BVI literature review

Seewoo Li

2024-07-31

Import Data

- The current example data are extracted from Web of Science (WOS).

```r
# import data
data <- xlsx::read.xlsx("savedrecs.xls", sheetIndex = 1) %>%
  filter(!(is.na(Abstract) | (Abstract == "")))

# filter columns
data_reduced <- data %>%
    select(Authors, Author.Full.Names, Article.Title, Source.Title, Document.Type, Conference.Title, Co
data_reduced <- data_reduced[1:234,]
```

Conduct Literature Review

```r
# research questions
r_questions <- "
1. What are the major accommodations currently used for students with BVI in classroom settings and larg
  a. Levels of learning: K-12, Higher Education
  b. Type (Purposes) of assessment: Larger-scale/Classroom; Performance/Aptitude
  c. Accommodations for testing for students with visual impairment
    i. What kind: past and now (classroom, standardized tests, large-scale tests)
    ii. Context of being used (Assessment context & Teaching and learning context)
    iii. Students' reactions to the accommodations?
    iv. Impacts of accommodations and Remediations?
  d. how K-12 students with visual impairment get schooling (or learn in schools) in the United States)
2. How are assistive technologies used in assessing students with BVI in different contexts?
3. How are modeling and scoring procedures adapted for students with BVI in different contexts?
4. What are the impacts of these accommodations on the academic performance and assessment experiences 
5. What gaps exist in the current literature regarding assessment accommodations for students with BVI?
  a. Equivalence of braille version and regular version?
"
```

```r
chunk_size <- 50
n_chunks <- nrow(data_reduced)%/%50
remainder <- nrow(data_reduced)%%50

BVI_lr <- list()
```

```r
for(i in 0:n_chunks){
  if(i!=n_chunks){
    from <- i*chunk_size+1
    to <- (i+1)*chunk_size
  } else {
    from <- i*chunk_size+1
    to <- i*chunk_size+remainder
  }
  # example data
  example_data <- data_reduced[from:to,] %>%
    toJSON(pretty = TRUE)

  # result
  BVI_lr[[i+1]] <- literature_review(
    r_questions = r_questions,
    bib_data = example_data,
    structure = NULL
  )
}
```

```
## Used tokens: 25349 + 1504 = 26853

## Price: $ 0.149305

## Used tokens: 26205 + 2152 = 28357

## Price: $ 0.163305

## Used tokens: 23218 + 1144 = 24362

## Price: $ 0.13325

## Used tokens: 21480 + 1829 = 23309

## Price: $ 0.134835

## Used tokens: 15536 + 1446 = 16982

## Price: $ 0.09937
```

```r
merged <- merge_results(BVI_lr)
```

```
## Used tokens: 8451 + 3301 = 11752

## Price: $ 0.09177
```

Printing Out

Literature Review Summary

Major Accommodations for Students with BVI in Classroom Settings and Large-Scale Assessments

Levels of Learning: K-12, Higher Education

- **K-12**: Various studies have focused on the development and implementation of assistive technologies and educational tools for visually impaired students in K-12 settings. For instance, the "Interactive Urdu Braille Learning System" (Iqbal et al., 2017) and "Dual Braille Code Translator" (Damit et al., 2014) are designed to enhance Braille literacy among young students. Adaptations such as braille transcriptions and tactile models are used to support visually impaired students in subjects like chemistry (de Souza et al., 2021). Oral health education programs using braille booklets and individualized training have shown effectiveness in improving oral hygiene among visually impaired children (Aggarwal et al., 2019; Khan et al., 2021; Das et al., 2019; Sardana et al., 2019; Sharififard et al., 2020; Bhor et al., 2021). The Benetech Math Editor is used in middle and high school settings to assist visually impaired students in solving math problems (Soiffer, 2018). In East Africa, many visually impaired children are inappropriately enrolled in special schools instead of mainstream schools (Tumwesigye et al., 2009). The use of tactile paths and coding tools like Bee-Bot in preschool education (Hacioglu & Suiçmez, 2022), and the implementation of specialized educational care in physical education (Walter et al., 2020). The study by Gudonis (2014) highlights the importance of pre-school education institutions in preparing visually impaired children for school, addressing issues such as hyperactivity, attention retention, and visual-motor coordination.
- **Higher Education**: Research on higher education is less prevalent, but some studies, such as "Factors affecting the reading media used by visually impaired adults" (Goudiras et al., 2009), explore the use of different reading media by visually impaired adults, which can be applicable to higher education contexts. E-learning systems and digital libraries are developed to support visually impaired students in higher education (Rana et al., 2014; Christensen & Stevns, 2012). Assistive technologies like voice recognition browsers and mobile applications for braille conversion are also utilized (Zaman et al., 2007; Farinella et al., 2015). The number of visually impaired students in higher education has increased due to positive political actions and changes in basic education (da Silva & Pimentel, 2021). However, actual inclusion requires suitable physical and material infrastructures (da Silva & Pimentel, 2021). Research has also focused on higher education, such as the challenges faced by visually impaired students in language education (Al-Busaidi & Tuzlukova, 2017) and the use of assistive technologies to enhance academic achievement (Gkouvatzi, 2010). Suzuki and Araki (2011) propose the Haptic Learning-Science Simulator (HALS) for higher education in science and mathematics, providing haptic experiences to aid visually impaired students in understanding complex concepts.

Type (Purposes) of Assessment: Larger-scale/Classroom; Performance/Aptitude

- **Classroom Assessments**: Tools like "BrailleBlocks" (Gadiraju et al., 2020) and "Slate Master" (Lee et al., 2017) are used to facilitate classroom learning and assessments. Use of braille transcriptions and adapted teaching materials in subjects like chemistry (de Souza et al., 2021). Oral health education programs using audio aids and braille booklets (Aggarwal et al., 2019; Khan et al., 2021; Das et al., 2019; Sardana et al., 2019; Sharififard et al., 2020; Bhor et al., 2021). The Smart Learning Assistance tool uses deep learning and computer vision techniques to assist visually impaired students in classroom settings (Srivastava et al., 2021). Studies have highlighted the use of assistive technologies and specialized tools to facilitate classroom assessments. For example, the use of 3D printed haptic models for teaching computer science (Papazafiropulos et al., 2016) and the development of a tangible programming game for creating accessible audio stories (Koushik et al., 2019). The study by van Leendert et al. (2022) discusses the use of braille displays and text-to-speech synthesizers in mathematics education, emphasizing the need for teachers to develop TPACK knowledge to effectively use these technologies.

- **Large-Scale Assessments**: The literature does not provide specific examples of large-scale assessments, but the need for accessible testing formats is implied in studies like "Effectiveness of technology for braille literacy education for children" (Hoskin et al., 2024). Development of braille reading assessments and the use of refreshable braille displays for standardized tests (Posey & Henderson, 2012). Research on large-scale assessments is less prevalent, but some studies have addressed the need for accessible formats and accommodations in standardized testing environments (Augestad et al., 2012).

Accommodations for Testing for Students with Visual Impairment

What Kind: Past and Now (Classroom, Standardized Tests, Large-Scale Tests)

- **Past**: Traditional methods included manual Braille transcription and the use of tactile materials (Doichinova et al., 2019).
- **Now**: Modern accommodations include digital Braille tools, mobile applications, and IoT-based systems (Latif et al., 2023; Ardiansah & Okazaki, 2021).
- **Classroom**: Braille transcriptions, tactile models, and adapted teaching materials (de Souza et al., 2021; Kao & Mzimela, 2019). The Benetech Math Editor and Smart Learning Assistance tool are used in classroom settings (Soiffer, 2018; Srivastava et al., 2021). Accommodations include the use of tactile and audio tools, specialized educational care, and assistive technologies (Walter et al., 2020; Papadopoulos & Goudiras, 2005). The use of intelligent tutoring platforms and e-learning solutions, as discussed by Brzoza and Mackowski (2014), has improved accessibility for visually impaired students in mathematics education.
- **Standardized Tests**: Braille reading assessments and refreshable braille displays (Posey & Henderson, 2012). Limited data available; however, the need for accessible formats and accommodations is acknowledged (Augestad et al., 2012).
- **Large-Scale Tests**: Use of digital libraries and e-learning systems (Christensen & Stevns, 2012; Rana et al., 2014).

Context of Being Used (Assessment Context & Teaching and Learning Context)

- **Assessment Context**: Tools like "Braille to Speech Prototype Application" (Ardiansah & Okazaki, 2021) are used to facilitate independent study and assessment. Braille reading assessments and oral health education programs (Posey & Henderson, 2012; Aggarwal et al., 2019; Khan et al., 2021; Das et al., 2019; Sardana et al., 2019; Sharififard et al., 2020; Bhor et al., 2021). The study by Hannan (2007) explores the assessment processes in specialized schools for visually impaired students, focusing on the reliability and validity of various measurement tools.
- **Teaching and Learning Context**: Interactive tools such as "BrailleBlocks" (Gadiraju et al., 2020) and "Slate Master" (Lee et al., 2017) are used to enhance the learning experience in classrooms. Adapted teaching materials, tactile models, and digital libraries (de Souza et al., 2021; Christensen & Stevns, 2012; Rana et al., 2014). The Smart Learning Assistance tool ensures convenient two-way communication with instructors and peers, making learning easier for visually impaired students (Srivastava et al., 2021). Assistive technologies and specialized tools are integrated into the teaching and learning process to enhance accessibility and learning outcomes (Al-Busaidi & Tuzlukova, 2017; Koushik et al., 2019). The study by Attie and Costa (2023) identifies the argumentative categories used in mathematics teaching activities for visually impaired students, highlighting the importance of inclusive teaching practices.

Students' Reactions to the Accommodations

- **Positive Reactions**: Studies like "BrailleBlocks" (Gadiraju et al., 2020) report positive feedback from both students and parents, highlighting the effectiveness of interactive and collaborative learning tools. Improved oral hygiene and academic performance (Aggarwal et al., 2019; Khan et al., 2021; Das et al., 2019; Sardana et al., 2019; Sharififard et al., 2020; Bhor et al., 2021). Visually impaired students in

Ghana supported inclusive education, although some students without disabilities disliked the practice (Asamoah et al., 2018). Students have generally responded positively to accommodations, reporting improved accessibility and learning experiences (Nowland et al., 2024; Papadopoulos & Goudiras, 2005).
- **Negative Reactions**: Some challenges remain, such as the need for more training for teachers and the diversity of visual impairments (Papadopoulos & Goudiras, 2005). Haegele et al. (2023) explore visually impaired students' views on activity modifications in physical education, revealing mixed feelings about the effectiveness and necessity of these modifications.

Impacts of Accommodations and Remediations

- **Improved Literacy and Engagement**: Tools like "BrailleBlocks" (Gadiraju et al., 2020) and "Interactive Urdu Braille Learning System" (Iqbal et al., 2017) have shown to improve literacy rates and engagement among visually impaired students. Enhanced academic performance and oral hygiene (de Souza et al., 2021; Aggarwal et al., 2019; Khan et al., 2021; Das et al., 2019; Sardana et al., 2019; Sharififard et al., 2020; Bhor et al., 2021). The Smart Learning Assistance tool significantly improves the efficiency and quality of education for visually impaired students (Srivastava et al., 2021). Accommodations have been shown to improve learning outcomes and participation in educational activities (Walter et al., 2020; Koushik et al., 2019). The study by Pamewa et al. (2024) evaluates the effectiveness of different tooth-brushing methods for blind children, showing significant improvements in knowledge, attitude, and oral hygiene.
- **Remediations**: Ongoing need for professional development and training for teachers to effectively use assistive technologies (Al-Busaidi & Tuzlukova, 2017).

How K-12 Students with Visual Impairment Get Schooling (or Learn in Schools) in the United States

- **Specialized Tools and Technologies**: The use of specialized tools such as "BrailleBlocks" (Gadiraju et al., 2020) and "Slate Master" (Lee et al., 2017) is prevalent in the U.S. educational system to support visually impaired students. Use of braille transcriptions, tactile models, and adapted teaching materials (de Souza et al., 2021; Kao & Mzimela, 2019). Programs like specialized educational care in physical education have been implemented to support visually impaired students (Walter et al., 2020). Efforts to integrate visually impaired students into mainstream classrooms with appropriate accommodations and support (Herold & Dandolo, 2009).

Assistive Technologies in Assessing Students with BVI in Different Contexts

- **Braille Learning Tools**: Various studies have developed tools like "Interactive Urdu Braille Learning System" (Iqbal et al., 2017) and "Dual Braille Code Translator" (Damit et al., 2014) to assist in Braille literacy.
- **Mobile Applications**: Tools like "Slate Master" (Lee et al., 2017) and "Braille to Speech Prototype Application" (Ardiansah & Okazaki, 2021) are used to facilitate learning and assessment through mobile devices. E-learning systems, digital libraries, voice recognition browsers, mobile applications for braille conversion, and assistive molecular fabricators (Rana et al., 2014; Christensen & Stevns, 2012; Zaman et al., 2007; Farinella et al., 2015; Lounnas et al., 2015). The Haptic Video Player uses mobile robots to create tangible video annotations, making dynamic visual content accessible to blind individuals (Guinness et al., 2018). The Wikipedia Math Accessor provides natural language descriptions of mathematical formulas, improving accessibility for visually impaired students (Sepúlveda & Ferres, 2012). Digital texts: Use of new technologies to improve access to information and learning literacy (Papadopoulos & Goudiras, 2005). Remote learning: Platforms like TeoDeVi for remote training exercises and consultations (Zimmermann et al., 2005). Programming tools: Development of accessible programming tools like StoryBlocks (Koushik et al., 2019). The study by Isazade (2023) reviews

advancements in navigation technologies, highlighting the positive impact of mobile applications and web services on the quality of life for visually impaired individuals.

Modeling and Scoring Procedures Adapted for Students with BVI in Different Contexts

- **NA**

Impacts of Accommodations on Academic Performance and Assessment Experiences of Students with BVI

- **Positive Impacts**: Studies like "BrailleBlocks" (Gadiraju et al., 2020) and "Effectiveness of technology for braille literacy education for children" (Hoskin et al., 2024) report improvements in academic performance and engagement. Improved academic performance, oral hygiene, and inclusion in mainstream education (de Souza et al., 2021; Aggarwal et al., 2019; Khan et al., 2021; Das et al., 2019; Sardana et al., 2019; Sharififard et al., 2020; Bhor et al., 2021; Christensen & Stevns, 2012; Rana et al., 2014). The Smart Learning Assistance tool and the Benetech Math Editor have positive impacts on the academic performance and assessment experiences of visually impaired students (Srivastava et al., 2021; Soiffer, 2018). The study by Rathore et al. (2021) shows that a customized oral health education program significantly improved the oral health of visually impaired children. The study by Budak et al. (2023) demonstrates the positive impact of a voice-assisted online exam system on the assessment experiences of visually impaired students.

Gaps in the Current Literature Regarding Assessment Accommodations for Students with BVI

Equivalence of Braille Version and Regular Version

- **Limited Data**: There is a lack of comprehensive studies comparing the equivalence of braille and regular versions of assessments (Augestad et al., 2012). The study by Cryer et al. (2013) examines the adoption of Unified English Braille (UEB) in the UK, revealing mixed opinions among stakeholders about its advantages and disadvantages.