

[Original Article]

Textual Requirements for High School Students with Developmental Disabilities: Text Analysis About Assessing Educators and Employment Support Professionals in Japan

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Abstract

Background: Individuals with developmental disabilities face various challenges in their educational journey, which often vary as per their particular disability.

Aims: This study aimed to clarify how information presentation should be considered in text teaching materials based on the characteristics of students with developmental disabilities.

Methods: 1. Creation of items to evaluate information presentation methods: As a preliminary survey, a questionnaire survey was conducted by mail (November–December 2008) to collect open-ended comments on “how to present information for creating text materials for children (persons) with developmental disabilities.” Questionnaires were sent to 750 educational institutions and 550 employment support institutions in Japan regarding employment readiness support for persons with developmental disabilities. The educational institutions were (A) regular high schools and (B) special needs schools in the upper secondary school stage. The employment support organizations were (1) Public Employment Security Offices (in charge of employment for persons with disabilities), (2) Vocational Skills Development Centers for Persons with Disabilities, (3) Vocational Centers for Persons with Disabilities, (4) Work/Life Support Centers for Person with Disabilities, (5) Support Centers for Persons with Developmental Disorders, (6) Employment Support Centers for Persons with Disabilities, and (7) Employment Transition Support Offices for Persons with Disabilities throughout Japan. The overall response rate was 33.9% (441 responses), and that for free descriptions was 22.0% ($n = 97$). Based on the opinions (free descriptions) about text materials ($n = 97$) identified in the preliminary survey, 30 items were created with reference to the KJ method. 2. A questionnaire survey was conducted by mail from February to March 2010 to understand how to present information on developmental disabilities according to the characteristics of the disabilities. The number of questionnaire responses was 374 (28.6% response rate). The characteristics of the information presentation method based on developmental disability characteristics were revealed by a correspondence analysis and hierarchical cluster analysis. Respondents to the survey were either teachers at educational institutions or support personnel at employment support agencies.

Respondents had experience in providing employment support to persons with developmental disabilities, and based on their experience, they recalled the general disability characteristics of LD, ADHD, and ASD and responded to the information presentation methods that they considered most important for each of these disabilities. Respondents also responded only to the disability types (LD, ADHD, and ASD) to which they could respond.

Results: To understand the considerations regarding information presentation based on the characteristics of developmental disabilities, a correspondence analysis and hierarchical cluster analysis using the dimension score of the correspondence analysis were carried out ($n = 173$). The information presentation method considered each developmental disability (LD, ADHD, and ASD) and was classified into three groups. A correlation analysis was carried out on the relationship between disability characteristics (LD, ADHD, ASD), and each item (30 items) of the information presentation method was classified into the same group as each obstacle ($n = 173$). A significant correlation was found between the characteristics of each developmental disability and the information presentation method. Text mining was applied to the free description responses (LD: $n = 114$; ADHD: $n = 152$; ASD: $n = 159$). After the extraction of characteristics, sentences were identified containing characteristic words that indicated the considerations necessary for each disability type. For LD, “illustration,” “ruby,” and “picture” were extracted as characteristic words, and the contents of sentences indicated that the use of these words was cited as a device. For ADHD, “information,” “short,” and “many” were extracted as characteristic words, and the contents of sentences indicated that not increasing the amount of information and expressing it in short sentences were cited as devices. For ASD, “concrete,” “necessary,” and “content” were selected, and the content of the sentences showed that explaining specific examples of the content was cited as a device.

Conclusions: This study clarified supporters’ consideration of the information presentation of teaching materials according to the characteristics of students with developmental disabilities.

Keywords: developmental disabilities, autism spectrum disorder, information presentation, text teaching materials, text mining

1. Introduction

1.1 What this paper adds?

For persons with disabilities, working is an important aspect of social participation and education is where students with disabilities acquire skills before entering the workforce. In learning situations, information is often presented as digital materials or paper texts. This study provides useful suggestions by clarifying the findings of practitioners who provide support in these situations. Previous studies report that developmental disabilities contribute to cognitive disabilities (Broman and Grafman, 2014) the degrees of which vary across developmental disorders (Kanai et al., 2012; Kanai et al., 2017). By clarifying how to present information so that it considers the characteristics of different developmental disorders, this study contributes to improving the learning effectiveness of persons with developmental disorders. Key attributes improving text comprehension (McTigue and Slough, 2010) and methods of information presentation for individuals with learning disabilities (Waight and Oldreive, 2021) have been studied. However, previous studies look at a single disorder, neglecting to compare disorders. Additionally, effective items were within the questionnaire set by researchers, and may not reflect unexpected content. Therefore, this study investigated ASD, LD, and ADHD. Further, to effectively reflect the experiences of practitioners in the data, we collected

data through free descriptions. Therefore, we add the cognitive characteristics of information for each developmental disability disorder and effective methods of information presentation, reflecting practical knowledge based on the experiences of practitioners of employment and education.

1.2 Brief overview of Japanese laws regarding persons with developmental disabilities

Learning disabilities (LD), attention-deficit hyperactivity disorder (ADHD), and autism spectrum disorder (ASD) were classified as developmental disabilities in Japan in 2005. The Act on Support for Persons with Development Disabilities was enforced in 2005. This act recommends support based on the characteristics of the obstacles persons with developmental disabilities face and the life stages of persons with such disabilities. The characteristics of the disabilities that are covered by this law are as follows: persons with LD have poorer calculation, writing, and reading abilities than those with typical intellectual development; the characteristics of ADHD include inattention, hyperactivity, and impulsivity; and the characteristics of high-functioning ASD are communication barriers, lack of interpersonal and social skills, patterned behavior, and wavering interest (Ministry of Health, Labour and Welfare, 2008). The Act on Support for Persons with Development Disabilities was revised in 2016. The revised law strengthened the conditions of providing appropriate educational and employment support based on the characteristics of these developmental disabilities. In the future, it is important to provide the support necessary for smooth transitions from education to employment based on the characteristics of an individual's developmental disabilities.

1.3 Issues Related to Transition to Employment for persons with Developmental Disabilities: on Textbooks to Support Work Readiness

In recent years, the difficulty of transitioning from school education to employment has become an issue for individuals with developmental disabilities such as LD, ADHD, and ASD. One of the pre-employment problems is the difficulty in choosing a career path suitable for them (Japan Parents' Association of Learning Disabilities, 2008), while another is separation from employment due to maladjustment in the workplace (National Institute of Vocational Rehabilitation, 2009; 2015).

In order to cope with such pre- and post-employment issues, it is important for students to deepen their understanding of such important aspects of work as social structure and occupational information (job understanding) and their understanding of themselves, such as their interests in work and their strengths and weaknesses (self-understanding), before they graduate from school, as these are fundamental for employment.

In addition, when providing career guidance to strengthen the job understanding of students with developmental disabilities, it is necessary to provide a wide range of information on such matters as vocational rehabilitation, a variety of career options including employment for persons with disabilities, and the differences between general employment and employment for persons with disabilities. As the amount of information to be provided has increased, it is necessary to provide information not only orally, but also in the form of textbooks (on paper). Under these circumstances, it is necessary to consider how to convey the information in the text in an easy-to-understand manner, taking into account the characteristics of disabilities. Accordingly, this study focuses on "employment" texts.

1.4 Disability Types and Cognitive Functioning Disorders in Developmental Disorders

Students with developmental disabilities face various challenges when seeking employment. Individuals with reading difficulties may face obstacles in comprehending and completing

employment-related materials. According to Broman and Grafman (2014), developmental disorders, such as ASD, contribute to cognitive impairment. Cognitive dysfunction negatively impacts reading, as reading requires short-term language memory (Castles et al., 2014). It has been reported that the degree of disability in such language memory varies depending on the disease; that is, verbal memory is high in Asperger's syndrome and low in other pervasive developmental disorders (Kanai et al., 2012). Cognitive functions other than verbal memory also differ depending on the disorder. Adults with ASD have higher language comprehension than adults with ADHD when evaluated by the Wechsler Adult Intelligence Scale-Third Edition (Wechsler, 1997), but the latter have higher picture completion skills (Kanai et al., 2017). In other words, since the characteristics of cognitive function differ depending on the disorder, the effective information presentation method should differ accordingly. Consequently, adults with ASD have lower language comprehension and higher painting skills than adults with ADHD (Kanai et al., 2017).

1.5 Issues related to reading materials and text presentation

The following are some of the ways in which textbooks are used in education. The authors of the current study focused on text teaching materials regarding employment for students (persons) with developmental disabilities. In the field of education, text teaching materials have been examined from the perspectives of plainness, ease of remembrance, and motivation. Specifically, previous studies have identified the following ways to increase users' understanding: including illustrations related to the written content (Larkin and Simon 1987; Mayer et al., 1995; Shimada and Kitajima, 2008); specifying the structure of training material contents, such as paragraphs and items, (Seki, 1997); and finally, providing titles for teaching materials and using illustrations and colorization to increase learners' motivation (Shimada, 2016).

Aside from these ways, the characteristics of developmental disabilities need to be considered, one reason being to create simpler specifications for students with developmental disabilities. The importance of providing teaching materials that consider the characteristics of developmental disabilities is that they guarantee information accessibility for persons with disabilities in the field of education. A previous study reported that it is important to consider the difficulty in finely adjusting eye movements for individuals with LD, impulsivity, and carelessness for individuals with ADHD, and the promotion of understanding through visual representation for individuals with ASD (Ministry of Education, Culture, Sports, Science and Technology, 2011). However, these simple examples do not sufficiently clarify the overall perspective on this issue. In the future, it will be necessary to accumulate basic knowledge. Specifically, text teaching materials should be developed while considering the characteristics of individuals with developmental disorders.

The following are some studies on the reading comprehension of persons with developmental disabilities. According to Hoover (2011), colored text is more effective than black and white text in presenting information to students with ADHD. In addition, there are reports that the use of graphic organizers is effective in presenting information to students with Asperger's syndrome. Research that focused on the reading comprehension abilities of students with ASD was reviewed (Singh et al., 2021). Effect size calculations indicated that visually cued instruction, metacognitive strategy instruction, and adapted text were highly effective, while collaborative strategies and technology-assisted instruction were moderately effective. This study highlights the effectiveness of visually cued instruction and adapted text in enhancing reading comprehension among students with ASD. In addition to graphic organizers, visual cues help students with high-functioning ASD process reading materials (Stringfield et al., 2011). Although some studies have examined the impact

of graphic organizers and technology-enhanced reading materials on learning among students with developmental disabilities and other studies have examined differences in processing textual information, there is less work regarding the ways to specifically present reading materials to persons with developmental disorders.

We highlight one study that indicates that text design is actually more important than technological enhancements; future studies could further test that finding. The significance of devising ways to present information in teaching materials is as follows. A survey of children with learning disabilities suggested that it would be effective to present both digital and paper materials to children with or without disabilities (Marino et al., 2014). There has also been research on online texts. Rello et al.'s (2012) experiment using online textbooks for persons with dyslexia showed which fonts and backgrounds, colors, font sizes, spacing (characters, rows, paragraphs), and column widths improved readability for persons with dyslexia. That is, sentences and figures are also displayed in electronic teaching materials. Therefore, the knowledge derived from this research can be used to improve the readability of electronic teaching materials. According to McTigue and Slough (2010), the main attributes that improve text comprehension are (a) text specificity, (b) the author's voice, (c) consistent descriptive structure, (d) selective use of visual information, and (e) integrated language and visual information. Further, Waight and Oldreive (2021) posit that it is important to consider the use of language, image, audio, and video in developing accessible information for individuals with learning disabilities. The use of clear and jargon-free language is also important (Waight and Oldreive 2021). Finnegan et al. (2016) integrated the results of previous studies and ascertained that direct instruction and graphic organizers positively affect reading comprehension for individuals with ASD. They also found collaborative learning, anaphoric queuing, and question generation to be promising.

However, electronic text does not affect reading comprehension. Even online and electronic books need to present the text in an accessible way. For this reason, as well as the fact that the main teaching materials for students with disabilities in Japan are printed, the current study focuses on print, (paper-based) materials. Furthermore, this study is highly relevant in today's scenario because there are still many teaching materials that are mainly printed on paper in some areas of the world. The cognitive functions involved in human information processing are important for both paper and digital teaching materials.

1.6 Focus on high school students with developmental disabilities who are about to enter the workforce

The Report of the Expert Group on Special Needs Education in the New Era (Ministry of Education, Culture, Sports, Science and Technology, 2019) points out that students with developmental disabilities "have difficulty adjusting to their environment and building relationships with others, and drop out of school or resign from their jobs, and become isolated from society. In some cases, they have difficulty adjusting to their surroundings or have trouble building relationships with others, and drop out of school or leave the company, leaving them isolated from society." The report also points out that "in addition to employment in the general framework, it is also possible to obtain a disability certificate and use the so-called 'employment framework for the disabled,' so it is necessary to understand how to deal with these systems and provide appropriate guidance and support accordingly." Under these circumstances, we considered it important to provide students with developmental disabilities with a wide range of information in an easy-to-understand manner at the upper secondary school level in order to enhance their future employment opportunities. As

a methodology to achieve this, we believe it is necessary to focus on text materials (information provided on paper), giving consideration to the characteristics of students with developmental disabilities.

1.7 Study objectives

Taking into account the discussion in the previous section, this study aimed to clarify the consideration of information presentation in text teaching materials based on the characteristics of high school students with developmental disabilities. Subsequently, the authors examined information that was particularly important according to the characteristics of LD, ADHD, and ASD. Therefore, this study is the first step in examining accessible texts in both printed and online media for students with developmental disabilities. Overall, the findings of this study are equally applicable to digital text and printed text.

2. Materials and Methods*¹

2.1 Item creation for the information presentation method

2.1.1 Preliminary study

As a preliminary study, a survey was used to collect responses regarding the information presentation of text teaching materials developed for students with developmental disabilities through free description. The survey was conducted by mail using a questionnaire (November–December 2008) as part of the study reported in Terada (2006). Questionnaires were sent to 750 educational institutions and 550 employment support institutions in Japan. The former included 1) regular upper secondary schools and 2) departments of special-needs schools that fall under the upper secondary school stage. The employment support organizations comprised (1) Public Employment Security Offices (in charge of employment for persons with disabilities), (2) Vocational Skills Development Centers for Persons with Disabilities, (3) Vocational Centers for Persons with Disabilities, (4) Work/Life Support Centers for Person with Disabilities, (5) Support Centers for Persons with Developmental Disorders, (6) Employment Support Centers for Persons with Disabilities, and (7) Employment Transition Support Offices for Person with Disabilities throughout Japan.

The response rate for the preliminary survey was 33.9% (number of questionnaires sent: 1,300; number of questionnaires collected: 441). The response rate for the free description was 22.0% (number of effective answers: 97).

2.1.2 Creation of evaluation items for information presentation methods

Thirty evaluation items of information presentation were developed based on the opinions (free descriptions) about text materials ($n = 97$) collected in the preliminary survey (Table 1), and categorized with reference to the KJ method (Scupin, 1997). This method aggregates data by categorizing and naming it according to its content. This method was chosen because it is suitable for creating item content that reflects qualitative data. In addition, regarding the wording, a checklist about the information presentation method was being referred to while creating text teaching materials for teachers (Enomoto et al., 2016). In creating the items, the 15-item perspective on how to include information in texts presented in Terada (2006) was used as a reference. The categorization process was discussed by two researchers with knowledge of the subject matter of this study. Specifically, one was a researcher in psychology and the other a researcher in education specializing in the area of employment support for developmental disabilities.

Table 1 Information Presentation Method

LABEL	LABEL
1	A design that will prompt users to pick it up and read it
2	A design that is easy to read
3	A design that makes it easy for a user to understand the content
4	A design that makes it easy to figure out which information is placed where
5	Terms such as disabilities (or disorders) are handled considerably
6	The structure of the information is simple
7	The objective of the teaching materials is stated clearly
8	It is written in plain sentences
9	A design that considers the pride of the user
10	A design that makes it easy to understand important points
11	Information is presented in a reliable form
12	A design that makes it easy for a user to utilize the information
13	Charts, illustrations, photographs, and flow charts are utilized effectively
14	A design that can be easily filled with information
15	Contents that a user can relate to
16	Contents that help solve the problems of the user are selected
17	The sentences are engaging
18	Grammatically correct sentences are used
19	Many examples that can serve as a reference for a user are selected
20	An appropriate quantity of information is included in one book
21	The information provided has a consistent structure
22	An appropriate quantity of information is included on page 1
23	The purpose and method of usage are stated clearly
24	A design that makes it easy to understand contents
25	A design that makes it easy for a user to make plans
26	A design that makes it is easy to find the required information
27	Charts, illustrations, photographs, flow charts, and so on are created correctly
28	Information is not misleading
29	Characters and terms are used appropriately
30	A design that is easy to handle

2.2 Survey participants

As part of this survey, we investigated how information is presented according to the disability characteristics of developmental disabilities. A questionnaire survey was conducted by mail (February to March 2010) targeting all regions of Japan. Questionnaires were sent to 750 educational institutions and 556 employment support institutions. The educational institutions were “educational institutions for students at the high school stage,” which are departments that fall under the high school stage of regular high schools or special needs schools, while the employment support institutions were basically “employment support institutions for developmentally disabled persons” who have already graduated from high school. The educational institutions specifically targeted were the same types of institutions as in the preliminary survey. Respondents were either teachers at the educational

institutions or support personnel at the employment support agencies. Each institution was asked to select one respondent most appropriate for the purpose of this survey.

The participants were informed that, by responding to the survey, they were considered to have consented to participating. Informed consent was obtained from all respondents. The study was approved by National Rehabilitation Center for Persons with Disabilities Ethical Review Committee. The study was conducted in accordance with ethical standards as specified in the 1964 Declaration of Helsinki and subsequent amendments or equivalent ethical standards.

2.3 Survey procedure

In this study, we analyzed a part of that survey; the actual questions are shown at the end of this paragraph. We focused on the content of the free text, and decided to examine the presentation of the text information. This study examines a survey used for a qualitative study we conducted ten years ago because the recent development of text mining software has made new analysis possible. Since human cognitive functions are unlikely to change significantly over the course of a decade, this study is still significant today.

In addition, with the development of information science and technology in recent years, text mining software that analyzes language quantitatively has become widespread. This made it possible to perform a mixed analysis entailing quantitative analysis of qualitative data, which was difficult at the time of the survey.

The self-report questionnaire concerned the development of text teaching materials for employment-preparation training of high school students with developmental disabilities and was constructed in a free description and selective style. This study analyzed responses to the information presentation method based on the characteristics of each developmental disability (LD, ADHD, ASD) that was part of the questionnaire. The concrete question items were:

- 1) The most important item among the 30 items of the information presentation method for LD, ADHD, and ASD: *selective answer* (Table 1)
- 2) Concrete information to create teaching materials considering point 1 (the most important item): *free description answer*

In the overall survey, respondents responded only to the disability types to which they were able to respond, given their experience in providing employment support to persons with developmental disabilities. Respondents were included in the analysis where they had indicated that they had direct support experience with any parties with LD, ADHD, or ASD (including those suspected of having such). The support experience is as follows. Respondents were those who answered “quite a bit” or “a little” with respect to “experience providing support to persons with (or suspected of having) LD, ADHD, or ASD developmental disabilities in preparation for employment.” Based on their experiences, the respondents were asked to recall the overall characteristics of each disability — LD, ADHD, and ASD — and the most important issues for each, along with the reasons why they considered them most important. As a result, the responses represent a synthesis of the respondents’ overall experience to date with regard to each of the disability characteristics of LD, ADHD, and ASD. Regarding diagnosis, responses were sought not only from those with a diagnosis of developmental disability, but also from those receiving support due to suspicion of a developmental disability.

2.4 Analysis methods

2.4.1 Selective type answer

Using correspondence analysis and cluster analysis, the information presentation method according to the characteristics of developmental disabilities was explored. Moreover, to check the absolute relationship between categories, a correlation analysis (ϕ coefficient) was conducted, and the existence and strength of the correlation were investigated.

2.4.2 Free description type answer

The free description responses were used to more concretely understand the selective type answers. Therefore, text mining was applied to the free description responses.

2.4.3 Statistical software

SPSS Statistics (Ver 24.0) was used to conduct the Mann-Whitney U test and hierarchical cluster analysis of the selective type answers. For the correspondence analysis of the selective type answers, the statistics analysis software HAD was used. KH Coder 3 was used for the text mining of the free description answers.

3. Results

3.1 Number of responses and response rate

The number of questionnaire responses in the final investigation was 374 (response rate: 28.6%). The number of educational institutions that responded was 197 (response rate: 26.3%). The number of employment support institutions that responded was 168 (response rate: 30.2%). The number of responses that did not specify the type of institution was 9. The numbers of responses and response rates by institution are shown in Table 2. However, effective responses differed for each analysis.

3.2 First-line information presentation method

3.2.1 Method 1

To understand the consideration of information presentation based on the characteristics of developmental disabilities, a correspondence analysis and a hierarchical cluster analysis using the dimension score of the correspondence analysis were conducted of the data for 173 respondents. Specifically, the data were for responses for all disability characteristics (LD, ADHD, and ASD) regarding the method of information presentation that was considered most important.

3.2.2 Result 1

The consideration of information presentation as per the characteristics of each developmental disability (LD, ADHD, and ASD) differed according to the results of the analysis. In addition, the information presentation method considered each developmental disorder and was classified into three groups (Figure 1).

Specifically, the results of the correspondence analysis of the multiple-choice responses showed that each disability type (LD, ADHD, ASD) was clearly identified as a separate group on the two-dimensional arrangement chart, and the cluster analysis results showed that each disability type group was defined by the respective following items: the LD group: 2. "easy-to-read design," 7. "the purpose of the material is clearly stated," 17. "the text is attractive," and 18. "grammatically correct sentences are used"; the ADHD group: 1. "the design makes the user want to pick up and read the material," 3. "the content is easily understood by the user: Design makes it easy for users to understand the content," 4. "design that makes it easy for users to know which information is located where," 5. "treats terms such as 'disability' with consideration," 15. "content that users can relate

Table 2 Number of responses and response rate per institution

Institution	Number of responses (Response rate)	Institution	Number of responses (Response rate)
Classification of educational institutions		Classification of employment support institutions	
High school	98 (26.2 %)	Public employment security office (in charge of employment for persons with disabilities)	35 (9.4 %)
High school stage of special needs schools	99 (26.5 %)	Vocational skills development center for persons with disabilities,	13 (3.5 %)
Classification of high schools		Vocational centers for persons with disabilities,	17 (4.5 %)
Full-time, General Course	62 (16.6 %)	Work/life support centers for person with disabilities	39 (10.4 %)
Full-time, specialized courses	25 (6.7 %)	Support centers for persons with developmental disorders	35 (9.4 %)
Distance learning, credit-based system	3 (0.8 %)	Employment support center for person with disabilities	4 (1.1 %)
Part-time (Evening)	8 (2.1 %)	Employment transition support office for person with disabilities	25 (6.7 %)
Classification of special needs schools			
High school for special needs	88 (23.5 %)		
Special support schools for higher education	10 (2.7 %)		
None specified	1 (0.3 %)		

to,” 24. “design that makes it easy to understand the content,” and 25. “design that makes it easy for users to plan”; and the ASD group: 9. “designed with user pride in mind,” 11. “provides information in a reliable manner,” 16. “content has been selected to address user concerns,” 21. “information provided has a consistent structure,” 27. “charts, illustrations, photos, flowcharts, etc., are correctly prepared,” 28. “information is not misleading,” and 29. “text and terminology are used appropriately.”

3.2.3 Method 2

The characteristics of the information presentation method based on the characteristics of developmental disabilities were revealed by Result 2 of the correspondence analysis and hierarchical cluster analysis. To check whether the relationship was statistically significant regarding the information presentation method, the following analysis was conducted. A correlation analysis was carried out on the relationship between disability characteristics (LD, ADHD, ASD) and each item (30 items) of the information presentation method was classified into the same group as each obstacle ($n = 173$).

3.2.4 Result 2

A weak correlation was found between LD and “A design that is easy to read” ($\phi = .305, p < .001$), “A design that makes it easy to understand important points” ($\phi = .160, p < .001$), and “effective utilization of diagrams” ($\phi = .250, p < .001$). Next, a weak correlation was found between ADHD and “A design that will prompt users to pick it up and read it” ($\phi = .170, p < .001$), “amount of information in one volume” ($\phi = .112, p = .01$), and “ease of understanding contents” ($\phi = .113, p = .01$). Finally,

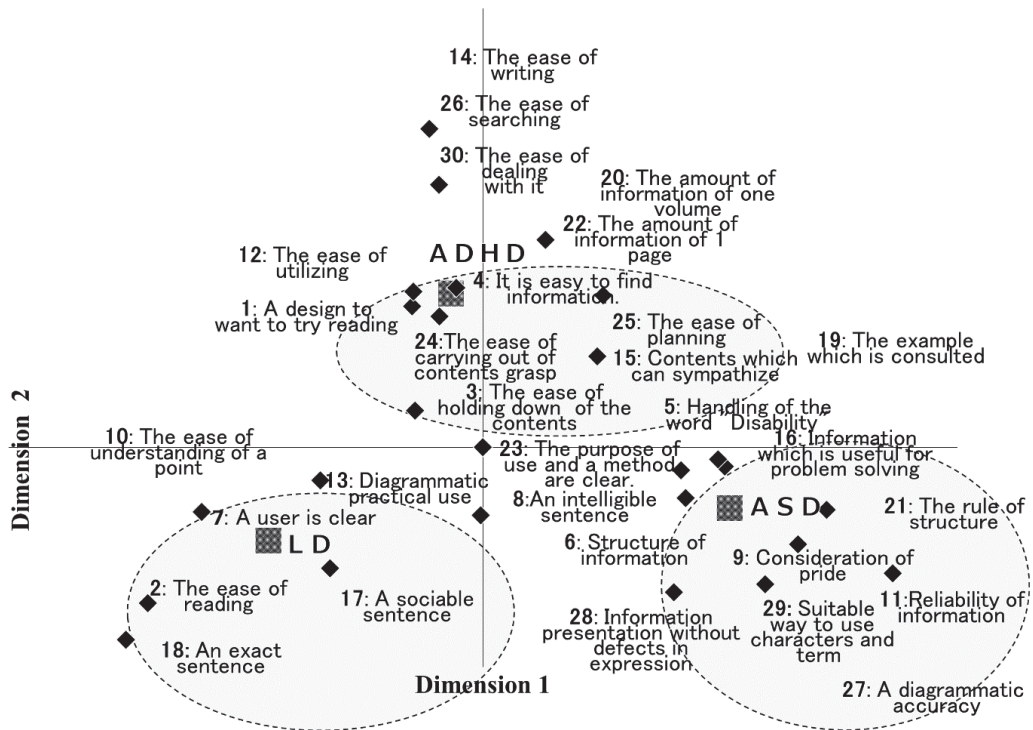


Figure 1 The results of a correspondence analysis of the selective type answers for the first-line information presentation method (the dotted line represents a group based on the results of a cluster analysis).

a weak correlation was found between ASD and “handling words such as ‘disability’ considerably” ($\phi = .112, p = .01$), “simple structure of information” ($\phi = .158, p < .001$), “consideration of the user’s dignity” ($\phi = .176, p < .001$), “information that is useful for problem solving” ($\phi = .228, p < .001$), “consistent structure” ($\phi = .187, p < .001$), “accuracy of diagrams” ($\phi = .141, p = .001$), and “using characters and terms suitably” ($\phi = .116, p = .01$). A significant correlation was found between the characteristics of each developmental disability (LD, ADHD, and ASD) and the information presentation method. Accordingly, the relationship between each disability characteristic and the information presentation method was statistically significant.

3.3 Difference in concrete consideration by disability characteristic

3.3.1 Method 3

The statistical relationship between the obstacle characteristics and some selective type answers to the first-line information presentation methods was examined. Based on this, the authors decided to devise an effective plan for the actual information presentation method. To this end, text mining was applied to the free description responses (LD: $n = 114$; ADHD: $n = 152$; ASD: $n = 159$). To create teaching materials based on the free description responses of those with experience in support for developmental disabilities, the necessary matter was discussed concretely.

3.3.2 Result 3

The authors decided to clarify the differences in the discussed matter to consider characteristics according to disability type. Therefore, the free description answer on the necessary device was

Table 3 Disability Characteristic Words

LD	Jaccard coefficient	ADHD	Jaccard coefficient	ASD	Jaccard coefficient
Illustration	.065	Information	.040	Consider	.066
Character	.060	Short	.036	Concrete	.054
Understanding	.055	Many	.035	Necessary	.054
Sentence	.054	Point	.032	Content	.052
Size	.051	Supporter	.032	Photograph	.044
Consideration	.045	Amount of Information	.028	Expression	.036
Ruby	.042	Time	.024	Many	.035
Teaching Materials	.041	1 page	.023	Explanation	.032
Photograph	.039	Think	.023	Case	.032
Comprehend	.036	Form	.023	Form	.027

Note. LD, learning disabilities; ADHD, attention-deficit hyperactivity disorder; ASD, autism spectrum disorder

analyzed. The Jaccard coefficient was computed to quantitatively clarify the difference arising from disability type. The authors extracted ten words with a high Jaccard similarity coefficient to represent each obstacle (Table 3). Then, the authors examined the sentences containing the extracted words and analyzed the contents of each sentence (Table 4).

For LD, the feature words “Illustration,” “Character,” “Understanding,” “Sentence,” “Size,” “Consideration,” “Ruby,” “Teaching Materials,” “Photograph,” and “Comprehend” were extracted. The content of sentences containing feature words indicated the following as textual innovations: “Use materials that can be understood without text,” “Use illustrations and photographs,” “The size of a character: Suitable size of a character, figure, and ruby,” “A color and a feel,” “Line is changed,” “Unfilled space and contrast,” “An itemized form is used,” “Electronization of a textbook,” “Assumed for upper elementary grades,” and “Addresses reading, writing, and math disabilities; different design (a display in white, character style, etc.) with the same teaching materials is applied.”

For ADHD, “Information,” “Short,” “Many,” “Point,” “Supporter,” “Amount of Information,” “Time,” “1 page,” “Think,” and “Form” were extracted. The content of sentences containing feature words indicated the following as textual innovations: “Design the text to be organized, structured, and easy to find without increasing the amount of information,” “Use short sentences,” “Keep it simple and easy to understand,” “Use bold text,” “Use bullet points,” “Be direct or specific,” “Provide a comments section,” “Make the text so that the reader can get a sense of accomplishment in a short time,” “Make the first page of the talk a one-page summary; complete it on one page,” “Data that can help consider what you should do,” and “Composition made with intuitive vision, such as color and form, reliance.”

For ASD, “Consider,” “Concrete,” “Necessary,” “Content,” “Photograph,” “Expression,” “Many,” “Explanation,” “Case,” and “Form” were extracted as feature words. The content of sentences containing feature words indicated the following as textual innovations: “Explain by showing specific examples,” “Use photographs, an example in question-and-answer format, or flowcharts,” “Use simple and easy-to-understand expressions,” “Avoid negative expressions and increase positive content and data from the survey,” “Use a clear and concise format. Use simple, easy-to-understand expressions,” “Avoid negative expressions,” and “Increase positive content and surveyed data.”

Table 4 Examples of sentences for Each Characteristic Word

Disability	Extraction word	Outline of the contents in a sentence
LD	Illustration, Character, Photograph, Understanding, Sentence	Text that can be understood even if there is neither a character nor a sentence is used. To make a character and a sentence empathic, a suitable illustration and photograph are used. The size of a character.
	Sentence, Ruby	An itemized statement is used. The level of elementary school upper classes is used.
	Size, Ruby	Suitable size of a character, figure, and ruby. A color and a feel.
	Consideration	A line is changed. Unfilled space and contrast.
	Teaching materials, Comprehension	The teaching materials of the contents correspond to the disability with respect to reading, writing, and arithmetic. A different design (a display in white, character style, etc.) with the same teaching materials is applied. Electronization of a textbook (teaching materials and sentence).
ADHD	Information, Many, Amount of information Short	The amount of information is limited and arranged. The flow of information is structured. A design that makes it easy to find information. Direct expression in a short sentence.
	Point	It is intelligible. It is simple. A bold letter is used.
	Supporter	An itemized statement is used. A concrete expression is used. While parents and a supporter communicate, a comment field is prepared so that problems can be dealt with and organized
	Time	Time is controlled. The text is written in a way that a sense of accomplishment is acquired in a short time.
	Page 1	It summarizes the talk on the 1st page. It is complete on page 1 and is not connected to the next page.
	Think	Data that can help consider what you should do, checking feelings and actions.
	Form	Composition made with intuitive vision, such as a color and a form, reliance.
	ASD	Concrete, Necessary, Explanation Photograph, Content
Expression		Simple and clear expression. Negative expressions are avoided.
Many		Affirmative contents are increased. The data investigated are increased.
Case		An example in question-and-answer format.
Form		A flow chart is used to make it easy for the user to obtain required information.

Note. LD, learning disabilities; ADHD, attention-deficit hyperactivity disorder; ASD, autism spectrum disorder

4. Discussion

This study examined the consideration of effective information presentation of text teaching materials based on the characteristics of students with developmental disabilities. First, the consideration of information presentation by a supporter by each obstacle classification was clarified quantitatively and statistically.

The relationship between each obstacle characteristic and the consideration of information presentation was ascertained. Next, to clarify the contents of the information presentation method, text mining was applied to the free description responses about the concrete matter of teaching materials that considered each obstacle characteristic. Further, the word characteristics of each disability were quantitatively extracted. Subsequently, the typical and concrete method of information presentation was arranged by reading and comprehending each sentence based on the results. We showed that effective information presentation differed according to disability classification through qualitative and quantitative analysis based on the participant's thoughts. However, regarding the evaluation of disability type and the effect, there is a limitation due to the subjectivity of the supporter who provided the response.

In line with a supporter's idea, the following is suggested based on the results of the correlation analysis, or characteristic word extraction and sentence reading comprehension. Regarding LD, "ease of reading" content on devices, such as "ease of understanding a point" and "effective utilization of diagrams" is critical. Further, teaching materials that consider various factors, such as "the size of a character," "use of an illustration and a photograph," and well-designed "intelligibility of a sentence or a character" are needed. Regarding ADHD, intelligibility (for example, a design that requires reading information in one volume) and ease of understanding the contents are required. Further, "shortening" of sentences, not being made to increase the information, ease of understanding important points, and information on page 1 are needed. For ASD, the following factors were considered important: accuracy, consideration of feelings, handling the word "disability" considerately, consideration of the user's dignity, structure of information, consistency of the information structure, accuracy of diagrams, a suitable way of using characters and terms, and information that is useful for problem-solving. The findings of this study regarding the consideration and use of effective information presentation methods for children with developmental disabilities by supporters are in line with those of previous studies. They correspond to the results of previous research on text teaching materials, such as illustrations (Larkin and Simon, 1987; Mayer et al., 1995; Shimada and Kitajima, 2008), clear statements (Seki, 1997) about the contents of teaching materials, illustrations and photographs, and colorization (Shimada, 2016). From this, it is suggested that the information presentation method for text teaching materials generally used is effective for persons with developmental disabilities. Moreover, in this study, consideration corresponding to the finer needs of each disability was suggested. Therefore, in the future development of teaching materials, it may be useful for support providers to consider information presentation corresponding to each disability characteristic.

This study highlights the importance of selecting characters, figures, photographs, and so on, tailored to each disease, as well as the specific content, format, and amount of information. This is consistent with the general text comprehension elements suggested by McTigue and Slough (2010): (d) selective use of visual information, and (e) language and visual information. Concurrently, it reinforces the importance of more specific content.

Moreover, this study shows the effects of using illustrations, photographs, ruby, colors, digitization, and so on, for learning disabilities. This information considers the use of elements for

learning disability information in Wait et al. (2021). In addition, this study embodies the clear and non-technical language pointed out by Wait et al. (2021) as follows. In other words, the writing should reflect the upper elementary school level. Furthermore, this study demonstrates that photographs, concrete examples, flowcharts, question-and-answer formats, and simple, straightforward, and positive expressions are effective for students with ASD. This is consistent with the graphic organizer found to be effective in Finnegan et al.'s (2016) study of ASD reading comprehension. It is also congruent with and reinforces the promising anaphoric queuing and question generation by Finnegan et al. (2016). However, no promising collaborative learning was identified. In addition, no electronic text was found to be ineffective. Based on the findings of Marino et al. (2014) and Rello et al. (2012), this result could apply not only to paper materials but also to electronic materials. Additionally, based on the findings of McTigue and Slough (2010), it can be applied to improve the understanding of general texts. A limitation of this study is that the results of this investigation on the topic of developmental disabilities in students are limited in terms of text teaching materials on employment training. However, information presentation can be applied regardless of the text content. Therefore, further verification is necessary. To clearly show whether the information presentation method extracted from this research is generalizable to other teaching materials and an understanding of the general contents of the study, it is necessary to conduct further research. However, one issue that should be openly addressed as a prospect for future study is interactive reading materials and other technological enhancements, which are an increasing research focus.

In this study, responses were not obtained by recalling individual cases, but through a procedure in which the respondents were presented with definitions of LD, ADHD, and ASD and asked to respond to the considerations for each disability characteristic based on their own experience in supporting persons with developmental disabilities in the workplace. Respondents responded only to those disability types to which they were able to respond based on their experience in providing support. Therefore, some respondents might have responded regarding all disability types, others only regarding some. However, respondents were not asked for details on which of the LD, ADHD, and ASD disability characteristics they had experience supporting, so they might not have experience supporting all disabilities. This point is considered a limitation of this study that should be addressed in future research.

5. Conclusion

This study clarified support providers' consideration of information presentation methods of teaching materials that consider the characteristics of students (persons) with developmental disabilities. The results of this study may contribute to the optimization of teaching materials for students with developmental disabilities to promote understanding and learning.

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Note

1. This study was conducted more than 10 years from the time of data acquisition to the time of analysis.

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