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Yoshimi Matsuzaki, Ph.D., *Department of International & Cultural Studies and Inclusive Education Support Division, Tsuda University*, Kodaira, Japan, mtzyoshi@tsuda.ac.jp

Wakaba Hamamatsu, *Graduate School of International & Cultural Studies and Inclusive Education Support Division, Tsuda University*, Kodaira, Japan

Kuniomi Shibata, Ph.D., *Department of International & Cultural Studies and Inclusive Education Support Division, Tsuda University*, Kodaira, Japan, kshibata@tsuda.ac.jp

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Reasonable Accommodation and Information Accessibility by Various Formats the Difference Between Braille, Sign Language, and Speech Format

Yoshimi Matsuzaki, Ph.D.
Department of International & Cultural Studies and Inclusive Education Support Division, Tsuda University, Kodaira, Japan

Wakaba Hamamatsu
Graduate School of International & Cultural Studies and Inclusive Education Support Division, Tsuda University, Kodaira, Japan

Kuniomi Shibata, Ph.D.
Department of International & Cultural Studies and Inclusive Education Support Division, Tsuda University, Kodaira, Japan

Abstract: Information accessibility for persons with visual disabilities is the transformation into text data, braille or speech format. For persons with hearing disabilities, information accessibility includes closed-captioning, notetaking, and sign language translation services. Although such methods are standard and essential, this paper will discuss possible differences in comprehensibility between these various formats. We designed a research project, 'Reasonable Accommodations of Reading Accessibility (RARA),' to evaluate the consistency of academic quality in braille, sign language, and speech formats. First, we will focus on the features of the Japanese language, because these features could possibly affect the differences in the understanding among each means of conveying. Second, we introduce two concepts, Basic Interpersonal Communicative Skills (BICS) and Cognitive Academic Language Proficiency (CALP), as key factors in our research project. Third, we will discuss the outcomes of interviews from 2018 that targeted each two users of braille and of sign language. The outcomes suggested mainly about unique ways of understanding content in various means of transmission. Finally, we will outline the present phase of the RARA project.

Keyword: Information Accessibility; Reading Accessibility; Higher Education; Means of Transmission

Knowledge Focus: Research/Theory Focus

Topic Area: Post-Secondary Education

Information Accessibility in Japan

The ‘Japanese Disability Discrimination Act’ has been in effect since 2016 and promotes reasonable accommodations for students with disabilities in most universities. Article 3 of the United Nations Convention on the Rights of Persons with Disabilities lists eight general principles, one of which is ‘accessibility’ (UN General Assembly [UN], 2007). Article 21 states that private entities should be encouraged to provide “information and services in accessible and usable formats for persons with disabilities” (UN, 2007, p. 12).

Many campus Disabled Students’ Services (DSS) provide sufficient information accessibility. Many service providers and researchers accumulate and share good examples of information accessibility. Reports (Japanese Student Services Organization [JASSO], 2019) indicate that many students with disabilities are aware of the various accommodations that are available to them.

This article concerns ‘information accessibility’ for persons with disabilities and also concerns other stakeholders who provide contents such as DSS, service providers, information coordinators. Many people with disabilities require assistance to access information. For example, a person with visual difficulties may not be able to access textual information unless it is conveyed via non-visual means. There are some key ways we could assist this type of user, which includes conversion of the text into audio media or braille. The audio media might consist of recording someone as they read out loud the text. Alternatively, the person could use a screen reader; a software application that converts text into speech. Modern screen readers come with verbosity settings that can differentiate the meanings of homophones. As we will discuss later (see “Braille in Japan”), the user might use a refreshable braille display, which relays the text on the computer monitor to the user via rising pins on a flat surface.

One way to ensure information accessibility in this case would be to provide sign language translation. Such provision is necessary, given that sign language is a language different from Japanese. Article 2 of the UN Convention stipulates that “‘Language’ includes spoken and signed languages and other forms of non-spoken languages.” There have been some notable examples (see Egusa, et al. 2015 and Hatano, Teruyama, & Matsunami, 2018) where Japanese text has been translated into sign language for the hard of hearing. Nonetheless, there is now a discussion about the need to train signers of staff members for universities and other higher education institutions. As we will discuss later (see “Sign Language in Japan”), the most pressing issues concern the need to help students gain the expert knowledge required for these accommodations.

Accommodation technologies and services undoubtedly benefit higher education students with disabilities, however, students will need to actively search for information related to their field of study as well as more general information. Because higher education requires students to discuss and research for developing highly specialized knowledge. The process of

learning on campus needs a more detailed understanding and careful approach from each view of points. In the process of learning in higher education, a student's ability with disabilities to process such information will depend to a large extent on individual factors unrelated to her/his disability. In the current study, we predicted that the differences of information transmission will have some significant impacts on their understanding of reading acquisition.

We will now move on to the question of how students with disabilities could and/or should read and digest academic contents. As alluded to earlier, students require a relativized, contextualized understanding of information in order to understand and interpret it correctly and to engage in discussions. Later, we will discuss how information should be presented to students in order to ensure an accurate understanding, even when there are individual differences between students.

Difference Among Means of Information Transmission

For different forms of information distribution, textbooks and text materials usually transform into braille or speech forms to make them accessible as reasonable accommodations of information accessibility for persons with visual disabilities. Learning institutions provide notetaking services and sign language for persons with hearing disabilities. These services follow the guidelines of the Japan Student Service Organization (JASSO) as a standard form of reasonable accommodation in higher education (Japan Student Service Organization [JASSO], n.d.). These guidelines have outlined the methods and the necessity of reasonable accommodation for information accessibility. They do not, however, represent whether the conventional methods within the guidelines could guarantee the closest equivalent to the original content.

It is well known in linguistics, even when the materials are in the same language, the impressions and understanding of that information depends on the form of the characters. The modification of fonts, font-colors, and styles are all ways that readers receive detailed information. Some foreign language learners need to access not only the translated text but also the original version in order to better understand the information. This is because there are possibilities of getting subtle different nuances through the process of translation. Previous studies of disabled student's literacies (i.e., Association on Higher Education and Disability [AHEAD], 2011; Leko & Griffin 2009, etc.) have recognized the potential of this issue in translations and access multiple versions of a text in order to compare the differences.

Our research focuses on the differences among braille, speech format, and sign language and discusses the characteristics of these means of information transmission. In many cases, when persons with disabilities receive content, it is provided with no consideration for ambiguities that might result from differences in format because the format they use is the only one they have available to them. We presume that each format has unique characteristics that can affect how easy or difficult it is to convey information in that format. Furthermore, these formats

of users might reinforce their literacies through digital divide situations without their intentions. This means that they have to recover the gap by their efforts, which should be adjusted as a reasonable accommodation. In the next section below, we would like to give more consideration to the fact that the Japanese language demands that service providers consider the unique characteristics.

Braille in Japan

Braille is a tactile writing system in which users receive information by touching raised dots. Braille characters are made up of six dots arranged in two columns of three dots each, and generally, one block represents one letter. The present style of braille was invented by Louis Braille in France in 1824 (Simpson, 2013).

In English braille, fundamentally, one letter of the alphabet has a corresponding braille letter. In Japanese, however, each syllable of a word has a corresponding braille letter, and this system sometimes makes it difficult for braille users to read; because the Japanese language includes an ideogram. Japanese language has four kinds of writing systems, kanji, hiragana, katakana, and romaji which are represented by alphabets.

Writers understand that there are subtle differences between the four writing systems. Hiragana and katakana are generally called phonograms, which consist of 46 characters that correspond to each syllable in Japanese. Kanji is used as ideograms where each character has a meaning. Japanese words are represented in hiragana, katakana, and kanji with the same pronunciation, but there are differences in nuance in each writing system. Most writers use hiragana or kanji letters to indicate specific meaning. For Japanese readers, how something is written in each writing system is an essential clue to understanding differences in meaning, especially because words are pronounced the same. Therefore, the Ministry of Education encourages students to read sentences through distinguishing hiragana, katakana, and kanji (Central Council for Education, 2016).

Readers can imagine the meaning of kanji, even if they cannot pronounce it. This means that an ideographic writing system such as kanji provides more readability than a phonographic writing system such as hiragana and katakana. Japanese braille is similar to the phonographic writing system because it does not have any ideographic characters. Inevitably, Japanese braille cannot identify differences between homophones for the reader, and the ideographic Japanese writing system (i.e. kanji) has many homophones. Japanese braille users must infer the meanings of words from context or to refer to annotations provided by braille translators. In many cases, because there is no standardized rule about inserting annotations, annotations depend on the interpretation of the braille translators. Certain types of annotations run the risk of being misleading or noise for braille users.

In higher education, learners must not only understand the information they read, but also analyze it critically. This means that learners need to pay careful attention to the texts themselves. In the case of academic content, and especially in Japanese, when learners only have access to a spoken version of the text, they receive limited information. Since students do not know how the sentences were written, they lack the necessary context. The way the information is written and presented in a particular writing system affects how deeply a reader or learner understands the text.

The Japanese language has 46 basic syllables, and also includes several voiced consonant syllables and plosive syllables—contracted sounds—which brings the total number of syllables to approximately 115. The combinations of dots in braille are only 64 patterns. Some sounds of the Japanese language need the combination of some brille, using numbers and alphabets in the Japanese braille also need such combinations. For example, in English, braille can express 'the' or 'and' as one letter of braille (Simpson, 2013). However, the Japanese letter 'あ,' the letter 'A,' and the number '1' all use the same combination of 6 dots in braille. In order to distinguish them, braille readers need a particular braille that indicates whether the next letter is number or letter (National Association of Institutions of Information Service for Visually Impaired Persons [NAIIV], 2019).

Braille has options to indicate special characters and particular font styles such as bold or underlined text. For example, braille is capable of expressing a parenthesis, square bracket, angle bracket, brace, and double parentheses. In some cases, however, the combined use of parentheses and quotations can lead to misunderstandings for both braille translators and readers because Japanese does not have a firm rule on how to insert these kinds of annotations. The authors always include special annotations as necessary, and readers are better able to grasp the authors' intention and meaning because they can understand how the author wrote. Attributable to problems such as this, it is important that there is a translation method for braille that accounts for these special annotations.

One of the difficulties in translating Japanese academic texts into braille is the mismatch between braille as a kind of phonogram and the Japanese language as an ideogram. Because braille does not indicate the nuanced differences between the various Japanese writing systems, braille users can find it difficult to recognize homophones, which sometimes include significant academic information. When authors use kanji as a rhetorical tool, the information that is conveyed by the form of the kanji is an essential clue for the reader to thoroughly understand the content. Although braille translators insert annotations to assist braille users, they are not always sufficient for a critical reading of the material because the additional information is dependent on translators' interpretation. In addition, the standardized rules that determine how to insert annotations in Japanese texts are insufficient in braille, which largely relies on grass-roots volunteers to translate. Each translation volunteer group has its own unique rules. This means that locality and other factors can subtly affect the way braille is translated.

Sign Language in Japan

Japanese sign language has been brought to public attention in recent years. Currently, sign language is one of the most important formats of communication for persons with hearing difficulties. Japanese sign language (JSL) is a unique language with its own independent linguistic system and is not the same as a signed Japanese, which uses Japanese grammar and vocabulary. The pairing of JSL and signed Japanese is similar to ASL and Sim Com.

Generally, languages create vocabularies through the combinations of vowels and consonants according to the rules of the language. In the case of JSL, the vocabulary comes from a combination of hand forms, position, motion, and direction of the palm. JSL also has an expression type called classifier (CL), which stands for the shape of the object, motion, and size. The use of CL corresponds to the use of adverbs in Japanese. JSL not only uses the hands and fingers, but the whole face. The motions of the eyebrows, eyes, mouth, jaw, and head play an important role in JSL. The motion and shape of the mouth are just as important as hand and finger movements to express a proper meaning in JSL. It is a language with independent grammar, and it is systematized by body parts and their motions. JSL is a language system that is able to concretely express situations. For example, the verb 'to eat' is expressed more concretely in JSL than in Japanese. JSL needs to describe how to eat something, with chopsticks, with hands, with a spoon, etc. That is, JSL's expression includes more detailed descriptions of the action because JSL needs details to express information concretely, and this makes it unique.

The importance of JSL in higher education has increased over the past few years, because sign language users can make their effort to learn and discuss on campus by the accommodation of sign languages. Prior to this, most persons with hearing difficulties in Japan had to receive an auditory-oral education and did not have much chance to learn in JSL. Students with hearing difficulties often learned JSL from their classmates after they entered university. It is more common for someone to learn JSL from their peers and communities rather than their parents. Because of this, JSL has subtle variations among generations, localities, and communities. The locality of sign language is reflected as unique dialects.

JSL has the significant potential to assist students with hearing disabilities receive clearer information, and it is believed this will motivate JSL users to learn within their communities or to learn in higher education. For a long time, people with hearing difficulties got information from the limited speech sounds they could hear or from lip-reading, both of which are not sufficient for deep understanding. Since there are various patterns of hearing disabilities, JSL does not always resolve communication problems. However, recent trends in higher education for persons with hearing disabilities places a greater importance on JSL. One example is the project of translation into JSL of an academic thesis titled Considering the Accessibility of Academic Publishing: From the Practice of Sign Language Translation of Books (Hatano, 2019). Some museums also arrange for staff, who are fluent in JSL and utilize videos in JSL, to describe the objects in the museum (Egusa et al., 2015). On campus, there is a growing need for

JSL for information accessibility. For students with hearing disabilities, JSL translators provide assistance to the students which allows them to join class discussions. Skill-up courses for JSL translators are gradually needed and opening of the students with hearing impairment deal with technical and abstract concepts in higher education (Sasaki, 2019).

On campus, learners are generally required to discuss and consider abstract topics, such as philosophy or sociology. In sociological thinking, students must consider events and phenomena from various aspects and it is presumed that there are no 'right' answers (Giddens & Sutton, 2014, 2017). One feature of JSL is that it can express information concretely. Owing to that, it can be a challenge to represent abstract concepts and technical terms. One researcher of JSL, Takei (2003), suggests that as a language, it should express all genres of contents. He also comments that the difficulties of understanding concepts in JSL depends on the students' level of proficiency with the language. However, the question remains whether generational and community JSL variations affect JSL proficiency level.

Concrete expression in JSL depends on detailed information. Therefore, JSL translators need to understand the details of materials and how to express them concretely. At the same time, this raises a question: how to translate unknown or ambiguous concepts into JSL. In higher education, classes deal with abstract topics and, often, the discussions that arise from these abstract concepts do not have a single, correct answer. JSL needs detailed accurate information for proper expression, and such a style makes it difficult to translate things such as philosophical and sociological topics into JSL. If JSL translators persist in concreteness, they run the risk of affecting their translations with their own bias.

Difference Between BICS and CALP

Having qualified the differences between translation formats and information accessibility, we will now proceed to the difference between 'literacy' and 'understanding.' Considering information accessibility in higher education, we see two types of literacy: academic literacy and literacy of everyday life.

Organization for Economic Co-operation and Development (OECD) (2009) reports that in Japanese higher education, "Universities have as their aim to conduct teaching and research in-depth in specialized academic subjects, to operate as 'centers of learning,' and to 'develop intellectual, moral and practical abilities'" (p. 11).

Previous studies described our thinking skills in six steps: Remember, Understand, Apply, Analyze, Evaluate, and Create (Anderson & Krathwohl, 2001; Bloom, 1956). They discussed how our thinking skills grow from Remember to Create (see Figure 1).

Figure 1. Revised Bloom's Taxonomy

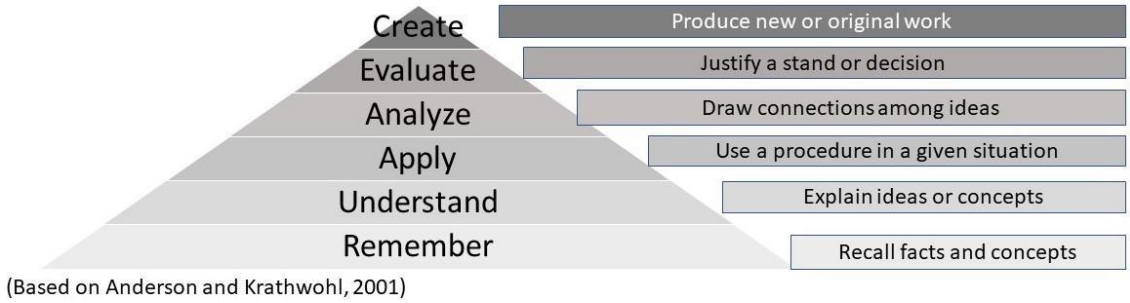

Figure 1 Image Description: Revised Bloom's Taxonomy, pyramid chart is the researchers' thinking skills consisting of six steps: Remember, Understand, Apply, Analyze, Evaluate, and Create. The Remember step is to recall facts and concepts; Understand step is to explain ideas or concepts; Apply step is to use a procedure in a given situation; Analyze step is to draw connections among ideas; Evaluate step is to justify a stand or decision; and Create step is to produce new or original work.

Bloom (1956) pointed out in particular that each thinking level has a unique literacy. These developing processes could be divided into two phases: academic literacy and daily literacy. This categorization is similar to Cummins' distinction between *Cognitive Academic Language Proficiency*, CALP, and *Basic Interpersonal Communicative Skills* BICS. Cummins (1984) explained the difference between CALP and BICS with two concepts: 'cognitively' and 'context.' He argued about CALP that learners need certain stocks of knowledge in order to read and understand difficult sentences; and defined that BICS is 'context embedded' and 'cognitively undemanding' (Cummins, 1984). Students' literacy evolves from BICS into CALP as they move through school.

Students need CALP more than BICS to understand academic content in higher education, and this has a strong influence on information accessibility. Many students develop the interest-specific abilities that allow them to effectively investigate their topics on campus. The students' learning process requires attentive reading, practical thinking, and a logical systematization of what they have learned. This process includes a manipulation of abstract concepts as well as detailed analysis and careful observation. Therefore, we presume that a particular means of transmission will have some obstacles to CALP academic reading because each means has unique characteristics. It is probable that the Japanese braille has some trouble with careful attentive readings of Japanese academic texts because Japanese braille, as a phonogram, has a different writing system from the Japanese writing system. JSL also faces translation difficulties for abstract concepts and technical terms.

Research Project & Pre-test

RARA Research Project

We will discuss and consider differences among means of transmission—braille, speech format, and sign language—through our research project, the Reading Accessibility of Reasonable Accommodation (RARA). For our project, the primary topic is information accessibility, especially the difference in the quality of understanding with each means of transmission. It is possible that the Japanese language will impact the quality of students' understanding. Though braille is a kind of phonogram, the Japanese language includes the ideogrammatic kanji letters. Japanese braille cannot express the authors' detailed meaning, which is described by ideograms, in the process of translation. Sign language has an advantage in that it can express more concrete information in comparison with other means of transmission, but there are problems when users try to translate abstract concepts into JSL. There is a significant difference in the actual process of reading between CALP and BICS. As far as we know, there have been few reports that examined differences in means of transmission, especially BICS and CALP in higher education.

Interviews: Users of Japanese Braille and Sign Language

To prepare our questionnaire, we conducted interviews with two braille users and two sign language users about their disabilities and their experiences of reading books. We held the interviews on December 23, 2018, December 25, 2018, and February 11, 2019.

The braille users were both researchers in research institutes, and they had been blind since before they were 8 years old. Both began to learn braille at the beginning of their elementary school life.

One participant's specialty is mathematics, and he primarily reads English texts about mathematics. He mentioned that he does not like reading books because it requires in-depth concentration and this often makes him exhausted. Usually, he reads these texts through a combination of a braille display and a speech format. At the age of 8, he moved to a school for the blind. This caused some instability in his life because he had to separate from his friends. Before he had moved to the school for the blind, he and his friends often played a video game, so after he moved, he kept playing it using only the sound. He was able to utilize the sound of the game as a guide and enjoyed playing video games.

The next participant specializes in politics. He repeatedly practiced braille when he was a child and obtained literacy. He read books because it was the only way for him to spend time. At his young age, other children with visual disabilities were in similar situations, they spent their time reading books. Moreover, they often read 'classic good books' which have been translated into braille through directions by the Ministry of Health, Labor and Welfare, because it was hard to get books translated into braille.

His current reading style is mostly speech format. He converts books into text formats through Optical Character Recognition / Reader (OCR); OCR and then can use them. He also referred to this style as "gathering information," and that it seemed to be far from reading books. For him, reading by braille or braille display device gives him a better understanding, so he thinks of this method more as reading. He sometimes reads by a combination of a braille display and a speech format, especially when he needs to understand a difficult text. However, he also mentioned that materials that use frequent kanji are harder to read for him and that these make him exhausted.

Next, we interviewed a married couple with hearing disabilities. The female participant lost a wide range of hearing at three years of age, and the male participant lost most of his hearing range not long after birth. Their mother tongue is Japanese because both of them learned in an integrated class. They learned sign language after they enrolled at university, and now they converse with each other in sign language. Interviews were conducted orally and with notetaking.

For the participants, they read books in written Japanese, and they did not experience any reading content in sign language. They usually read books and made clear images in their head about the written material. The visualization is done precisely and concretely according to how it is described in the books. However, the male participant stated that he experienced difficulties when he read *The Sorrows of Young Werther*, written by Johann Wolfgang von Goethe (1774). He explained that he could not visualize the abstract expressions very well. He also mentioned that when the texts clearly indicated their logic, it was easier to understand, even if they were philosophical topics. The couple also commented on the difficulties of ideograms such as kanji. When they saw unknown words in kanji, they did not, as readers, have a way to refer and understand the meaning unless the pronunciations were indicated.

In addition, they discussed the use of sign language, which requires concrete expressions. The examples they gave demonstrate that JSL needs a process of reconstitution of the meaning: although there is a particular expression for ‘taking medicine’ in Japanese, for sign language users, it is easier to understand this through the expression ‘take medicines.’

These outcomes suggest that each user has a unique way that they understand content and that there are some differences of trend of understanding in various means of transmission.

Main Research Project of RARA

RARA is designed as a longitudinal postal study, and the target participants are persons with visual disabilities and hearing disabilities. Respondents received ‘reading texts’ in either format braille, speech format, sign language, or text as their choice. The six texts consisted primarily of two categories: BICS and CALP. Respondents summarized and made comments about each of the texts, and returned responses to us. We then calculated the responses and analyzed. The main analysis of RARA was compared with the results of the BICS and CALP

texts on each means of information transmission. Generally, the BICS score is presumed to be higher than CALP, regardless of the means of transmission. In addition, profiles of disabilities and the attitudes of reading books are regarded as the variables which should be adjusted; they are questioned at first contact with respondents; the data are also analyzed (see Figure 2). We will conduct a content analysis from the summary and comments of respondents.

Figure 2. The Flowchart of the Process of RARA Project Research

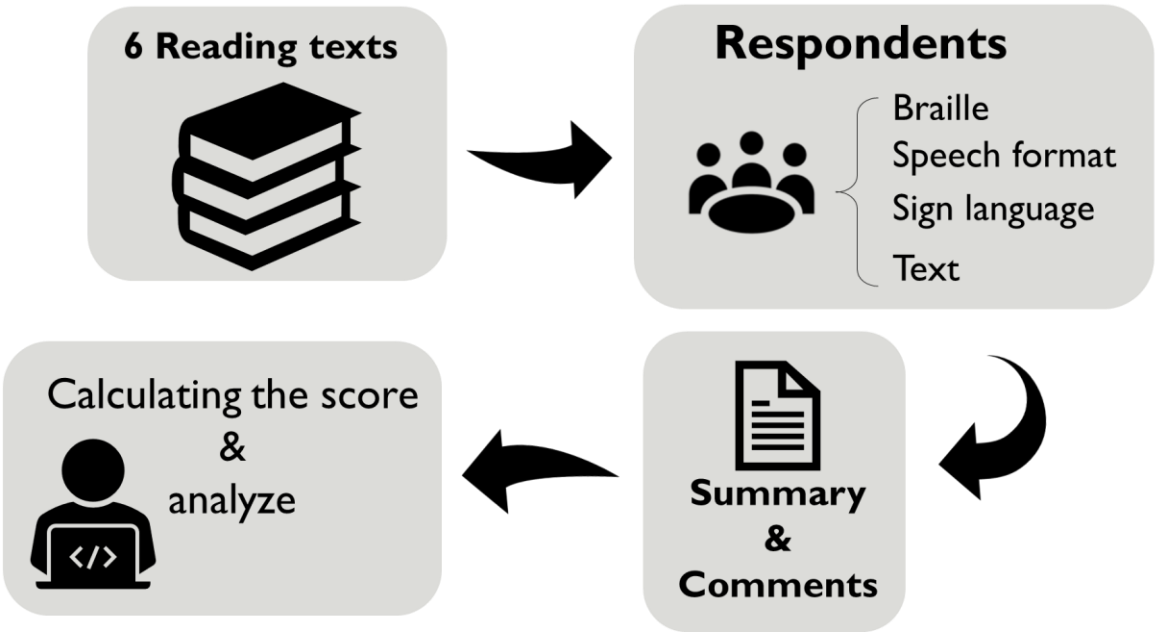

Figure 2 Image Description: The Flowchart of the Process of RARA Project Research is a flowchart of the procedure consisting of 4 steps. First, the six reading texts that include three BICS and three CALP. Second, respondents get a text by turn: The reading texts have been translated into appropriate means of transmission like braille, speech format, sign language, and text. Third, the respondents will make summaries and comments about each reading text and return responses to researchers. Fourth, researchers calculate the scores and analyze them.

In the present study, most people with visual disabilities chose a questionnaire in braille. The questionnaire and texts were translated by a professional braille translator. There are still significant challenges that affect our ability to conduct social research for people with disabilities through the use of questionnaires. We do not have all of the necessary ‘know-how’ to implement quantitative research that targets persons with disabilities. Although it is not unusual for many people to conduct social research with questionnaires, it might be unusual for a person with visual disabilities. Generally, it is a demanding challenge to design a post and cohort study. We also discussed and constructed research logistics with cooperation among braille users and the braille translator.

The JSL version was also exciting and interesting for us. Translations into JSL were performed primarily by Deaf translators and supported by hearing JSL translators. During the process of translation into JSL, abstract portions of sentences were difficult to perform in sign language and, therefore, we need to discuss their expressions. For example, the phrase, "the dialectical tension" was difficult to translate into JSL. The Deaf person who translated the sentence was neither a specialist in linguistics nor philosophy. The Deaf translator told us that she could not translate this phrase into JSL unless she had a clear understanding of it, and that if she tried to translate it literally, the translation would be just 'signed Japanese,' not JSL. Furthermore, she explained that a combination of JSL and signed Japanese could potentially be confusing for the readers and affect their understanding of the text. The process of translation into JSL is ongoing, and the reaction of respondents with hearing disabilities will be presented in a future work.

Conclusion

In conclusion, there are clear differences in understanding between BICS and CALP in both formats, and braille and sign languages. The difference in sign languages, however, is assumed to be larger than in the case of braille. Not only braille and sign language users, but also translators must pay careful attention in order to ensure consistency between the original content and a suitable format. The purpose of our research is to research how information should be presented to students in higher education. In terms of information accessibility for students with disabilities, one should note the difference among the formats of information conveyance.

In higher education, students require CALP, a relativized, contextualized understanding of most contents, not BICS, the familiar literacy of their daily lives. The 'RARA' research project is an ongoing study, which is on the way to discuss the qualitative difference among information formats, and hopes to assist the conveyance for every student with disabilities.

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Correspondence concerning this proceeding should be addressed to Yoshimi Matsuzaki, and Kuniomi Shibata, Department of International & Cultural Studies, Tsuda University, 2-1-1 Tsuda-machi, Kodaira-shi, Tokyo 187-8577 Japan. E-mail: mtzyoshi@tsuda.ac.jp, kshibata@tsuda.ac.jp.

Authors

Yoshimi Matsuzaki, Ph.D., is an associate lecturer at Tsuda University, specializing in social epidemiology of youth with special emphasis on mental health. She received her doctorate from Tsuda University in 2018 and has begun research for reasonable accommodation of reading accessibility (RARA), that aims to examine and consider better accommodation to learn and understand reading material deeper. Employed at the Inclusive Education Support (IES) Division she was a teaching assistant from 2015 to 2016, and community coordinator since 2017. Matsuzaki's role in IES is to connect actors in communities and make opportunities of co-working.
Image Description: Photo of Yoshimi Matsuzaki

Wakaba Hamamatsu is a graduate student at Tsuda University. She majors in disability studies. When she was an undergraduate student, she learned how media and technology influenced the support for people with disabilities. She practiced it through "scene description" for students with visual disability as a volunteer staff in inclusive education support (IES). Since this April, she has been employed by IES as a teaching assistant and held several events and workshops regarding reasonable accommodation. Her main research interest is how to improve the situation of employment of people with disabilities in Japan. *Image Description: Photo of Wakaba Hamamatsu*

Kuniomi Shibata, Ph.D., is an associate professor at Tsuda University and specializes in assistive technology, especially focusing on information technology for persons with disabilities. Currently, he is in charge of support programs for students with disabilities. *Image Description: Photo of Kuniomi Shibata*

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