☑ CE Article

An Artificial Intelligence Tutor: A Supplementary Tool for Teaching and Practicing Braille

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Structured abstract: *Introduction:* This study evaluated the usability and effectiveness of an artificial intelligence Braille Tutor designed to supplement the instruction of students with visual impairments as they learned to write braille contractions. *Methods:* A mixed-methods design was used, which incorporated a single-subject, adapted alternating treatments design as well as qualitative teacher interviews and surveys. *Results:* Students seemed to reach 100% accuracy faster when using Braille Tutor (average = 7.0 sessions; range 1.0 to 12.0 sessions) than when they did not (average 9.6 sessions with a teacher of students with visual impairments; range 3.0 to 16.0 sessions). Also, students who used Braille Tutor more often tended to learn more contractions overall during the study (average = 21.25; range 13.0 to 30.0) than students who used it less (average 9.0; range 9.0 to 9.0). *Discussion:* The first trend noted was that students in the teacher of students with visual impairments plus Braille Tutor phase (hereafter, TVI+Tutor) tended to learn contractions more quickly. A second trend surfaced: The students in the TVI+Tutor phase tended to get more frequent reinforcement as opposed to students in the TVI Only phase. A third trend was noted: Students in the TVI+Tutor phase saw a quicker initial jump and tended to be more consistent in that initial jump. Although the prototype version of Braille Tutor in this study needs further development to broaden its capabilities, some students found its use highly motivating. *Implications for practitioners:* Although there is strong evidence that advanced technologies are not suitable replacements for braille literacy instruction, technology can be used along with quality instruction by a teacher of visually impaired students to enhance proficiency in braille literacy.

Braille is the primary literacy medium for those who are blind. Braille literacy strongly correlates with better reading habits and involvement in post-secondary education (Ryles, 1996). There is also a strong link between braille literacy and employment: A survey of 1,056 individuals with visual impairments of working age found that the daily use of braille had a positive impact on employment, salary, and self-esteem (Bell & Mino, 2013).

Approaches to teaching beginning braille readers vary; however, a commonality among approaches is that learners need

the opportunity to use braille and develop their knowledge of braille contractions (Swenson, 2016). The Alphabetic Braille and Contracted (ABC) Braille Study, the only longitudinal study of beginning braille readers, followed 38 readers from 2002 to 2007. Although it was not clear from the research if beginning braille instruction with contracted or uncontracted braille increased the student's later literacy abilities, the researchers concluded that "all things being equal, the introduction of contractions early in a student's reading process is associated with higher literacy performance later in the student's literacy career" (Wall Emerson, Holbrook, & D'Andrea, 2009, p. 622).

Teachers of students with visual impairments have many job roles, including the responsibility for teaching the expanded core curriculum in the area of compensatory skills, a component of which includes the use of braille for reading and writing. They must also ensure that students have academic support and are provided with materials in their literacy medium (Allman & Lewis, 2014; Griffin-Shirley, Koenig, & Layton, 2004; Wolffe et al., 2002); ensure other teaching responsibilities are met (Griffin-Shirley et al., 2004; Wolffe et al., 2002); and manage large caseloads. Griffin-Shirley and colleagues (2004) reported that, on average, the teachers they surveyed had 22 students on their caseloads, including two students who were blind. These large caseloads often result in inequity in the amount of time students who are blind spend in literacy instruction compared with their sighted peers (Wall Emerson et al., 2009). Thus, a tool that can assist in supporting the literacy skill development of beginning braille readers and allow students to practice braille contractions in the absence of teachers of visually impaired students or other adults who know braille could prove invaluable.

Intelligent tutoring (that is, adaptive computer instruction) may help teachers of visually impaired students provide their students with practice in developing their braille skills at times when teachers are not present to provide reinforcement or answer questions. The third and fourth authors conducted a national survey of teachers of visually impaired students to assess if there was a need for a tutoring program that would provide reinforcement of braille contractions being learned by students. Responses from 68 teachers of students with visual impairments (84% of whom were itinerant teachers) confirmed the potential value of using intelligent tutoring software, with 90% and 88% rating the opportunity for additional one-on-one tutoring in braille as having moderate, high, or very high value to their students working at school and at home, respectively (similar ratings were obtained, interestingly, for potential value to the teachers of visually impaired students themselves).

Despite the major strides achieved in access technologies such as synthesized speech (for example, screen readers), braille remains an important tool for readers with visual impairments. The exclusive use of audio can result in deficiencies in spelling and composition skills, as pointed out by Foulke (1979) more than

three decades ago. Others have argued that full reliance on audio is inconsistent with an operational definition of literacy, which includes writing (Tuttle & Hatlen, 1996). Wittenstein and Pardee (1996) reported that 89% of teachers of visually impaired students agreed that speech technology should be used as a supplement to braille, not as a replacement. For sighted readers, progress in technology has obviously not replaced print—just the opposite: it has greatly simplified and empowered access to the printed word. Similarly, the use of an intelligent electronic braille tutor can be used to augment instruction by teachers of visually impaired students and to promote increased levels of braille literacy. This study sought to evaluate the impact of such a braille tutor with the following questions:

- Is Braille Tutor easy to use? What would increase its usability?
- What are users' experiences as they become oriented to Braille Tutor?
- What kinds of problems do users have in getting started with Braille Tutor?
- Do students learn braille contractions more efficiently with Braille Tutor?
- Does Braille Tutor provide explanations that are clear?
- Is Braille Tutor fun to use?

Method

Participants

This study involved 10 students who were instructed by 7 teachers of students with visual impairments. Inclusion criteria for student participants were that the student: (a) was a braille reader who did not know either one-cell whole word contractions represented by a single letter of the alphabet or short-form words, and (b) did not have additional significant intellectual disabilities. The teachers had to have access to a computer with Internet, speech, and a braille display.

Recruitment occurred in the summer and early fall of 2013. Advertisements were placed on electronic discussion groups in the field of visual impairment. Teachers who had prior experience in working with one of the authors were contacted individually. Teachers who expressed interest in the study and had a student or students who met the criteria were sent consent packets for both themselves and the children's families.

Teacher training

Prior to the start of the study, a one-hour online training session was held. Participants viewed a demonstration of how to use Braille Tutor and its features, how to administer the assessments used in testing and intervention, and the basics of the study design. Annotated versions of these presentations were provided to the teachers for reference. Throughout the study, one author was available for assistance with the assessments and procedures of the study, and a different author was available for technical assistance.

Study design

The study was approved by the Institutional Review Board of the Wexford Institute. It employed a single-subject, adapted alternating treatments design with a probe at the end of each phase. Experimental control was demonstrated primarily within participants but was also

demonstrated across participants. Teachers were also interviewed to determine attitudes about the device.

All participants began at the baseline phase. After baseline, participants were assigned to one of two groups: TVI Only or TVI+Tutor. Participants in the TVI Only group taught a list of words to their student in their typical manner. Participants in the TVI+Tutor group were instructed to teach the students in the manner they would typically teach and to reinforce instruction by allowing the student to use Braille Tutor as often as they desired, or a minimum of two sessions per week.

After the teachers finished their first assigned phase with students (TVI Only or TVI+Tutor), they completed a probe using the adapted Assessment of Braille Literacy Skills (ABLS, Koenig & Farrenkopf, 1995) tool and then switched to the other phase. For example, if the teacher was originally assigned to the TVI Only phase, at the completion of that phase, the student would be probed and would then start the TVI+Tutor phase. The student would be probed again to assess maintenance of the contractions learned in the first interventional phase.

Instruments and tools

Braille Tutor

Braille Tutor is an Internet-based tool that uses a form of artificial intelligence known as adaptive computer instruction. Each person who uses it has a unique user name and password. The user logs into the Braille Tutor website using a computer with a screen reader, a refreshable braille display, and a braille keyboard or a QWERTY keyboard that permits six-key entry.

During a session with the device, the prompt on the screen was presented to the student via the screen reader. For this study, the prompt was a single word, although the device can also present sentences. After hearing the word spoken by the screen reader (the prompt), the student brailled the word using a braille keyboard or a QWERTY keyboard that permitted six-key entry. The Braille Tutor website contains different units that focus on different types of contractions (for instance, single-letter, whole-word contractions or short-form words). Some units focus on the contractions in isolation; some focus on the contractions in the context of sentences. This study only included units that focused on contractions in isolation. For example, a computer programmer set up an individualized unit for each student participant that was based on the identified list of contracted words in order to specifically control which contractions were introduced during each phase of the study. Typically, however, a teacher would choose a unit from a preprogrammed list that most closely aligned with the types of contractions the student was currently learning. What sets Braille Tutor apart from other devices is that the program analyzes the type of brailling mistake made by a student and offers specific feedback based on the particular mistake rather than providing a stock response. For instance, if a student was given the prompt "not" and brailled each letter—*n, o, t*—Braille Tutor reminded the student that there was a single-cell whole-word contraction that could have been used. This type of feedback can be compared to a student who was given the same prompt but brailled the contraction upside down

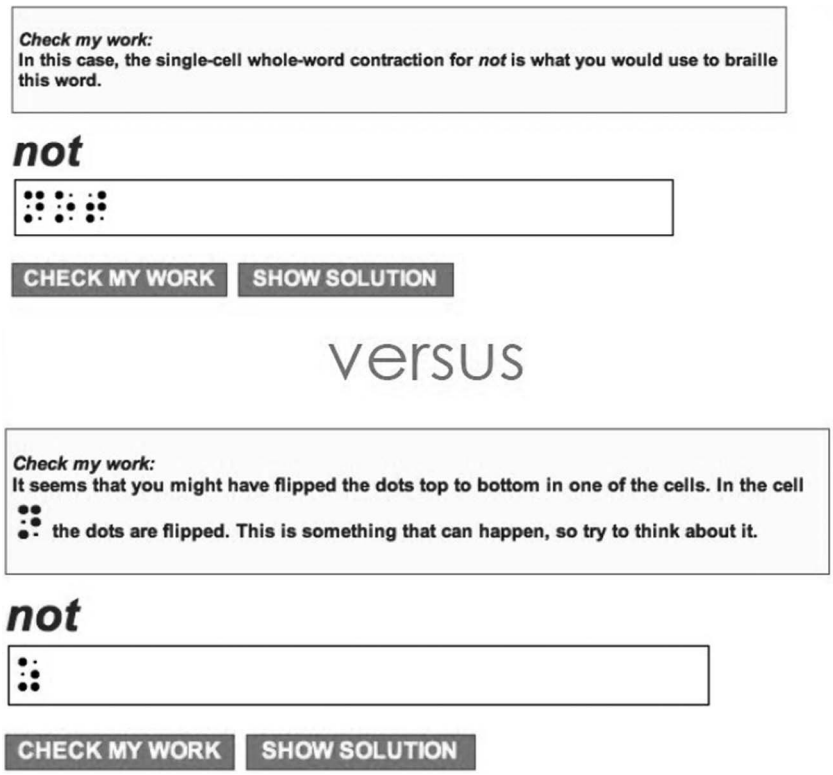

Figure 1. The Braille Tutor uses a type of artificial intelligence referred to as adaptive computer instruction.

(dots 1, 3, 5, 6). In the case of upside-down braille, the device would tell the student that the dots had been flipped top to bottom (see Figure 1).

Assessment of braille literacy skills

An adapted version of the ABLS tool, which was also used in the Alphabetic Braille Contracted (ABC) Braille Study (Wall Emerson et al., 2009), was used to establish prior student knowledge of contractions and baseline). Although the format of the tool was the same as the tool used in the ABC Braille Study, the checklist we used in the present study only contained the one-cell, whole-word contractions that are represented by a single letter of the alphabet (for example, *b* = *but*) and short-form words (such as *br* = *braille*). Other contractions were not assessed, since the prototype of the Braille Tutor that was used for this project only provided practice with these two types of contractions. These words were brailled into a word list. Teachers were asked to administer the list without specific prompts (for example, "Sound it out, *b, b, b*"), although general prompts of encouragement were permitted (such as "Just do your best") to reduce student frustration. Teachers were also instructed to not give any feedback on student performance (for instance, "You got it right"). The ABLS was administered as a pretest to establish a list of target words for each participant; these lists also served as the first data point

Table 1
Student demographic data.

Name	Gender	Grade	Age	Ethnicity	Eye condition(s)	Educational placement	Number of target words
Adam	M	Pre-K	4:11	Caucasian	Optic nerve damage	Itinerant	14
Bobby	M	K	5:10	Hispanic	Leber's congenital amaurosis	Residential	8
Curt	M	K	5:4	Mixed race	Septo-optic dysplasia	Residential	8
Ellen	F	K	6:8	African American	Alagille syndrome	Residential	8
Gina	F	2	7:5	Caucasian	Coloboma	Itinerant	22
Hal	M	2	7:9	Caucasian	Optic nerve damage	Itinerant	8
Lisa	F	5	10:2	Hispanic	Leber's congenital amaurosis	Residential	20
Mark	M	4	10:7	Hispanic	Retinitis pigmentosa	Itinerant	20
Rachel*	F	8	13:9		Trauma	Itinerant	20
Sue	F	9	14:11	Caucasian	Rod cone dystrophy	Itinerant	30

K = kindergarten.
* Rachel did not disclose her ethnicity.

in baseline. The tool was also administered after each phase as a probe.

Word lists

After administering the adapted ABLS once, the teachers were asked to select a list of the contracted words each student missed in the ABLS. The words the teacher selected were the target words that were used for the remainder of the study. Once the teacher selected these target words, the first author confirmed that the words selected by the teachers were in fact words that the student had missed. The authors recommended that teachers choose 20 target words, but the teachers could choose a different number if they wished. They were instructed to "choose enough words so your student will not learn the entire list in a day or two, but not so many that the student will be overwhelmed." The number of target words for each student varied based on age and ability (see Table 1).

The words were divided into two groups and were matched based on their word frequency to ensure that students did not learn some words more quickly simply because they received more environmental exposure to them. Words were organized by frequency using the Standard Frequency Index (SFI; Breland, 1996), which is based on word frequency as measured by the Educator's Word Frequency Guide (Zeno, Ivens, Millard, & Duvvuri, 1995). The first author rank-ordered the words according to their SFI and assigned words with an odd rank order number to the TVI Only group and words with an even rank order number to the TVI+Tutor group.

Phases

Baseline

In baseline, the adapted ABLS was administered a minimum of two more times after target word selection. This testing was done to establish that the students definitively did not know any of the target words. Baseline was conducted until there were at least three data points with zero celeration.

Intervention: TVI Only

Half of the student participants were assigned to the TVI Only phase as the first

interventional phase after baseline. In this phase, the teacher was instructed to begin teaching only the target words to the TVI Only group. The teacher was instructed to teach the words in the usual manner and at the typical pace, and was asked to test the words being used in this phase by having the student read the words using ABLS after each instructional period. Teachers were instructed to send the results of testing to the first author on the same day they completed the assessment. This phase was considered complete when the student identified the target words with 100% mastery in three consecutive sessions.

Intervention: TVI+Tutor

Half of the student participants were assigned to the TVI+Tutor phase as the first interventional phase after baseline. In this phase, the teacher was instructed to begin teaching only the target words to the TVI+Tutor group. The words were taught in the typical manner and pace. The teachers were asked to test the student on the selected target words on days they worked with the student or on days the student used Braille Tutor. If the student used the device on a day when the teacher was not present, the teacher was asked to have a classroom teacher or paraeducator who had received training in conducting the assessment evaluate the student on the target words. Participants were required to use the device a minimum of two times per week, but were permitted to use it as often as they liked. On average, participants used the device three times per week, with a range of one to five times. In all but two instances, when the device was only used one time per week, it was because the participant began using it at the end of the week or had met the criteria after one session during a particular week. The average session with the Braille Tutor lasted approximately 15 minutes, but varied based on the number of words on each student's individualized list. This phase was considered complete when the student identified the target words with 100% mastery in three consecutive sessions.

Probes

Between the two intervention phases and after the completion of the second intervention phase, teachers were instructed to administer the adapted ABLS so the authors could see the students' total contraction knowledge at different points throughout the study. This ongoing monitoring helped control for maturation as a threat to internal validity and allowed the authors to assess maintenance of words learned in the first interventional phase.

Inter-rater reliability

The teachers were the primary coders of student progress. To ensure teachers were following instructions related to student prompting and feedback as well as coding student errors correctly, teachers were instructed to record a video of a session with a student at least once during baseline and every fifth time during intervention. The video recordings were likewise coded by the first author. In baseline, inter-rater reliability was collected on more than 33% of sessions. In all cases, teachers were 100% reliable in coding student responses on the ABLS. Since they were so reliable in baseline, in order

to reduce the amount of time spent in study activities versus instruction, the percentage of sessions monitored was reduced to 23%. All reliability checks held at 100%.

Teacher interviews

Following the student's work with the Braille Tutor, the teachers were interviewed by the second author. Interviews lasted 20 to 30 minutes and were designed to understand the experience the teacher and student had using the device and the teacher's thoughts on how it could be expanded and improved. A structured interview containing 14 questions was used.

Results

Data collection occurred from October 2013 to March 2014. Ten students completed all phases of the study.

Demographic data

Teachers

Seven teachers completed the study. All were Caucasian: one (14.3%) was male and six (85.7%) were females. All but one self-reported extreme comfort with a computer. Teaching experience ranged from 1 to 16 years with a median of 11.5 years. Five (71.4%) of the teachers were itinerant and 2 (28.6%) were employed at a residential school. Five of the teachers had 1 student who participated in the study, while 1 had 2 students in the study, and 1 had 3 students in the study.

Students

Table 1 reports the demographic data for the students. Four (40.0%) of the students attended a residential school and the remainder attended their local schools. The students ranged from pre-kindergarten to ninth grade, and they had various eye conditions.

Baseline, intervention, and probes

Data were graphed and analyzed visually. In Figures 2 and 3, instructional days run along the x-axis. The y-axis indicates the percentage of contracted words the students learned. Connected data points represent data that was collected on consecutive days. Data points that are not connected indicate a break between instructional days. The dotted vertical lines indicate a phase change. In baseline, the student participants were assessed on contraction knowledge using the adapted ABLS. The percentage of the total target words (words in both the TVI Only phase and words in the TVI+Tutor phase) the student read correctly was graphed. In the first intervention phase, the student was assessed on the target words for only that phase (TVI Only or TVI+Tutor). The percentage the student read correctly was graphed. The probe following the first phase allowed the authors a measure of maintenance and generalization.

TVI Only phase first

All of the students who were in the TVI Only phase first made progress. Three students who were in the same classroom with the same classroom teacher (who was a teacher of visually impaired students), made slow and steady progress, acquiring one new target word each week (Curt, Bobby, and Ellen). This contrasts with Sue, who made quick progress after an initial period of learning. Lisa learned very quickly, but did not retain all the

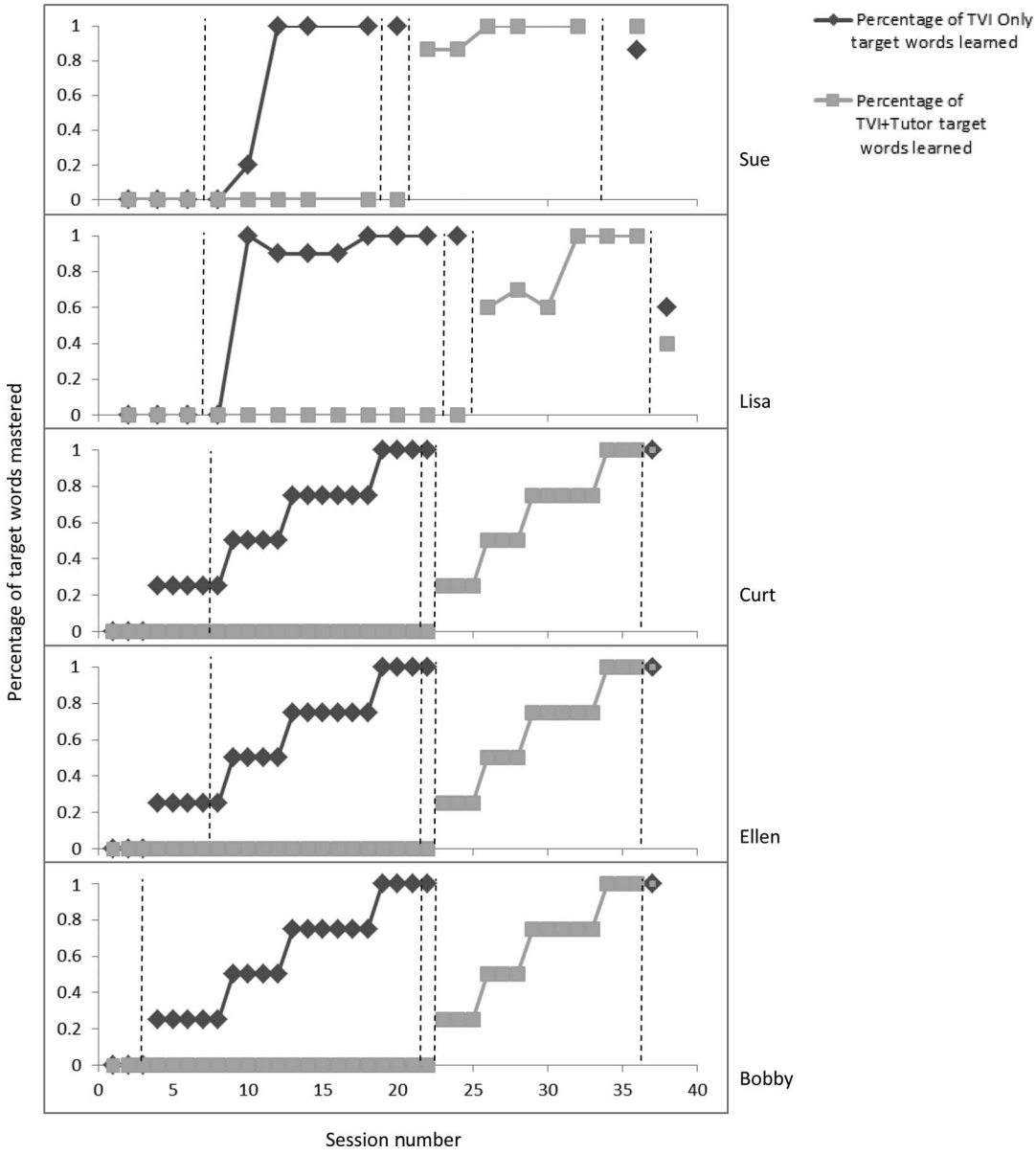

Figure 2. Participants who completed the sequence: Baseline, TVI Only, Probe, TVI+Tutor, posttest.

words she had learned until she had practiced with her teacher several times (see Figure 2).

TVI+Tutor Phase First

Students who began the study in the TVI+Tutor phase also made progress. Most students made a quick jump after the first day of instruction reinforced by the Braille Tutor. One student jumped to 20% correct (Rachel) but did not have a steep increase until the fifth session. It should be noted that the fourth session was when Rachel actually used the device

for the first time, so the steep jump occurred right after its introduction.

Gina's teacher ended the TVI+Tutor phase just before the student's holiday break. She probed the student when the student returned after three weeks. When the evaluator realized that a three-week break had occurred, she asked that Gina return to the TVI+Tutor phase for two more data points at 100% before switching to the TVI Only phase in order to prevent a phase change from occurring after a gap in data collection (see Figure 3).

Pretest and posttest

All students in the study made progress from pretest to posttest on the Adapted ABLS, which measured student contraction knowledge using a word list. On average, students learned 16 (range 9 to 30) braille contractions during the study.

Teacher interviews

The second author conducted telephone interviews with the teachers following the students' work with Braille Tutor. The teachers reported that after initial instruction with the device's functions, the majority of students were able to use it independently with minimal assistance from the teacher. The older the student, the more likely that the student used the device with greater independence. The majority of teachers felt students would be able to use Braille Tutor in the general education classroom with minimal support. The majority of students were positive about using the device, with one second-grader even writing the Braille Tutor a letter to tell "him" how much she enjoyed working with him. Several teachers reported that the motivating factor for their students was the opportunity to use technology, breaking the monotony of working with their teachers. A few teachers reported their students did not enjoy using Braille Tutor after the initial novelty wore off. Reasons cited included that the device did not vary the order of presentation, that the feedback was limited, and that there was significant time needed between pressing "Check My Work" and being provided with the next question. These reasons, though valid, were not under the control of the authors, since the Braille Tutor prototype was limited in its abilities and many schools had slow Internet connections that led to time lags. Typically, the device requires less than one second to process the entered information and respond.

Almost all students learned to navigate Braille Tutor independently once the teacher completed any "setup" (such as setting up the refreshable braille display). Teachers of younger students felt the language used in the feedback was more advanced than the child's level. Several teachers, especially those of older students, reported that the students quickly became bored with the feedback, which did not vary. They suggested, for example, using a variety of reinforcer sounds or phrases such as "Way to go!" or "You aced this one." Several of the students in the study were dual-media users, and their primary literacy medium was print, not braille. Teachers reported that these students navigated Braille Tutor visually, not auditorially. The amount of information on the screen was problematic for one visual user. The teacher suggested that a screen that contained only the braille configuration and the needed buttons in a larger font would be helpful for dual-media users.

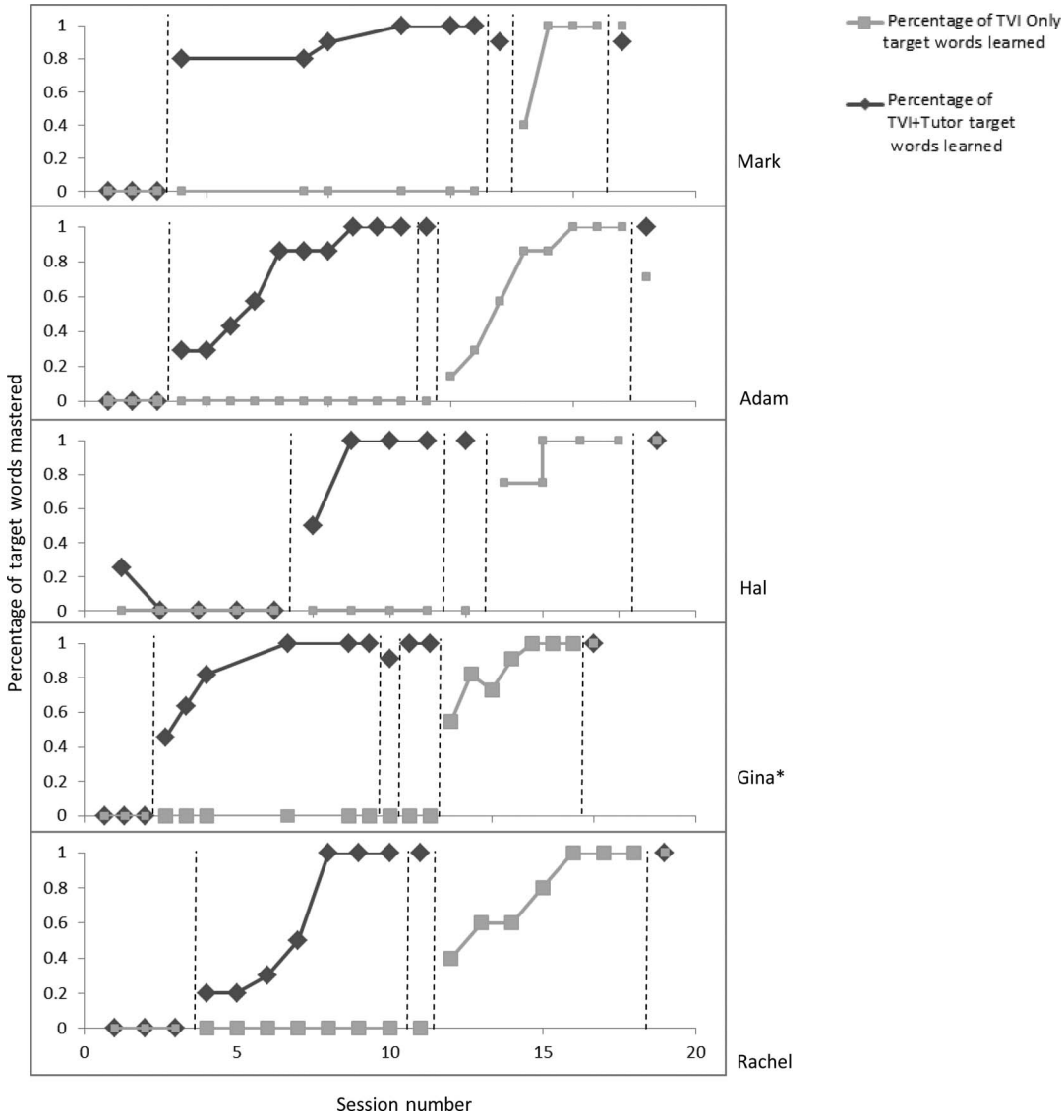

Figure 3. Participants who completed the sequence: Baseline, TVI+Tutor, Probe, TVI Only, posttest.
*Gina had an extra phase. The student had completed the TVI+Tutor phase, but was out of school for the holiday break before the probe. A phase change should never occur after a break in data collection, so the student returned to the TVI+Tutor phase for two additional data points before moving to the TVI Only phase.

Almost all teachers reported that the Braille Tutor concept was a viable one for instruction, especially since students can use it independently after initial training. Several teachers said it would be more viable if students had the opportunity to read and write passages, to play games, and if it could be tied in to a curriculum with activities that built skills such as fluency, decoding, and comprehension. Two teachers suggested that the use of a game-like theme would be valuable, and

another suggested that a curriculum to accompany the Braille Tutor would extend its use in the classroom.

Teachers were positive about their beliefs that a more robust version of Braille Tutor would be effective in increasing a student's acquisition of braille contractions. A teacher of a second-grader commented during the study that her student had mastered 22 contractions. She felt that, without the motivation provided through the use of Braille Tutor, the student might have only mastered 10 contractions in the same amount of time. A teacher of a fourth-grader spoke of how her student had generalized the contractions he learned with Braille Tutor to his general education–classroom work and how she felt this generalization had occurred more quickly as a result of the sessions with it.

Discussion

There are two things to consider when evaluating the student data in Figures 2 and 3. The first is the speed with which the student learned the contractions. Did the student master the contractions in fewer sessions with Braille Tutor, or was the learning equivalent to when the teacher taught the contractions without the assistance of a device? The other consideration is how long instruction took as a whole. Since one purpose of the device was to provide practice to students when they were not able to see an itinerant teacher of visually impaired students, did students receive instruction and reinforcement more often when they were permitted to use Braille Tutor?

An initial evaluation of the graphed results indicates that students mastered all the contractions introduced during both phases of intervention. Taken at face value, this finding could be seen as an indication that Braille Tutor was ineffective. That conclusion, however, would be inaccurate. The goal was never to teach braille contractions without a teacher of visually impaired students, but rather to augment the instruction provided and particularly to offer meaningful assistance when the teacher was not present. Therefore, it is positive that students reached mastery in both intervention phases. Furthermore, a deeper analysis of the data finds that Braille Tutor was effective.

Three important trends surfaced within the collected data. The first trend identified had to do with the number of instructional sessions. A *session* was defined as any time the student worked with the teacher in the TVI Only phase or any time the student worked with the teacher or the Braille Tutor in the TVI+Tutor phase. Students seemed to reach 100% accuracy faster when using Braille Tutor (average = 7.00 sessions; range 1 to 12 sessions) than when they did not use it (average 9.58 sessions with the TVI; range 3 to 16 sessions). Furthermore, the students who used the device more often tended to reach mastery in fewer sessions, while students who used it less often tended to reach mastery after more sessions. Also, students who used Braille Tutor more frequently tended to learn more contractions overall during the study (average = 21.25; range 13 to 30) than did students who used the device less often (average 9.00; range 9 to 9).

A second trend was that the students in the TVI+Tutor phase tended to receive more frequent reinforcement than students in the TVI Only phase. The average length of time between instructional days when the student worked with the teacher

or the Braille Tutor for the TVI+Tutor phase was 0.38 days (range 0 to 6 days). The average length of time between instructional days for the TVI Only phase was 0.65 days (range 0 to 15 days).

A third trend was that the students in the TVI+Tutor phase demonstrated a greater increase in the number of contractions learned during the first day of instruction. The students in the TVI+Tutor phase were also less likely to demonstrate a notable drop in learning after the first day. The average percentage increase in known contractions on the first instructional day for the TVI+Tutor phase was 44% (range 20% to 87%). The average percentage increase in known contractions on the first instructional day for the TVI Only phase was 25% (range 0% to 55%). The authors hypothesize that this increased initial jump was related to increased student motivation when using Braille Tutor.

Limitations

One limitation of the study involved the relatively small number of participants, which made it difficult to conduct group analyses. Although the raw data appeared to show a trend toward students who used the Braille Tutor learning more new contractions during the study and mastering the words more quickly, a Pearson two-tailed correlation did not provide any insight, as the analysis was underpowered.

An additional limitation had to do with braille contraction instruction. Although teachers had input on the braille words selected and were instructed to teach braille as they typically would, many of the participating teachers deviated from their typical practices and only focused on teaching the target words. This increased emphasis on teaching the target words most likely inflated the rate of student learning during the TVI Only phase compared to their typical instruction. This instructional change may have elevated student performance in that phase due to a testing effect. If teachers were not being observed as part of a study, it is likely that students in the TVI Only phase would have mastered target words less quickly, creating a larger difference between the TVI Only and the TVI+Tutor phases. When this issue was addressed with several teachers, the research team received responses such as "I gave the student the words. Then, she wrote them five times each. I asked her to study them for homework and then the next day I tested her." Although this method might represent this particular teacher's way of teaching new contractions, it does not necessarily reflect best practices for teaching braille. It also seems doubtful that the teacher would have typically taught a student that many contractions in one day.

Future directions

The use of tools that employ artificial intelligence, such as Braille Tutor, hold promise for educators as they allow for patient drill and practice with feedback to guide the student. The prototype used in this study should be developed into a more robust version to further evaluate its efficacy. Furthermore, Braille Tutor has the potential to assist individuals as they learn Unified English Braille (UEB) Code after mastering English Braille, American Edition (EBAE). Braille Tutor also has the potential to serve as a refresher course. Teachers of students with visual impairments may occasionally

have stretches of time without a student who reads braille and may need to refresh their own braille skills from time to time. Finally, Braille Tutor could provide preservice teachers in personnel preparation programs with supplementary practice as they learn braille.

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