islander	3 (2.2)
Hispanic or Latino	4 (2.8)
Years teaching students with visual impairments ($n = 132$)	
1–5	29 (22.0)
6–10	20 (15.2)
11–15	21 (15.9)
16–20	20 (15.2)
21–25	10 (7.5)
26–29	11 (8.3)
30 or more	21 (15.9)
Setting in which employed ($n = 133$)	
Itinerant	111 (83.5)
Resource room	7 (5.3)
Specialized/residential school	6 (4.5)
Early intervention	3 (2.2)
Other	6 (4.5)

transition plan. Of the 141 who responded, 107 said their state did have a plan, 10 said it did not, and 24 were unsure. Participants were asked how they got information about the state UEB plan, and multiple responses were allowed. Seventy-seven individuals reported that they learned about it from conferences, workshops, or professional development events; 73 through state electronic mailing lists; 34 from the state consultant in visual impairment; and 17 from special education directors. Only 34 respondents participated in the development of their state's transition plan for UEB, with 18 attending stakeholder meetings, 16 reviewing the plan and providing feedback, 10 completing a survey, and 6 assisting in the actual writing of the plan.

When asked to share their thoughts about their state's transition to UEB, comments varied widely on what was occurring in the state. Overwhelmingly, participants felt there were unanswered needs. One teacher said,

> UEB implementation in our district is on a case-by-case basis depending on the student and their learning pace. It is felt that, generally speaking, there will be an overlap period between EBAE and UEB during transition. There has been quite a bit of frustration while we (as a department) try to decide how to best teach our current students the [UEB] changes. This greatly impacts older students who are fluent in EBAE. There does not seem to be much available ready-made curriculum to help these students learn the new UEB code.

Another said,

> Our state did a nice job of creating videos to educate parents and administrators of the changes. Our educational resource center staff led the charge in the transition to UEB, and the prison braille program was quickly trained. Unfortunately, we do not have transcriptionists available on the local level.

Learning UEB oneself and resources for UEB

When asked about the BANA website, 116 (87.2%) of 133 participants reported they had visited the website in the last year.

The teachers were provided with a list of options for learning word-based UEB and were asked to select as many as applied. Sixty-two had not completed any formal training for word-based UEB. The most frequently used way to learn word-based UEB was the Hadley School for the Blind's *Transition to Unified English Braille* course (2015) ($n = 41$), followed by RIDBC's (Australia) UEB Online Course ($n = 18$), Northern Illinois University's UEBOT course ($n = 7$), the National Library Service's braille transcription course ($n = 6$), CNIB's Transcriber's UEB Course ($n = 3$), and the Wisconsin Center for the Blind's Introduction to UEB ($n = 2$).

When asked about the resources they used during the transition for learning word-based and math-based UEB, 8 teachers reported that no resources were used for word-based UEB, and 32 indicated none were used for math-based UEB. The most frequently listed was self-study ($n = 108$ word-based, $n = 63$ math-based); followed by informal meetings with colleagues ($n = 66$ word-based, $n = 17$ math-based); in-service classes or workshops ($n = 54$ word-based, $n = 28$ math-based); university instructors ($n = 18$ word-based, $n = 14$ math-based); teachers of visually impaired students' preparation programs ($n = 10$ word-based, $n = 7$ math-based); and electronic mailing lists, social media, or websites ($n = 54$ word-based, $n = 28$ math-based). Sixty-six teachers provided at least one electronic mailing list or website they utilized. Frequently mentioned resources included the BANA website, the Paths to Literacy website, state electronic mailing lists, and the Association for Education and Rehabilitation of the Blind and Visually Impaired (AER) electronic mailing lists.

The authors defined a workshop as "3 or more hours of instruction involving information and practice of new content. During the workshop one has opportunities to practice new content, receive feedback, and participate in discussion." Workshops about word-based UEB were attended by just over half of the participants ($n = 73$), while only one-fifth ($n = 30$) of teachers of visually impaired students attended math-based UEB workshops. Workshops were most frequently sponsored by state departments of education ($n = 37$ word-based, $n = 11$ math-based); followed by workshops held in conjunction with national conferences ($n = 23$ word-based, $n = 0$ math-based); and state-level conferences ($n = 23$ word-based, $n = 11$ math-based). The UEB workshop attendees were given a list of topics and asked how well each was covered within the workshop. Responses included really well, adequately, and not well. The responses were assigned a value of 3 to 1, respectively, and means were obtained. These data are reported in Table 2.

Participants were asked to whom or where they go with questions and concerns regarding UEB. They could check more than one option, including fellow teachers of visually impaired students ($n = 50$ word-based, $n = 60$ math-based); BANA ($n = 45$ word-based, $n = 0$ math-based); national or international electronic mailing lists ($n = 27$ word-based, $n = 30$ math-based); braille transcribers ($n = 26$ word-based, $n = 29$ math-based); state consultants ($n = 19$ word-based, $n = 21$ math-based); university braille course instructors ($n = 18$ word-based,

Table 2
UEB content covered in workshops.

Statement	*n*	Really well	Adequately	Not well	Mean
Word-based					
Elimination of contractions	73	55 (75.4%)	16 (21.9%)	2 (2.7%)	2.72
Changes in the use of contractions within words	73	42 (57.5%)	21 (28.8%)	10 (13.7%)	2.44
Changes in use of punctuation	72	36 (50%)	30 (41.7%)	6 (8.3%)	2.42
Grade 1 indicators and their use	70	35 (50%)	25 (35.7%)	10 (14.3%)	2.36
Typeform indicators (e.g., bold, underline)	69	34 (49.3%)	23 (33.3%)	12 (17.4%)	2.32
Math-based					
Numbers	29	11 (37.9%)	18 (62.1%)	0	2.38
Signs of operation	27	10 (37.0%)	17 (63.0%)	0	2.37
Signs of comparison	28	8 (28.6%)	18 (64.3%)	2 (7.1%)	2.21
Abbreviations	28	7 (25.0%)	19 (67.9%)	2 (7.1%)	2.18
Signs of omission	27	7 (25.9%)	17 (63.0%)	3 (11.1%)	2.15
Grouping symbols	28	8 (28.6%)	15 (53.6%)	5 (17.9%)	2.11
Fractions	28	7 (25.0%)	16 (57.1%)	5 (17.9%)	2.07
Superscripts	27	6 (22.2%)	14 (51.9%)	7 (25.9%)	1.96
Signs of shape	14	5 (35.7%)	3 (21.4%)	6 (42.9%)	1.93
Radicals	21	4 (19.0%)	11 (52.4%)	6 (28.6%)	1.90
Spatial layout of math problems	24	4 (16.7%)	13 (54.2%)	7 (29.2%)	1.88
Functions	16	3 (18.8%)	5 (31.3%)	8 (50.0%)	1.69
Geometry	17	3 (17.6%)	5 (29.4%)	9 (52.9%)	1.65

$n = 15$ math-based); faculty at university personnel preparation programs ($n = 18$ word-based, $n = 15$ math-based); social media ($n = 3$ word-based, $n = 11$ math-based); adults who were braille readers ($n = 3$ word-based, $n = 3$ math-based); and adult service providers ($n = 1$ word-based, $n = 1$ math-based). One participant reported no consulting resources for word-based UEB, while 32 participants reported using no consulting resources for math-based UEB.

Materials for teaching students UEB

Teachers of visually impaired students were asked to indicate materials they used to teach word-based and math-based UEB to their students. More than one response was permitted. Items selected were materials from conferences and workshops ($n = 38$ word-based, $n = 17$ math-based); *The Rules of Unified English Braille* (ICEB, 2013) ($n = 38$ word-based, $n = 27$ math-based); *Ashcroft's Programmed Instruction: Unified English Braille* (Holbrook & D'Andrea, 2014) ($n = 31$ word-based, $n = 18$ math-based); *Building on Patterns: Primary Braille Literacy Program* (America Printing House for the Blind [APH], 2006–2012) ($n = 23$ word-based, $n = 0$ math-based); *Unified English Braille: An Australian Training Manual* (Howse, Riessen, & Holloway, 2014) ($n = 9$ word-based, $n = 6$ math-based); teacher-made materials ($n = 19$ word-based, $n = 29$ math-based); materials from the Hadley School for the Blind's *Transition to UEB* course (Hadley School for the Blind, 2015) ($n = 31$ word-based, $n = 11$ math-based); and *The Hitchhiker's Guide to UEB Mathematics* (UEB

Curricula Support Writing Group, 2013) (n = 10 math-based).

Beliefs and perceptions

Participants were provided with a list of 30 statements (see Table 3) and asked to rate them on a 5-point Likert-type scale from strongly disagree to strongly agree. The higher the mean, the higher the rate of agreement with the statement. Statements were grouped into six categories, as shown in Table 3. Three statements did not fit within any of the six categories. Independent sample *t*-tests were conducted to determine if there was a difference in ratings for those participants whose state had a UEB transition plan and for those who were unsure if their state had a plan or knew their state did not (see Table 4), and for participants who reported attending a word-based UEB workshop and those who did not (see Table 5). There were significant differences in belief statements for skills, students' successes, administration, and family understanding between those who lived in a state where a UEB transition plan was proposed and those who were unsure if their state had a plan or knew their state did not have any plan. When the same groups of belief statements were examined for participants who attended word-based UEB workshops and those who did not, there were significant differences in those belief statements for my skills, my students' success, my administration, assessment, and family understanding.

Discussion

This study examined the experiences and beliefs of 141 teachers of visually impaired students related to the implementation of UEB in the United States.

State transition plans

Since these teachers are on the "front lines," it is important that they actively participate in the decision-making process and transition to UEB at their state level. Less than a quarter of them participated in the development of their state's UEB transition plan.

Availability of training and resources

The number of teachers who attended UEB word-based workshops was 72, while attendance for math-based workshops was only 29. One teacher reported, "It is very difficult to incorporate the UEB and Nemeth code rules. Not a lot of resources are available at the state level for support or instruction." Another participant discussed the lack of state-wide coordination about math-based UEB: "I think my state needs to step up and give direction to teachers of visually impaired students throughout the state. I feel as if there is no leadership on this point." It is not surprising that participants were concerned about ways that math-based UEB and Nemeth code are being used differently by different states.

Half of the participants attended workshops focused on word-based UEB, while only 20% attended workshops focused on math-based UEB. Content covered in the word-based workshops was viewed as covered really well or adequately by more than 80% of respondents for each topic (for example, elimination of contractions, typeform indicators). Similarly, when content was covered in math-based UEB

Table 3
Belief statement ratings.

Statement	*n*	*M*	*SD*
My skills			
I am confident in my ability to determine which of my students should receive materials in word-based UEB.	123	4.30	.789
I understand the difference between EBAE and word-based UEB.	128	4.28	.869
I am confident in my ability to provide word-based UEB instruction to students who are braille readers.	123	4.09	.849
I believe the training I received in word-based UEB had me ready for the official implementation date of January 4, 2016.	126	3.56	1.256
I believe the training I received in math-based UEB had me ready for the official implementation date of January 4, 2016.	119	2.19	1.122
My students' success			
I believe my students will successfully make the transition to word-based UEB.	116	4.25	.684
I believe my students will benefit from using word-based UEB in the future.	120	4.13	.931
I believe my students will benefit from using math-based UEB in the future.	92	3.27	1.250
I believe UEB instruction has positively impacted my students' success in the classroom.	90	3.13	1.124
I believe my students will successfully make the transition to math-based UEB.	82	3.11	1.111
My administration			
I believe I am supported by my administration to teach word-based UEB to my students.	117	4.05	1.074
I believe there is a clear plan in my district, school, or agency to transition students to word-based UEB.	114	3.38	1.251
I believe I am supported by my administration to make a decision on what math code my students will use.	94	3.68	1.147
I believe that the administration at my district, school, or agency is knowledgeable about UEB and its implementation.	119	2.84	1.390
I believe there is a clear plan in my district, school, or agency to transition students to math-based UEB	90	2.54	1.172
Assessment			
For the 2015–2016 school year, I know what braille codes are being used to produce standardized tests my students will be taking.	102	3.93	.936
For the 2016–2017 school year, I know what braille codes are being used to produce tests my students will be taking	103	3.60	.932
I believe that in spring 2016 my students will be prepared for high-stakes tests (state or national) prepared in word-based UEB.	91	3.01	.983
I believe that in spring 2016 my students will be prepared for high-stakes tests (state or national) prepared in math-based UEB.	72	2.46	.749
Materials for students			
I believe that technology used to produce braille materials (e.g., Duxbury) includes UEB code.	124	4.34	.774
I believe classroom materials prepared in word-based UEB are available for students served by my district, school, or agency.	111	3.85	1.105
I have a transcriber or transcription service that can prepare word-based UEB materials for my students.	127	3.57	1.389
I believe classroom materials prepared in UEB that include Nemeth code are available for students served by my district, school, or agency.	101	3.48	1.119

(cont.)

Table 3
(cont.)

Statement	*n*	*M*	*SD*
I believe classroom materials prepared in math-based UEB are available for students served by my district, school, or agency.	84	2.92	1.184
I have a transcriber or transcription service that can prepare math-based UEB materials for my students.	120	2.66	1.393
Family understanding			
I believe families of my students understand the implications of their child learning word-based UEB.	103	3.00	1.138
I believe families of my students understand the implications of what math code their child will use in math and science classes.	82	2.45	1.090
Other statements			
I believe the information on the BANA website about UEB is helpful.	126	4.14	.827
My state's UEB transition plan is comprehensive.	137	3.49	1.008
I understand my state's decision or plan as to whether a student will use Nemeth code or math-based UEB in math and science classes.	113	3.45	1.102

Table 4
***t*-test results for teachers of visually impaired students based on state UEB transition plan.**

	Yes	No/Unsure			
Statement	*n* *M* (*SD*)	*n* *M* (*SD*)	*t*	*DF*	*p*
*My skills	97 3.77 (.668)	31 3.43 (.850)	2.32	126	.022
*My students' success	93 3.86 (.735)	29 3.33 (1.015)	2.61	37	.013
*My administration	97 3.54 (.870)	30 2.66 (.979)	4.77	125	.000
Assessment	84 3.47 (.755)	26 3.16 (.767)	1.86	108	.064
*Materials for students	97 3.57 (.771)	31 3.21 (.821)	2.18	126	.031
*Family understanding	80 2.96 (.992)	27 2.25 (.859)	3.28	105	.001
*My state's UEB transition plan is comprehensive.	104 3.70 (.984)	3 2.82 (.769)	5.36	68	.000
I believe the information on the BANA website about UEB is helpful.	94 4.21 (.815)	32 3.94 (.840)	1.63	124	.104
*I understand my state's decision or plan as to whether a student will use Nemeth code or math-based UEB in math and science classes.	88 3.66 (1.060)	25 2.72 (.936)	4.00	111	.000

*Result is significant, $p < .05$.

Table 5
***t*-test results for teachers of visually impaired students based on attendance at word-based UEB workshops.**

Statement	Yes *n* *M* *(SD)*	No or unsure *n* *M* *(SD)*	*t*	*DF*	*p*
*My skills	71 3.95 (.610)	57 3.36 (.734)	4.98	126	.000
My students' success	68 3.91 (.780)	54 3.51 (.863)	2.68	120	.008
*My administration	71 3.69 (.809)	56 2.88 (.980)	5.06	125	.000
Assessment	57 3.59 (.721)	53 3.19 (.767)	2.78	108	.006
Materials for students	71 3.58 (.769)	57 3.36 (.815)	1.57	126	.118
*Family understanding	58 2.96 (.977)	49 2.57 (1.00)	2.05	105	.043
*My state's UEB transition plan is comprehensive.	73 3.75 (1.024)	58 3.10 (.852)	3.96	128	.000
I believe the information on the BANA website about UEB is helpful.	70 4.20 (.791)	55 4.07 (.879)	.850	123	.397
I understand my state's decision or plan as to whether a student will use Nemeth code or math-based UEB in math and science classes.	64 3.59 (1.09)	49 3.27 (1.09)	1.58	111	.117

*Result is significant, $p < .05$.

workshops approximately 70% of participants found the mathematics content typical in elementary and middle school to be really well or adequately covered. Content related to higher-level mathematics (for example, radicals, functions) was not covered as thoroughly as content for earlier-level mathematics.

Lack of training opportunities for math-based UEB amplified frustration among teachers of visually impaired students who were actively seeking ways to learn and to teach math-based UEB. They reported fewer available resources for learning math-based UEB. Only 36% had access to a math-based UEB transcriber.

Materials used by these teachers for the instruction of word-based UEB were most frequently obtained from conferences or workshops they had attended, while materials for math-based UEB were most frequently teacher-made. The lack of any comprehensive curricula or materials for either word-based or math-based UEB is of concern. Materials used by teachers of visually impaired students at in-service training sessions are not equivalent to materials that are effective for students learning UEB as their

primary reading medium. For prompt delivery of accurately transcribed braille materials to students, transcribers who are skilled and knowledgeable in all aspects of UEB are necessary.

There was a high rate of agreement by participants that information on the BANA website is helpful to teachers of visually impaired students. Continued updates by BANA of materials, state implementation plans, and other resources promote increased knowledge for these teachers. Technology for producing braille is ever-changing, and having up-to-date information on functions and features of common braille translation software and technology (Duxbury and BrailleBack, for example) is imperative so that the time of these teachers and transcribers is used efficiently.

Beliefs of teachers of visually impaired students

The teachers believed they were more confident in their own skills and their students' future success with word-based UEB compared to their own skills in math-based UEB and their beliefs about their students' future success with math-based UEB. It is noteworthy that 90% of them believed their students will make a successful transition to word-based UEB, while only 38% believed their students will do so for math-based UEB. Likewise, only 46% believed their students will benefit from using math-based UEB, whereas 83% believed their students will benefit from using word-based UEB.

Belief statements were put into six groups: my skills, my students' success, my administration, assessment, materials for students, and family understanding. Teachers whose states had a UEB transition plan had significantly higher ratings for statements at the $p < .05$ level in all areas but assessment. States with an established UEB transition plan potentially have more opportunities and resources to support teachers of visually impaired students in developing their own UEB skills.

Availability of assessments

Only 30% of the respondents suggested their students were prepared for high-stakes testing using word-based UEB, and only 13% for math-based UEB. These data are not surprising, because there has been little information available about the codes and time lines for state and national assessments.

Nemeth code vs. math-based UEB

It was beyond the scope of this study to determine the status of math-based UEB or Nemeth code in a participant's state at the time the survey was completed. Only a fifth of the participants believed that "there is a clear plan in my district, school, or agency to transition students to math-based UEB." Few believed that "families of my students understand the implications of what math code their child will use in math and science classes." Regardless of the code used, teachers of visually impaired students need to provide instruction to students so they can access material in their mathematics and science classes. Leaving the decision to parents, school administrators, and other personnel who are not familiar with braille codes and the complexities of obtaining instructional and assessment materials is not a sound educational practice.

Limitations

This study had several limitations. Data were self-reported, and no verification of

teacher responses was obtained. It is probable that those completing the survey were interested in the topic of UEB and therefore took the time to complete the survey. Since the survey was advertised on electronic mailing lists and social media, it is possible that those who responded differed in their experiences from those who did not use these communication tools. Because all 50 states implemented UEB in their own unique ways, opportunities for these teachers to learn UEB, access resources, and gather information about high-stakes testing varied considerably. Not all teachers had the same level of information or access to training or to materials. Due to the large number of *t*-tests run (see Tables 4 and 5) it is possible that a type 1 error occurred, thus caution needs to be used when interpreting the results of the *t*-tests.

Implications for the future

This study is a beginning step to understanding the implementation of UEB in the United States. Repeating this study in a year or two to determine the changes in experiences and beliefs of teachers of visually impaired students will be valuable for understanding UEB implementation. Although BANA made the decision for the United States to adopt UEB in late 2012, it is clear from these data that not everything was in place for a seamless implementation of UEB on January 4, 2016. Clear guidelines and materials that address the use of Nemeth code and UEB continue to be necessary. Trained and available transcribers who know UEB and can produce accurate materials for both instruction and assessment are needed. Finally, opportunities for continued training and additional resources and curricula for math-based UEB need to be made available.

References

American Printing House for the Blind (APH). (2006–2012). *Building on patterns: Primary braille literacy program.* Louisville, KY: Author.

Bogart, D. E., Cranmer, T. V., & Sullivan, J. E. (2000). Unifying the braille codes. *Braille into the next millennium*. Washington, DC: National Library Service for the Blind and Physically Handicapped, Library of Congress.

Braille Authority of North America (BANA). (2011–2012). *The evolution of braille: Can the past help plan the future?* Retrieved from http://www.brailleauthority.org/article/index.html

Cranmer, T. V., & Nemeth, A. (1991). *A uniform braille code*. Retrieved from http://www.iceb.org/cranem.html

D'Andrea, F. M. (2013). Unified English Braille: The future of braille in the United States. *Journal of Visual Impairment & Blindness*, *107*(3), 243–246.

D'Andrea, F. M. (2015). *Unified English Braille implementation guide*. Washington, DC: Council of Chief State School Officers.

D'Andrea, F. M., Wormsley, D. P., & Savaiano, M. S. (2014). Unified English Braille in the United States: A research agenda for transition and instruction. In D. Hatton (Ed.), *International review of research in developmental disabilities, Vol. 46: Current issues in the education of students with visual impairments* (pp. 145–176). Waltham, MA: Academic Press, Elsevier.

Gerber, E., & Smith, B. (2006). Literacy & controversy: Focus-group data from Canada on proposed changes to the braille code. *Journal of Visual Impairment & Blindness, 100*(8), 459–470.

Hadley School for the Blind. (2015). *Transition to Unified English Braille*. Winnetka, IL: Author.

Holbrook, M. C., & D'Andrea, F. M. (2014). *Ashcroft's programmed instruction: Unified English Braille.* Germantown, TN: SCALARS Publishing.

Holbrook, M. C., & MacCuspie, P. A. (2010). The Unified English Braille Code: Examination by science, mathematics and computer science technical expert braille readers. *Journal of Visual Impairment & Blindness, 104*(9), 533–541.

Howse, J., Riessen, K., & Holloway, L. (2014). *Unified English Braille: An Australian training manual.* Lindisfarne, Tasmania, Australia: Round Table on Information Access for People with Print Disabilities.

Irwin, R. B. (1955). The war of the dots. In R. Irwin (Ed.), *As I see it* (pp. 3–56). New York, NY: American Foundation for the Blind.

Jackson, J., Bogart, D., & Caton, H. (1993). The Unified Braille Code: Some myths and realities. *Journal of Visual Impairment & Blindness, 87*(10), 395–396.

Jolley, W. (2005). Unified English Braille: Australians blazing the trail. *Journal of Visual Impairment & Blindness*, *99*(9), 517–519.

Lorimer, P. (1996). *A critical evaluation of the historical development of the tactile modes of reading and an analysis and evaluation of researches carried out in endeavours to make the braille code easier to read and to write.* Birmingham, UK: University of Birmingham.

Marshall, C., & Holbrook, M. C. (2015). Description of Unified English Braille implementation in Canada. *Journal of Visual Impairment & Blindness*, *109*(6), 518–520.

Navy, C. (1991). The history of the Nemeth code: An interview with Dr. Abraham Nemeth. *Raised Dot Computing Newsletter, 93. https://nfb.org/images/nfb/publications/fr/fr28/fr280110*

Nemeth, A. (2004). My take on the status of braille. *Journal of Visual Impairment & Blindness, 98*, 71–73.

Simpson, C. (2013). *The rules of Unified English Braille.* Lindisfarne, Tasmania, Australia: International Council on English Braille, Round Table on Information Access for People with Print Disabilities.

UEB Curricula Support Writing Group. (2013). *The UEB hitchhiker's guide to mathematics*. Retrieved from http://www-.banzat.org.nz/documents/HHGMaths.pdf

White, M. (2011). *Implementation of UEB (Unified English Braille Code) in Australia and New Zealand—The experiences of a small sample of native braille users.* Peterborough, UK: RNIB Braille Development Unit.

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