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[Original Article]

Clinical Utility of the Japanese Version of *the Baby and Infant Screen for Children with aUtIsm Traits* (BISCUIT) Part 1

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Abstract

Background: Early diagnosis of autism spectrum disorder (ASD) is crucial for timely interventions. Given this, there is an urgent need for accurate, but quick ASD diagnostic tools that can be used with very young children around 2 years of age. We assessed the clinical utility of the Japanese version of the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) Part 1 that is designed to measure ASD symptoms in children aged 17–37 months.

Method: Seventy-six children (mean age: 30.2 ± 5.1 months) referred to local specialized clinics were assessed using the BISCUIT, together with the Modified Checklist for Autism in Toddlers (M-CHAT), the Strength and Difficulties Questionnaire (SDQ), and a developmental test. Clinical diagnoses were assigned by independent practitioners. The scale's internal consistency was calculated and the mean scores were compared in terms of sex, age, and developmental quotient (DQ). To examine validity, correlational and hierarchical multiple regression analyses were performed.

Results: Cronbach's α for the scale was over 0.9. The scale scores differed by DQ. The total scores were strongly correlated with the M-CHAT and SDQ prosocial behavior scores, suggesting convergent validity. Divergent validity was demonstrated by nonsignificant correlations with the SDQ emotional and conduct subscales. M-CHAT scores were significantly associated with the BISCUIT-Part 1 total score and all three domain scores even after controlling for sex, age, DQ, and SDQ hyperactivity.

Conclusions: The Japanese version of the BISCUIT-Part 1 can measure early ASD symptoms and may therefore be useful in community clinical settings. (248 words)

Keywords: autism spectrum disorder (ASD), early diagnosis, The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), reliability, validity

1. Introduction

Autism spectrum disorder (ASD) is a lifelong developmental disorder characterized by deficits in social communication, social interaction and restricted and repetitive behavior or interests (American Psychiatric Association, 2013). The earliest symptoms of ASD start to manifest overtly from the first few years onwards and can be detected as early as 18 months, which suggests that ASD can be diagnosed before 2 years of age (Guthrie et al., 2013). Early detection and diagnosis of ASD is crucial since initiating integrated developmental and behavioral interventions as soon as a diagnosis of ASD is given is recommended for better outcomes (Zwaigenbaum et al., 2015).

Recent increased awareness of ASD and an improved ability to detect potential cases earlier with the use of autism-specific screeners, has highlighted the need for further comprehensive evaluation tools to confirm an ASD diagnosis for high risk infants and toddlers. However, the current gold standard ASD diagnostic tools such as the Autism Diagnostic Observation Schedule (ADOS) toddler module (Luyster, et al., 2009) and the Autism Diagnostic Interview-Revised (ADI-R) for toddlers and young preschool children (Kim & Lord, 2012) require specialized training and a considerable amount of time to administer. Because of this, a barrier remains to their widespread use in community pediatric clinics or developmental centers that are not highly specialized in ASD, especially in countries with fewer resources. Thus, there is an urgent need for accurate and quick ASD diagnostic tools that can be used by non-ASD specialists with very young children around 2 years of age.

Comorbid symptoms that are frequently observed in school-age children with ASD (Simonoff, et al., 2008) have also been reported in very young children with ASD as early as 2 years of age in the form of hyperactivity, anxiety, aggression and tantrums (Davis et al., 2010; Fodstad, et al., 2012). These conditions need to be detected as early as possible because their persistence may further worsen children's quality of life and complicate assessment of ASD-related symptoms (Joshi et al., 2010). Thus, when identifying ASD in very young children, clinical evaluations should be comprehensive and include comorbid problems.

The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) is a diagnostic instrument which was designed as a comprehensive assessment battery for the purpose of measuring not only the core symptoms of ASD but also comorbid symptoms frequently observed in very young children with ASD aged 17-37 months (Matson, 2007). BISCUIT is composed of three informant-based components and one observational component. The three informant-based components are: (1) BISCUIT-Part 1 which is used for the assessment of autistic symptomatology (Matson, et al., 2011); (2) BISCUIT-Part 2 which assesses comorbid symptoms commonly seen in ASD (Matson, et al., 2009a); and (3) BISCUIT-Part 3 which assesses the occurrence of problem behaviors such as aggressiveness and self-injurious behaviors (Matson, et al., 2010). BISCUIT-Part 1 includes 62 items which assess daily observed behaviors related to symptoms across all of the core ASD domains (i.e., socialization, communication, repetitive behaviors and restricted interests) through a parent-interview. Compared to the gold standard diagnostic tools, the test administration time of BISCUIT-Part 1 is relatively short (approximately 20-30 min), which means that it might be ideally suited for the early assessment of ASD in community clinical settings with greater time constraints.

In Japan, although awareness of early ASD signs has increased in primary health care settings, in most cases diagnostic procedures are not comprehensive and are often delayed due to a relative lack of specialized clinics. Thus, to fill the practice gap between clinical needs and appropriate

service provision for young children with ASD, we aimed to assess the clinical utility of the Japanese version of the BISCUIT-Part 1 as an early ASD diagnostic tool. In this paper we report on the reliability, and convergent and divergent validity of the Japanese version of the BISCUIT-Part 1. Theoretically, the BISCUIT Part 1 total score was expected to converge with the total number of ASD symptoms listed by diagnostic criteria, total number of failed items on the Modified Checklist for Autism in Toddlers (M-CHAT) (Robins, et al., 2001), and with the social relatedness subscale scores of the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997). In contrast, the scale score was expected not to correlate with the SDQ subscales that are non-specific to ASD such as emotional or conduct problems.

2. Methods

2.1 Participants

Seventy six children were recruited from four specialized clinics in different geographical regions of Japan. The study inclusion criteria were as follows: (1) children were aged between 17-37 months; (2) they were suspected of having ASD or other developmental delay/disabilities such as global developmental delay, language disorder; (3) they had no severe physical and/or sensory impairments. Among the 76 children, 73 met the diagnostic criteria for ASD according to DSM-5 (Table 1). Three children were diagnosed as not having ASD but clinically judged as exhibiting atypical development.

2.2 Measures

2.2.1 The Baby and Infant Screen for Children with aUtIsm Traits Part 1

BISCUIT-Part 1 consists of 62 items including 24 socialization/nonverbal communication domain items, 7 communication domain items, and 23 repetitive behavior/restricted interests domain items, as well as 8 items that are not included in the three abovementioned domains (the other domain) (Matson, 2007). Using a parent-interview format, caregivers are instructed to rate each item on a 3-point Likert scale while comparing the child to a typically developing peer of the same age. A rating of 0 indicates "not different; no impairment", a rating of 1 indicates "somewhat different; mild impairment", and a rating of 2 indicates "very different; severe impairment". The scale in its original form is reported to have acceptable psychometric properties (Matson & Tureck, 2012). For 276 children aged 17 to 37 months who were at risk for developmental and/or physical disability, Cronbach's α was 0.97 (Matson, et al., 2009b). In a study that used a mixed clinical sample, a cutoff score of 17 differentiated ASD from non-ASD cases with a sensitivity of 0.84 and a specificity of 0.86 (Matson, et al., 2009c). A large positive correlation was also observed between the scale score and the total number of failed M-CHAT items (r=.80) (Matson et al., 2011). The Japanese translation of BISCUIT-Part 1 was undertaken by the last author (Y.K.) with permission from the original developers, and was back-translated into English by independent translators. The last author (Y.K.) and original developers then confirmed that there was content equivalence between the two languages. The final version authorized by the original developers was used in this study.

2.2.2 The Modified Checklist for Autism in Toddlers (M-CHAT)

M-CHAT is a parent-reported ASD screening tool for children aged 16-30 months consisting of 23 questions (Robins, et al., 2001), which has been widely used in countries throughout the world. Its Japanese version (M-CHAT-JV) has been shown to have good inter-rater and test-retest reliability and sufficient convergent and discriminant validity (Inada, et al., 2011). When it was used in the

Table 1 Sample characteristics (n=76)

Diagnosis, n	
ASD	73
Non-ASD	3
Age at examination (months), Mean ± SD (range)	30.2 ± 5.1 (17-37)
Gender, Male: Female	58 : 18
Symptom checklist (n=76), Mean ± SD (range)	
Impairments in social interaction	2.5 ± 1.3 (0-5)
Impairments in communication	4.7 ± 1.3 (2-7)
Restricted, stereotyped patterns of behavior	2.5 ± 1.4 (0-5)
Total	11.6 ± 3.4 (3-18)
KSPD total DQ (n=63), Mean ± SD (range)	74.8 ± 15.6 (42 -107)
Developmental delay, n (%)	
Present	38 (60.3%)
Absent	25 (39.7%)
Birth order, n (%)	
First child	37 (48.6%)
Second child later	39 (51.4%)
Siblings diagnosed with ASD, n (%)	
Present	27 (35.5%)
Absent	49 (64.5%)
Medical diagnoses (epilepsy, allergy, gastrointestinal disorders), n (%)	
Present	24 (31.5%)
Absent	52 (68.5%)
M-CHAT-JV (number of failed items), Mean ± SD (range)	
Mother-reported (n=75)	5.1 ± 4.6 (0-19)
Clinician-reported (n=73)	9.9 ± 5.5 (0-20)
SDQ (n=76), mother-reported, Mean ± SD (range)	
Total difficulties score	16.1 ± 5.9 (5-31)
Emotional symptoms	2.1 ± 1.9 (0-7)
Conduct problems	3.2 ± 1.9 (0-9)
Hyperactivity/inattention	6.1 ± 2.6 (1-10)
Peer Problems	4.7 ± 2.1 (0-8)
Prosocial behavior	3.1 ± 2.5 (0-8)

M-CHAT-JV: The Japanese version of Modified Checklist for Autism in Toddlers; KSPD: Kyoto Scale of Psychological Development; DQ: developmental quotient.
Note: KSPD data were available for 61 children with an ASD diagnosis and two with a non-ASD diagnosis. Developmental delay was defined as a developmental quotient lower than 70

primary screening of ASD, sensitivity and specificity values of 0.476 and 0.986 were respectively reported, while its positive predictive value was 0.455 (Kamio et al., 2014). Following the lead of an earlier study (Matson et al., 2011), we used the total number of failed M-CHAT-JV items as an index of autistic symptomatology. In this study, we collected mother- and clinician-reported M-CHAT-JV data. The internal consistency of the 23 items for the ASD children in this study was excellent (α =.860 for mother ratings, α =.859 for clinician ratings).

2.2.3 Symptom checklist

The 18-item checklist (see Appendix) included symptoms from the three core areas of ASD;

impairment in social interaction (5 items), impairment in communication (7 items), and restricted, repetitive and stereotyped patterns of behavior, interest or activities (6 items) (Matson, et al., 2008). In the original study (Matson et al., 2008), the internal consistency was robust (α =.95) and the mean number of endorsed items for the ASD group (aged 2 to 16 years) was 11.76 with a range of 4-19. In our ASD sample in this study, Cronbach's α was .652 and the mean number of endorsed items was 11.9 ± 3.0 (4-18).

2.2.4 Strengths and Difficulties Questionnaire (SDQ)

The SDQ is a 25-item questionnaire that assesses both psychopathology and the positive strength of children aged 4-16 years (Goodman, 1997), which has been validated in Japan (Moriwaki & Kamio, 2014). The twenty-five items are classified into five subscales; four difficulties subscales relating to emotional symptoms, conduct problems, hyperactivity/inattention, and peer problems and one strengths subscale relating to prosocial behavior. Each item is scored on a 3-point scale (0 = not true, 1 = somewhat true, 2 = certainly true). Higher difficulties scores indicate more problems and the scores of the four difficulties subscales can be summed to obtain a total difficulties score (range 0-40), while the prosocial subscale score is reverse coded. A preschool version has been shown to have satisfactory psychometric properties with a five-factor structure for 2-year olds (D' Souza, Waldie, Peterson, Underwood, & Morton, 2016). The Japanese version of the parent-reported preschool SDQ was used in this study.

2.2.5 Kyoto Scale of Psychological Development (KSPD)

The child's development was assessed using the Kyoto Scale of Psychological Development Test (KSPD) (Society for the Kyoto Scale of Psychological Development Test, 2008), which is widely used in Japanese clinical settings for young and/or developmentally delayed children. The KSPD is comparable to the Bayley Scales of Infant Development second edition (BSID-II) (Bayley,1993) (KSPD cognitive-adaptive (C-A) DQ and the BSID-II Cognitive facet, KSPD language-social (L-S) DQ and the BSID-II Language facet, KSPD postural-motor (P-M) DQ and the BSID-II Motor facet) (Tatsuta et al, 2013).

2.3 Procedure

Before the administration of the BISCUIT, the administrators (experienced pediatricians, child psychiatrists or clinical psychologists) at the four sites mentioned above read the BISCUIT manual and then received one-day's training from the first author (M.I). In parallel, clinicians who were not involved in the BISCUIT administration and blind to the results were required to obtain information using the M-CHAT-JV, SDQ, KSPD, symptom checklist and to assign a diagnostic classification (ASD/non-ASD) based on all available clinical information except the BISCUIT results. Those diagnoses were confirmed by M.I. and Y.K according to DSM-5.

2.4 Ethical issues

The study protocol was approved by the ethics committee of the National Center of Neurology and Psychiatry, Japan and the work was carried out in accordance with the Declaration of Helsinki as revised in 2000. Written informed consent to participate in this study was obtained from the parent of each child.

2.5 Data analyses

To examine the internal consistency of the Japanese version of the BISCUIT-Part 1, Cronbach's α was calculated for its total and three domain scores. As the scale scores were found to be normally

distributed (Shapiro-Wilk test, p> .05), parametric tests were used for the subsequent statistical analyses. The effect of sex, the presence of developmental delay, age and diagnostic subcategory on the scale scores was examined with a t-test. To investigate convergent and divergent validity, Pearson's correlation coefficients were calculated for the scale total score, the symptom checklist total score, the M-CHAT-JV, the SDQ scores and the KSPD DQs. Finally, hierarchical multiple regression analyses were conducted with the scale total scores and three domain scores as the dependent variable, respectively. In Step 1, children's gender and age were entered as control variables. In Step 2, DQ was also entered, and in Step 3, SDQ problems scores were added. In Step 4, M-CHAT-JV scores were entered. The statistical analysis was performed using SPSS Version 21.0 J (SPSS Inc.).

3. Results

Descriptive statistics for the 76 children are presented in Table 1. Given the small number of non-ASD children (n=3), only data from ASD children (n=73) were used in the subsequent analyses. These children all scored above the original cut-off score of 17 (Matson, et al., 2009c)

3.1 Internal consistency

Cronbach's α for the total scale was .954 while for each domain the α value was greater than .874 in the ASD children, indicating that the BISCUIT-Part 1 had a high degree of internal consistency (Table 2). Cronbach's α values for the total and individual domains were very similar for males and females, as well as for children with and without developmental delay.

Table 2 Cronbach's alpha coefficients for the BISCUIT-Part1

	ASD total (n=73)	Male (n= 57)	Female (n=16)	With Developmental Delay (n=24)	Without Developmental Delay (n=37)
Socialization (24 items)	.942	.945	.918	.931	.932
Communication (7 items)	.882	.884	.864	.800	.854
Repetitive Behavior (23 items)	.874	.884	.818	.785	.891
Total (62 items)	.954	.956	.934	.933	.953

Note: Developmental delay was defined as a developmental quotient lower than 70.

Table 3 Mean BISCUIT-Part1 scores in children with ASD (n=73)

BISCUIT-Part1	Gender		*p*	Developmental delay[a]		*p*	Age		*p*
Mean ± SD, (Range)	Male (n=57)	Female (n=16)		absent (n=37)	present (n=24)		≧24 months (n=64)	<24 months (n=9)	
Total score	59.9 ± 24.8 (11-101)	48.8 ± 20.0 (16-84)	.104	48.7 ± 23.4 (11-97)	70.1 ± 19.0 (40-100)	<.001	55.4 ± 23.6 (11-101)	71.9 ± 23.9 (35-100)	.054
Socialization	28.1 ± 12.6 (2-48)	22.4 ± 10.6 (4-42)	<.001	22.5 ± 11.6 (2-45)	33.4 ± 10.3 (12-47)	<.001	25.9 ± 12.2 (2-48)	34.1 ± 11.3 (16-45)	.059
Communication	9.1 ± 4.0 (0-14)	7.6 ± 4.0 (1-14)	.174	7.2 ± 3.8 (0-14)	11.4 ± 2.6 (5-14)	<.001	8.3 ± 4.0 (0-14)	12.3 ± 2.1 (9-14)	<.001
Repetitive Behavior	17.0 ± 9.2 (1-36)	14.4 ± 7.4 (5-29)	.305	13.8 ± 9.1 (1-35)	19.5 ± 7.1 (6-32)	<.05	15.9 ± 8.7 (1-36)	19.9 ± 9.4 (8-32)	.209

[a] Developmental delay was defined as a developmental quotient lower than 70.

3.2 Mean differences in the BISCUIT-Part1 total score by gender, developmental level, and age

The BISCUIT-Part1 total scores did not differ significantly by gender, while gender differences were observed only in the socialization domain (Table 3). ASD children with developmental delay (DQ<70) had significantly higher scores than those without developmental delay for all three domains. Among them, the presence of developmental delay had a large effect on the communication domain scores (Cohen's d=1.29). An age effect was observed only in the communication domain: ASD children aged <24 months scored significantly higher than ASD children aged ≧24 months, although these two groups had similar DQs (80.4 ± 14.4 for children aged <24 months, 73.9 ± 15.8 for children aged ≧24 months).

3.3 Convergent and divergent validity

As shown in Table 4, the correlation between the BISCUIT-Part 1 total scores and the total number of failed items on the mother-reported M-CHAT-JV was strong, and those with symptom checklist total scores, mother-reported SDQ total difficulties scores were moderate, indicating the convergent validity of this scale. On the other hand, the BISCUIT-Part 1 total scores were not significantly correlated with either the SDQ emotional symptoms or conduct problems subscale scores, indicating divergent validity.

The scale total scores, however, were also moderately correlated with the SDQ hyperactivity subscale scores and DQ (Table 4). To investigate whether the BISCUIT-Part 1 total scores are explained by ASD-specific difficulties rather than developmental problems nonspecific to ASD, hierarchical multiple regression analyses were conducted. Multicollinearity was not a problem in these analyses, since the VIF (Variance Inflation Factor) was 1.81 or under for all variables.

Table 4 Correlations of the BISCUIT-Part 1 total score with other measures

Scale	Pearson's correlation coefficients (r)	95% CI
Symptom checklist [a]	.484***	.286 - .643
M-CHAT-JV		
Mother-reported [a]	.735***	.608 - .826
Clinician-reported [b]	.391***	.177 - .570
SDQ, mother-reported [a]		
Total difficulties	.486***	.288 - .644
Emotional symptoms	.099	−.134 - .322
Conduct problems	.213	−.018 - .422
Hyperactivity/inattention	.492***	.295 - .649
Peer problems	.437***	.230 - .606
Prosocial behavior	−.536***	−.682 - −.349
DQ (KSPD) [a]		
Total	−.370**	−.553 - −.153
Cognitive-adaptive	−.402**	−.579 - −.189
Language-social	−.398**	−.575 - −.185
Postural-Motor	.195	−.037 - .407

*p <.05 , **p <.01 , ***p <.001

CI: confidence interval; M-CHAT-JV: The Japanese version of Modified Checklist for Autism in Toddlers; SDQ: Strengths and Difficulties Questionnaire.

Note: [a] calculated for 73 ASD children; [b] calculated for 70 ASD children; [c] calculated for 61 ASD children.

Table 5 Results from hierarchical multiple regression analyses (n=61)

		BISCUIT-Part 1 total			Socialization			Communication			Repetitive behavior		
		B (SE)	β	ΔR^2	*B* (*SE*)	β	ΔR^2	B (SE)	β	ΔR^2	B (SE)	β	ΔR^2
Step 1	Gender (0 for girls, 1 for boys)	−.329 (5.44)	−.006	.041	−.565 (2.85)	−.020	.043	.926 (.946)	.102	.142*	.537 (2.23)	.027	.015
	Age (months)	.133 (.426)	.029		.123 (.223)	.053		−.214 (.074)	−.285**		.085 (.174)	.051	
Step 2	DQ	−.022 (.157)	−.014	.124**	−.021 (.082)	−.026	.123**	−.099 (.027)	−.393**	.278**	.061 (.064)	.110	.052
Step 3	SDQ hyperactivity/ inattention	1.63 (.992)	.178	.169**	.660 (.519)	.142	.143**	−.113 (.173)	−.075	.007	.785 (.406)	.237	.194**
Step 4	M-CHAT-JV	3.35 (.609)	.653**	.236**	1.70 (.318)	.654**	.237**	.344 (.106)	.408**	.092**	1.10 (.249)	.592**	.194**
R^2		.570			.545			.520			.455		
adj R^2		.531			.504			.476			.406		

*$p < .05$, **$p < .01$

B (SE), β, R^2, and *adj* R^2 are for Step 4 when all dependent variables are included in the analyses.

In the models explaining the BISCUIT-Part 1 scores, the coefficients of determination increased significantly when the M-CHAT-JV scores were included in Step 4 in addition to the DQ and SDQ hyperactivity variables added in Step 2 and 3 (Table 5).

4. Discussion

The present study demonstrates satisfactory reliability and validity of the Japanese version of the BISCUIT-Part 1 for toddlers with ASD aged from17 to 37 months in Japan.

The internal consistency of the BISCUIT-Part 1 in our sample was generally satisfactory and comparable to that of the original version (Matson, et al., 2009b).

The convergent validity of this scale was indicated by a large correlation between the scale total score and the mother-reported M-CHAT score, which is consistent with the original study (Matson et al., 2011). In addition, the large correlation that occurred between the BISCUIT-Part 1 and the SDQ prosocial behavior subscale scores concurs with an earlier study where a sizeable correlation was observed between the BISCUIT-Part 1 and the Personal-Social domain of the Battelle Developmental Inventory-second Edition (BDI-2) (Matson, et al., 2011), indicating convergent validity. At the same time, the divergent validity of the scale was demonstrated by nonsignificant correlations with SDQ subscales that measure conceptually different behaviors, emotional symptoms and conduct problems.

Hierarchical multiple regression analyses revealed that the M-CHAT-JV scores were significantly associated with total and all domain scores of the BISCUIT-Part 1 scale even after controlling for gender, age, DQ, and hyperactivity scores. These findings also suggest that the scale reflects ASD-specific difficulties rather than developmental problems nonspecific to ASD.

In this study, there were no evident gender differences in the scale total scores except socialization scores, which is in line with earlier studies. A study that examined autistic symptoms in 390 toddlers with ASD aged 17 to 37 months using the BISCUIT-Part 1 found no gender differences even when DQ was taken into account (Sipes, et al., 2011). A systematic review of gender differences in autistic symptoms that used data from 4195 subjects with ASD revealed that there were no gender differences in children under age 6 (Van Wijngaarden-Cremers et al., 2014). A more recently published study (Lawson et al., 2018) reported that there were no gender differences in overall autistic severity but females were found to exhibit more social-communication impairments than males.

Children with developmental delay scored higher on all BISCUIT domains than those without developmental delay in this study. These findings are similar to those obtained for toddlers with ASD aged between 12 to 30 months when using the ADOS toddler module (Guthrie, et al., 2013).

In terms of age differences, children aged <24 months scored significantly higher than those aged ≥ 24 months only on the communication domain. This finding might reflect a natural referral bias, given that toddlers with lower receptive and expressive language are more likely to be referred for an ASD evaluation (Bickel, et al., 2015).

We also found that there was a positive and moderate correlation between the BISCUIT-Part 1 and SDQ hyperactivity subscale scores which also accords with a study that reported a moderate correlation between BISCUIT-Part 1 total scores and BISCUIT-Part 2 inattention/impulsivity scores (Cervantes & Matson, 2015). This is not surprising given that overactivity is often reported in preschool children with ASD (Reetzke et al., 2022). Our finding highlights the importance of undertaking further research on co-occurring overactivity in toddlers with ASD, as it may cause a delay in diagnosing ASD due to possible diagnostic over-shadowing in some cases (Miodovnik, et al., 2015).

There are several study limitations to be considered. First, the sample size was small and every child included in the analysis had an ASD diagnosis. Second, we did not use the current gold standard diagnostic tools such as ADOS and ADI-R to assign a clinical diagnosis because they had not been standardized for Japanese toddlers at the time of this study. Instead, we used best practice clinical diagnoses by experienced diagnosticians where full agreement between them was obtained for DSM diagnoses.

In conclusion, the results of this study indicate that the Japanese version of the BISCUIT-Part 1 may be a potentially useful tool for aiding early ASD diagnosis in primary settings. Specifically, its adoption and use may lead to the timely referral of, and earlier interventions for young children with possible ASD while placing less of a work burden on community pediatricians.

Conflict of interests

The authors declare no conflict of interest associated with this manuscript.

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Appendix

Symptom Checklist

Please indicate if the following applies to the child. Place a "1" in the blank if the statement does apply to the child and place a "2" in the blank if the statement does not apply to the child.

1 = yes, 2 = no

1. Impairment in social interaction, such as:

_____ a. Impairment in the use of multiple nonverbal behavior, such as eye-to-eye gaze (e.g., eye contact), body posture, or gestures.

_____ b. Failure to develop peer relationships appropriate to developmental level (e.g., little to no interest in forming friendships or lack understanding of how to interact socially with others).

_____ c. Lack of spontaneous seeking to share enjoyment, interest or achievements with others (e.g., not showing, bringing, or pointing out objects he/she finds interesting)

_____ d. Lack of social or emotional reciprocity (e.g., not actively participating in social play or games, preferring solitary activities).

_____ e. Rarely seeking or using others for comfort in times of stress or offering comfort or affection to others in distress.

2. Impairments in communication, such as:

_____ a. Delay in development or lack of spoken language (i.e., not accompanied by an attempt to communicate through alternative ways to communicate such as gestures or mime).

_____ b. In those with adequate speech, impairment to initiate or sustain conversations with others.

_____ c. Stereotyped and repetitive use of language or idiosyncratic language (e.g., using words in a peculiar or odd way).

_____ d. Lack of varied, spontaneous make-believe play (e.g., pretend play) or social imitative play (e.g., imitating adults) appropriate to developmental level.

_____ e. Lack of emotional response to others' verbal or non-verbal communication.

_____ f. Lack of variation in the rhythm or emphasis of speech (e.g., speech is monotone)

_____ g. Impaired use of gestures to aid spoken communication.

3. Restricted, repetitive and stereotyped patterns of behavior, interest or activities such as:

_____ a. Preoccupation with one or more stereotyped and restricted patterns of interest of abnormal intensity or focus (e.g., few interests).

_____ b. Inflexible adherence to specific, nonfunctional routines or rituals.

_____ c. Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or other complex whole-body movements such as rocking, dipping or swaying).

_____ d. Persistent preoccupation with parts of objects (e.g., buttons, parts of the body).

_____ e. Specific attachments to unusual objects (e.g., string).

_____ f. Distress over changes in small, non-functional details of the environment.

[Original Article]

Physiological and Psychological Effects of Using the Body-Enveloping "CALM CHAIR" with Relaxation Benefits: Analysis in Typically Developing Children and Comparison with Data from Children with Developmental Disabilities

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Abstract

This study investigated the physiological and psychological effects of the "CALM CHAIR," *1 a body-expanding chair designed for relaxation, on typically developing children and compared the results with data from children with developmental disabilities. The subjects were 24 typically developing children (9 boys and 15 girls, aged 6–10 years) who sat for 5 min each on a school chair and the CALM CHAIR. Physiological measurements (heart rate and skin temperature) and subjective evaluations were also performed.

The results showed that the use of the CALM CHAIR significantly decreased the heart rate ($p < .01$, $d = 0.57$) and increased the skin temperature ($p < .01$, $d = -1.24$) compared with the regular chair, indicating enhanced parasympathetic nervous system activity. In the subjective evaluation of psychological effects, the CALM CHAIR was rated significantly higher in terms of comfort ($p < .01$, $d = -0.74$). These findings are similar to those reported by Kamiji et al. (2024) in children with developmental disabilities. Moreover, children with developmental disabilities exhibit more pronounced physiological responses, particularly heart rate variability, suggesting potential difficulties in autonomic nervous system regulation. The use of the CALM CHAIR resulted in relaxation effects in both groups, indicating its potential as an effective tool for stress management and environmental adaptation, especially in children with sensory sensitivities.

Keywords: hildren with developmental disabilities, relaxation, chair, CALM CHAIR

1. Introduction

Individuals with developmental disabilities often experience sensory hypersensitivity and difficulty in sensory processing, leading to increased stress and anxiety in daily life (Wada et al., 2023). Particularly in children with developmental disabilities, hypersensitivity to sensory stimuli

is high; these children may exhibit difficulties processing sensory information such as auditory, visual, and tactile inputs. Sensory hypersensitivity affects the regulatory function of the autonomic nervous system, triggering physiological responses such as increased heart rate and decreased skin temperature under stress (Baranek et al., 2006). In this study, the term "children with developmental disabilities" refers to those diagnosed with autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), or mild intellectual disabilities, in accordance with the Japanese Act on Support for Persons with Developmental Disabilities.

It has been reported that children with developmental disabilities, especially those with ASD, tend to have higher resting heart rates compared to typically developing children (Takeshima & Seiwa, 1993). Additionally, Porges (2007) proposed the polyvagal theory, suggesting a relationship between the autonomic nervous system function, social behavior, and emotional regulation. This theory provides an important perspective for understanding the relationship between physiological responses and behavior in children with developmental disabilities. Yamashita (2015) pointed out that individuals with ASD exhibit greater emotional responses to stress. These studies suggest a link between sensory hypersensitivity and physiological responses, emphasizing the importance of appropriate environmental adjustments and stress management. To objectively evaluate the effects of such interventions, heart rate and skin temperature were selected as physiological measures because they are non-invasive, real-time indicators of autonomic nervous system activity and have been shown in previous studies to reliably reflect relaxation responses through parasympathetic activation (Darki et al., 2022; Itao et al., 2018). Heart rate tends to decrease during relaxation, while skin temperature increases due to peripheral vasodilation associated with parasympathetic activation. These changes are consistent with reductions in sympathetic arousal and can serve as non-invasive markers for evaluating relaxation effects.

Given this background, various relaxation techniques have been explored to reduce stress and regulate behavior in children with developmental disabilities. For example, in the field of music therapy, Miyake (2011) reported the effectiveness of rhythmic activities for developmental support in children with developmental disabilities. Moreover, focusing on sensory stimulation, Onishi and Kumagai (2019) developed a learning method (somatosensory method) that considered the cognitive processing styles and somatosensory input methods of children with developmental disabilities, finding it improved the accuracy rate of kanji writing.

In particular, deep pressure stimulation (DPS) has garnered attention as a technique for reducing anxiety and promoting relaxation (Grandin, 1992), with the enveloping pressure believed to provide a sense of security. Based on this DPS concept, Kamiji et al. (2024) developed a body-enclosing chair, "CALM CHAIR", aimed at relaxing children with developmental disabilities, and conducted a study to validate its effectiveness. The results showed that compared to a regular chair, the CALM CHAIR significantly reduced the average heart rate and increased the average skin temperature, suggesting a relaxation effect on the mind and body. Additionally, subjective evaluations by the children (relaxation level and comfort) and observational evaluations by the instructors (level of calmness) were significantly higher when using the CALM CHAIR. These results support the theory of DPS and indicate its potential to aid stress management in children with sensory hypersensitivity.

However, the effectiveness of the CALM CHAIR has only been verified in studies involving children with developmental disabilities, and its effects on typically developing children have not been investigated. A comparative analysis between these two groups has yet to be conducted. Therefore, this study aimed to analyze the effects of using the CALM CHAIR on physiological indicators (heart

rate and skin temperature) and subjective psychological states in typically developing children and compare these findings with data from children with developmental disabilities.

Based on sensory integration theory, we hypothesized that children with developmental disabilities would exhibit more pronounced physiological changes when seated in the CALM CHAIR, which provides DPS, compared to typically developing children. Specifically, we expected that the use of the CALM CHAIR would promote parasympathetic nervous system activity, leading to a decrease in heart rate and an increase in skin temperature.

2. Methods

2.1 Target Child

The study included 28 typically developing children (9 boys and 19 girls) weighing less than 50 kg. All participants were enrolled in regular elementary school classes and had no history of developmental disorders, cardiovascular disease, or other medical conditions that could affect autonomic nervous system function. Their ages ranged from 6 to 10 years (M = 8.11, SD = 1.16). Children who had a fever, were feeling unwell on the day of the experiment, or had engaged in vigorous physical activity immediately before measurement were excluded from participation.

2.2 Procedure

Participants were tested in pairs in a classroom with the air conditioner set to 25℃. Humidity was not measured. The two subjects sat with their backs to each other so that they could not see one another during the experiment.

Each participant completed two consecutive conditions: (1) sitting on a standard school chair for 5 minutes, followed immediately by (2) sitting on the CALM CHAIR for 5 minutes. The order of conditions was fixed for all participants to ensure procedural consistency; therefore, potential order effects could not be ruled out and are addressed in the Limitations section.

For the school chair condition, participants were simply instructed to “Please sit on the chair.” For the CALM CHAIR condition, participants were told that their hips would sink deeply into the seat when they sat down. In both conditions, participants remained seated without speaking and refrained from unnecessary movements throughout the measurement period. Psychological and physiological evaluations were conducted continuously during each condition, as described below.

2.2.1 Physiological Evaluation

(1) Sitting posture observation: Sitting postures were recorded on video for later observation and qualitative assessment.

(2) Changes in heart rate: Heart rate was measured continuously using an arm-worn optical heart rate sensor (Polar OH1+, Polar Electro, Kempele, Finland). Although the manufacturer does not explicitly state the accuracy, previous validation studies have confirmed its reliability. Hettiarachchi et al. (2019) compared Polar OH1 measurements with electrocardiography (ECG) during treadmill walking and cycling at moderate to high intensities, reporting intraclass correlation coefficients above 0.95 across forearm, upper arm, and temple placements, with mean biases less than 3 bpm. These results indicate that the Polar OH1 provides sufficient accuracy for physiological research settings.

(3) Changes in skin temperature: Skin temperature was measured using a smartphone-compatible infrared camera (FLIR ONE PRO, FLIR Systems, Wilsonville, OR, USA; thermal resolution 160 × 120 pixels, accuracy ± 3℃ or ± 5%, whichever is greater). The camera was positioned

approximately 1 m from the participant's face and hands to capture consistent thermal images.

All physiological indicators were recorded continuously from the start of the school chair condition until the end of the CALM CHAIR condition. Heart rate data were recorded at 1-second intervals, and thermal images were captured every 5 seconds. The same devices and measurement protocols were used for all participants.

2.2.2 Psychological Evaluation

Subjective assessment: Immediately after completing each seating condition, participants were asked to rate their experience with the chair they had just used. Semi-structured interviews were conducted by the researchers, who were trained in working with children, to ensure that the questions were easily understood.

Participants rated each chair on a 5-point Likert scale with the following anchors: 1 = "very bad," 2 = "bad," 3 = "neutral," 4 = "good," and 5 = "very good." Children were also encouraged to explain the reasons for their ratings in their own words, and brief notes of these comments were recorded for qualitative reference.

2.2.3 Analysis Method

Paired-sample t-tests (two-tailed) were used to compare physiological and psychological outcomes between the school chair and the CALM CHAIR conditions. Independent-sample t-tests (two-tailed) were used to compare results between children with developmental disabilities and typically developing children. Prior to conducting t-tests, the Shapiro-Wilk test was applied to confirm the normality of the data distributions.

Effect sizes were calculated as Cohen's d, interpreted as small (0.20), medium (0.50), or large (0.80) according to conventional benchmarks. The significance level was set at $p < .05$. All statistical analyses were performed using JASP version 0.17.1 (JASP Team, Amsterdam, The Netherlands). Missing data were excluded pairwise from the relevant analyses.

2.3 Ethical Considerations

This study was approved by the Ethics Committee of Sanyo Gakuen University (approval number: A2024U002) and was conducted in accordance with the principles of the Declaration of Helsinki. The purpose, procedures, potential risks, and benefits of participation were explained in writing and verbally to both the children and their guardians. Written informed consent was obtained from the guardians, and verbal assent was obtained from the children. All data were anonymized, and care was taken to minimize potential risks to participants throughout the study.

3. Results

After reviewing the video footage of the experiment, four children who remained excited and could not be measured correctly were excluded. The final analysis included 24 typically developing children (9 boys and 15 girls) aged 6-10 years ($M = 8.08$, $SD = 1.18$).

3.1 Physiological Evaluation

3.1.1 Sitting Posture Observation

Video analysis showed that many participants appeared relaxed when using the CALM CHAIR (Figure 1).

3.1.2 Changes in Heart Rate and Skin Temperature

Average heart rate was significantly lower when participants were seated in the CALM CHAIR

(M = 97.75, SD = 9.22) compared with the school chair (M = 100.35, SD = 9.34; t (23) = 2.81, p < .01, d = 0.57) (Figure 2). This moderate effect size suggests that the use of the CALM CHAIR was associated with a decrease in heart rate.

3.1.3 Skin Temperature Changes

Figure 3 shows an example of skin temperature distribution captured by an infrared camera when using the school chair (left) and the CALM CHAIR (right). The average skin temperature was significantly higher when using the CALM CHAIR (M = 35.41, SD = 1.21) compared with the school chair (M = 34.69, SD = 1.11; t (23) = −6.05, p < .01, d = −1.24) (Figure 4). This large effect suggests that the CALM CHAIR has a strong influence on increasing skin temperature.

3.2 Psychological Evaluation

Comfort ratings were significantly higher for the CALM CHAIR (M = 4.57, SD = 0.84) than for the school chair (M = 3.36, SD = 1.16; t (23) = −3.92, p < .01, d = −0.74) (Figure 5). This medium-to-large effect size indicated that the CALM CHAIR was perceived as more comfortable.

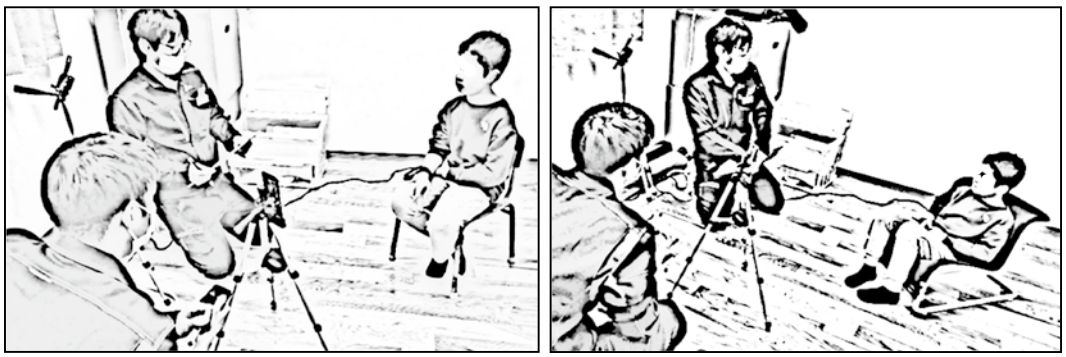

Figure 1 Sitting in a chair during the experiment

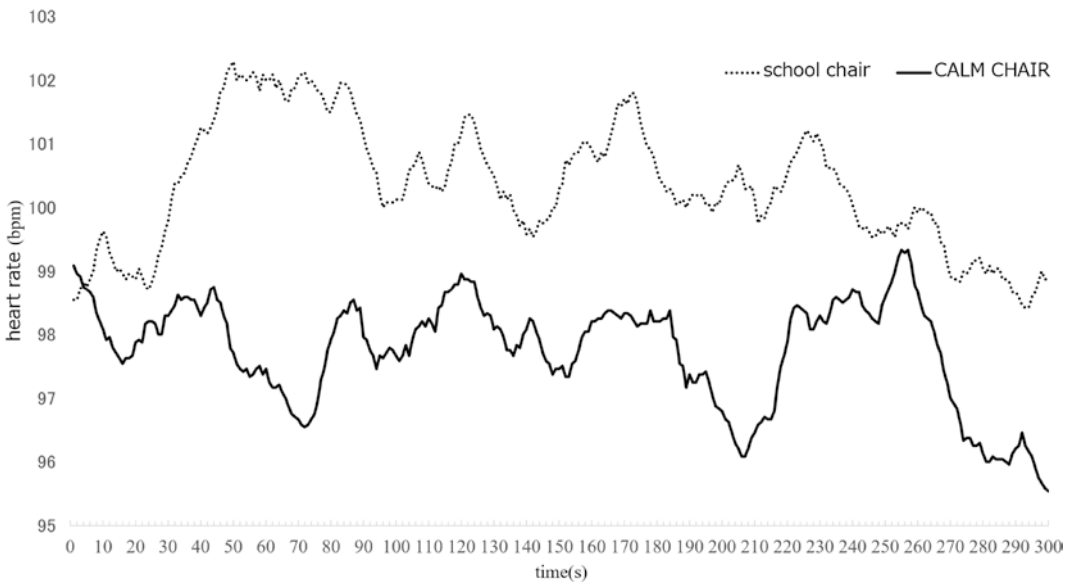

Figure 2 Heart rate variability during school chair and the CALM CHAIR use in typically developing children

Figure 3 Skin temperature change during the experiment

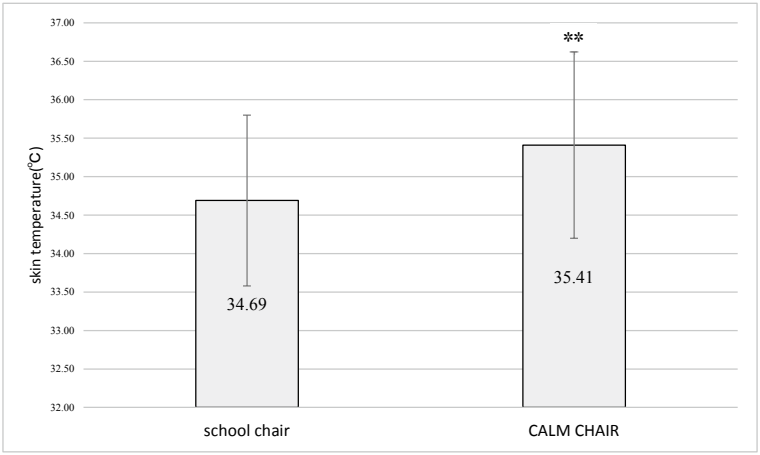

Figure 4 Results of t-test for skin temperature measured by infrared camera during use of school chair and the CALM CHAIR
Note: Mean ± SD. **p < .01.

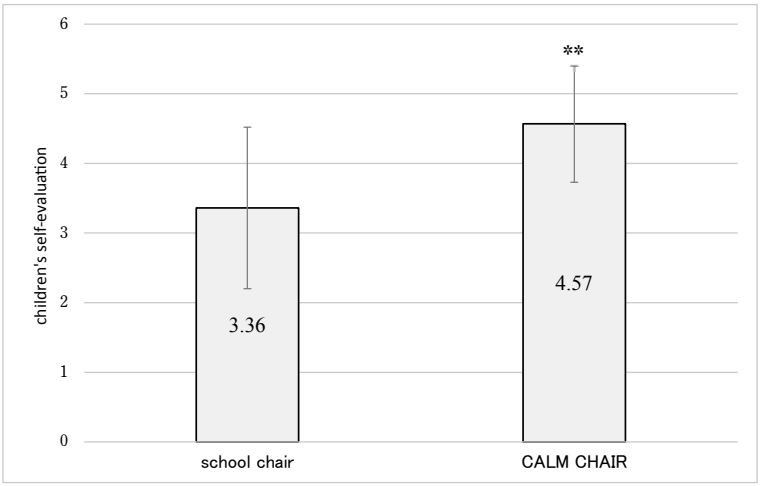

Figure 5 Results of t-test comparing comfort ratings between the school chair and the CALM CHAIR in typically developing children
Note: Mean ± SD. **p < .01.

4. Discussion

This study evaluated the impact of the CALM CHAIR on psychological and physiological responses in typically developing children by measuring heart rate, skin temperature, and subjective comfort ratings, compared with regular school chairs. The results suggest that the CALM CHAIR may provide relaxation effects in typically developing children, consistent with those observed in children with developmental disabilities in a previous study by Kamiji et al. (2024).

Physiological indicators revealed a significant decrease in the average heart rate and a significant increase in the average skin temperature when using the CALM CHAIR. A decreased heart rate is associated with increased parasympathetic nervous system activity and is widely recognized as an indicator of relaxation (Porges, 2007). These physiological changes suggest a reduction in the stress response, indicating that the CALM CHAIR may help alleviate physical tension.

Children with developmental disabilities (Kamiji et al., 2024) showed a significantly larger initial drop in heart rate compared with typically developing children (Figure 6: school chair; Figure 7: CALM CHAIR). These figures illustrate potential differences in physiological responses between the two groups, and such a pronounced early decrease may represent a physiological response specific to children with developmental disabilities. Individuals with developmental disabilities, especially those with ASD, have been reported to show stronger emotional reactions to stress (Yamashita, 2015). This rapid drop in heart rate can be interpreted as an adaptive reaction to unfamiliar environments or as a manifestation of sensory hypersensitivity. Children with ASD, in particular, often have difficulty regulating physiological arousal and tend to have higher resting heart rates than typically developing children (Takeshima & Seiwa, 1993). Additionally, Matsushima et al. (2016) found that school-age children with developmental disabilities generally exhibit lower parasympathetic activity involved in self-regulation.

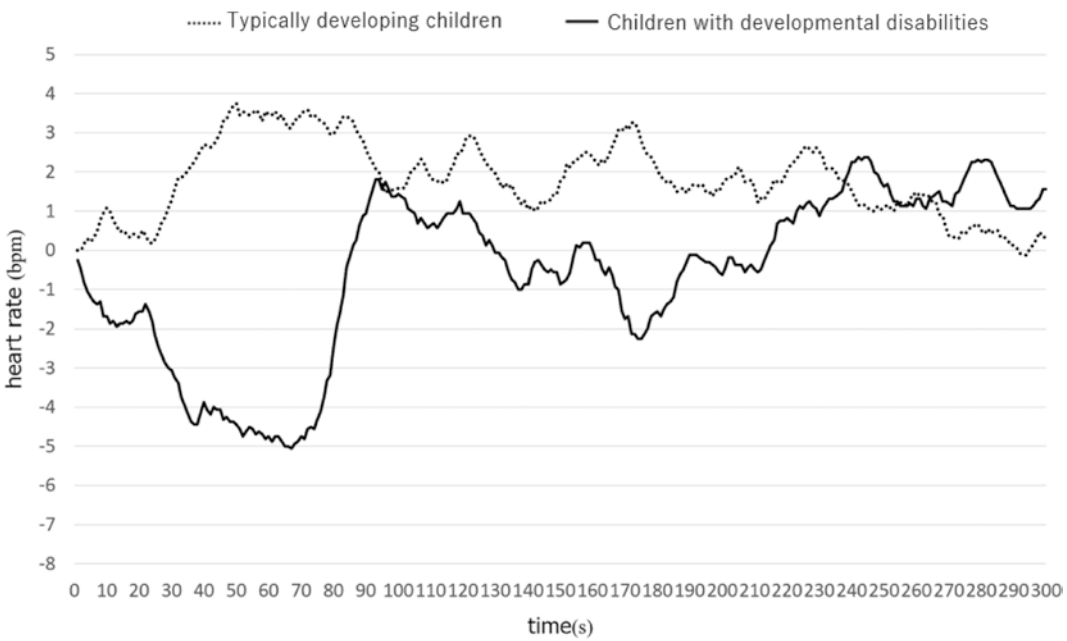

Figure 6 Changes in heart rate from initial baseline when using a school chair in children with developmental disabilities and typically developing children (adapted from Kamiji et al., 2024).

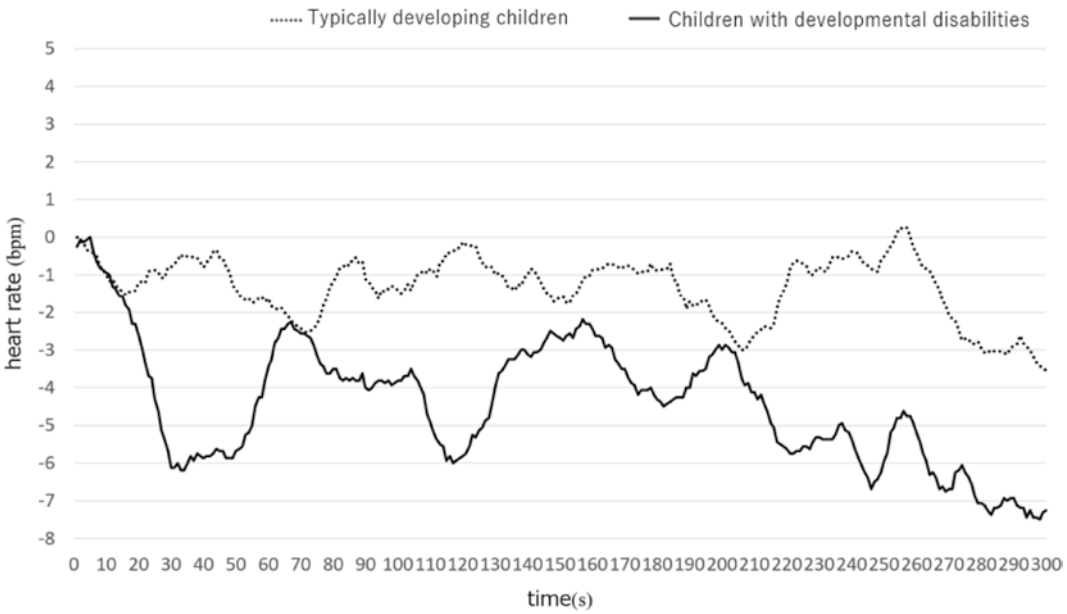

Figure 7 Changes in heart rate from initial baseline when using the CALM CHAIR in children with developmental disabilities and typically developing children (adapted from Kamiji et al., 2024).

Furthermore, this study revealed that children with developmental disabilities showed significantly greater changes in heart rate over time than typically developing children, both when using a school chair and the CALM CHAIR. This finding suggests that autonomic nervous system regulation in children with developmental disabilities may be less stable. Differences in sensory processing have been shown to affect physiological responses in these children (McIntosh et al., 1999), who tend to show excessive reactions to novel stimuli or unpredictable environmental changes compared to typically developing children (Ben-Sasson et al., 2009; Rodgers et al., 2012).

In terms of psychological indicators, subjective evaluations were significantly higher when using the CALM CHAIR, suggesting that it provides comfort and is a preferred seating experience for typically developing children. This result indicates that the CALM CHAIR not only promotes physiological relaxation but also provides psychological comfort. Children with developmental disabilities often show hypersensitive reactions to sensory stimuli (Baranek et al., 2006), and environmental adjustments such as the CALM CHAIR may help promote psychological stability.

From the perspective of sensory integration theory, the CALM CHAIR's body-enveloping design and moderate pressure may stimulate proprioceptive and tactile senses, potentially mitigating sensory hypersensitivity (Grandin, 1992). Deep pressure stimulation has been shown to calm the nervous system and promote relaxation (Ayres, 1972), providing a plausible mechanism for the observed effects. Compared with auditory-based calming interventions, which are often limited by individual differences in sound sensitivity (Maeda, 2014), tactile-based approaches such as the CALM CHAIR may be more broadly applicable.

Research on the relaxation effects of touch has demonstrated increased parasympathetic activity and decreased sympathetic activity (Kondo et al., 2012), a pattern similar to that observed here. However, unlike conventional touch therapy, the CALM CHAIR does not require direct human contact, allowing individuals to maintain personal space while receiving relaxation benefits.

Overall, these findings suggest that the CALM CHAIR may serve as a supportive environmental

tool for children with sensory or attentional difficulties. The National Institute of Special Needs Education (2012) has noted links between developmental disabilities and emotional disorders, indicating that appropriate environmental adjustments may also help prevent secondary emotional problems.

Future research should investigate the long-term effects of CALM CHAIR use, its applicability across age groups and disability types, and potential synergistic effects when combined with other relaxation strategies.

5. Conclusion

This study demonstrated that the CALM CHAIR provides both physiological and psychological relaxation effects in typically developing children, as shown by a decrease in heart rate, an increase in skin temperature, and higher subjective comfort ratings. These effects are consistent with previous findings in children with developmental disabilities (Kamiji et al., 2024), although children with developmental disabilities exhibited a significantly larger initial drop in heart rate than typically developing children. The results suggest that the CALM CHAIR may serve as an effective environmental intervention for children with sensory hypersensitivity, supporting both physical relaxation and emotional stability while allowing them to maintain personal space.

6. Limitations

This study has several limitations that should be acknowledged. First, the sample size was relatively small, which may limit the statistical power and reduce the ability to detect subtle effects. However, the effect sizes observed for heart rate ($d = 0.57$), skin temperature ($d = -1.24$), and comfort ratings ($d = -0.74$) were in the medium-to-large range, suggesting that the detected differences are likely to be meaningful despite the limited sample size. Replication with larger samples will be important to confirm these findings. Second, the study employed a short-term experimental design; therefore, the long-term effects of CALM CHAIR use remain unknown. Third, participants were limited to typically developing children aged 6–10 years and weighing less than 50 kg, which may restrict generalizability to other populations. Fourth, the study compared typically developing children only with children with developmental disabilities as reported in Kamiji et al. (2024). No direct comparisons were conducted with adults, and such comparisons will be important in future research. Fifth, the order of chair conditions was fixed, which may have introduced order effects.

Future studies should employ randomized or counterbalanced designs, include larger and more diverse samples, and investigate potential synergistic effects when the CALM CHAIR is combined with other relaxation strategies.

Conflict of Interest Statement

The CALM CHAIR used in this study was designed and manufactured based on a joint R&D agreement between Kamiji and OM Equipment Co., Ltd. Under this agreement, Kamiji received the research funds necessary for the design and prototyping of the CALM CHAIR from OM Equipment Co., Ltd. Nii, Itami, Oki, and Yuasa are employees of OM Equipment Co., Ltd. and were responsible for the design, manufacturing, and data collection of the CALM CHAIR in this study. To ensure the independence of the research, Kamiji primarily conducted the study design, data analysis,

interpretation of results, and manuscript writing without corporate involvement.

Acknowledgments

We would like to express our sincere appreciation to the staff of the Okayama Prefecture Child Support Class “Kirari” Bizen Mikado School and the Okayama City Hirafuku Elementary School Children’s Club Bamboo Shoot Club for their cooperation in conducting this study, and to the children and their parents for their cooperation in the experiments.

Note

The chair is constructed to envelop the body for relaxation purposes developed by Kamiji et al. in 2024 (Patent pending). It is designed to provide continuous support from the back to the buttocks, sinking along the natural curves of the body and providing moderate pressure sensation from the soft fabric. In addition, the fabric is made of a material that stretches as it sinks in response to body weight, providing soft stimulation to the skin sensation.

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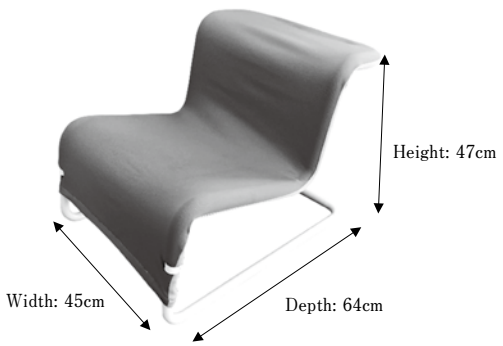

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[Paper]

An Exploratory Study on Perspectives of International Educators on Inclusive Education for Children with Disabilities in Japan

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Abstract

Based on the Convention on the Rights of Persons with Disabilities, which was adopted by the UN General Assembly in 2006 and entered into force in 2008, various efforts for inclusive education are being made in many countries. Japan ratified the Convention in 2014, and in August 2022, the Constructive Dialogue on the Convention on the Rights of Persons with Disabilities was held in Geneva, Switzerland, and in September of the same year, the UN Committee on the Rights of Persons with Disabilities was concerned about "the perpetuation of segregated special education of children with disabilities through medically based assessments" and issued recommendations to the Japanese government.

Since FY2014, the Japan International Cooperation Agency (JICA) Yokohama Center has conducted the Knowledge Co-Creation Program (KCCP) on inclusive education for children with disabilities. By FY2023, the program had hosted 134 participants from 47 countries, primarily developing nations. The program aims to provide participants with insights into Japan's initiatives in inclusive education through lectures and observation tours, enabling them to formulate concrete action plans for implementation in their home countries.

The purpose of this study is to gain an exploratory perspective on Japan's inclusive education initiatives by analyzing action plans developed by international educators with reference to Japanese initiatives. After the Structural Analysis by Quantification Method III, four perspectives were organized, "Promotion of Understanding and Awareness", "Development of Education System,", "Movement Toward Inclusion" and "Individual Support."

The Educators frequently highlighted two key perspectives—"Promotion of Understanding and Awareness" and "Individual Support"—as defining features of inclusive education in Japan. These findings align closely with the policies outlined by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

It will be essential to build on these strengths by further advancing the "Movement Toward Inclusion" and "Development of Education Systems" in the future. By leveraging these strengths, Japan can continue to refine and expand its inclusive education initiatives to pursue increased equity and inclusion.

Keywords: Inclusive Education, Children with Disabilities, International Perspectives

1. Introduction

Based on the Convention on the Rights of Persons with Disabilities, which was adopted by the UN General Assembly in 2006 and entered into force in 2008, various efforts for inclusive education are being made in various countries. Japan ratified the Convention in 2014, and in August 2022, the Constructive Dialogue on the Convention on the Rights of Persons with Disabilities was held in Geneva, Switzerland, and in September of the same year, the UN Committee on the Rights of Persons with Disabilities was concerned about "the perpetuation of segregated special education of children with disabilities through medically based assessments" and issued recommendations to the Japanese government.

While Japan has a long history of implementing special needs education, when the country was aiming to ratify the Convention on the Rights of Persons with Disabilities since 2012, it has been seeking to develop a flexible system that can provide "diverse places of learning" according to individual educational needs, while pursuing the same place for all children to learn.

Aoyama (2022) pointed out the current situation in Japan, where the term "inclusive education" has been used solely by itself without sorting out the differences between the orientations of special needs education and inclusive education, resulting in confusion. The study also points to the "fusion" of special needs education and regular education and the use of knowledge from other countries as future research issues.

While there have been studies that have explored the inclusive education initiatives of other countries, particularly Western countries, there have been few studies that have shown how Japan's initiatives are perceived by educators in other countries, and such an objective perspective will provide important insights for Japan to promote inclusive education in the future.

Since FY2014, the Japan International Cooperation Agency (JICA) Yokohama Center has conducted the Knowledge Co-Creation Program (KCCP) on inclusive education for children with disabilities. By FY2023, the program had hosted 134 participants from 47 countries, primarily developing nations. The program aims to provide participants with insights into Japan's initiatives in inclusive education through lectures and observation tours, enabling them to formulate concrete action plans for implementation in their home countries.

The purpose of this study is to gain an exploratory perspective on Japan's inclusive education initiatives by analyzing action plans developed by international educators with reference to Japanese initiatives. Gaining an objective understanding of Japan's inclusive education efforts, as viewed by educators from other countries, will provide valuable insights to promote inclusive education within Japan further.

2. Method

2.1 Research period

May 2024 – December 2024

2.2 Participants

Of the 134 participants from 47 countries who attended the KCCP, 133 successfully completed the program and developed action plans. By region, the participants represented 14 African countries, 13 Asian countries, 10 Oceanic countries, 4 Middle Eastern countries, 4 Latin American and Caribbean countries, and 2 European countries. This study analyzed the action plans of all

133 participants. In some instances, multiple participants from the same country collaborated on a single action plan, resulting in 112 unique action plans. It is essential to note that the program was not conducted in FY 2019 due to the outbreak of the COVID-19 pandemic. Additionally, the entire program was held in FY 2021 online.

2.3 Research Method

We analyzed outlines of the action plans in the KCCP's nine-year report.

2.4 Ethical Considerations

Written permission to use the report was obtained from the Japan International Cooperation Agency (JICA) Yokohama Center, the copyright holder of the report. The study was conducted with strict adherence to ethical guidelines, ensuring the protection of personal information. Additionally, this study received approval from the Ethics Committee of Tokyo Gakugei University (Approval Number: 817).

2.5 Methods of analysis

The data were analyzed qualitatively using the KJ method, with specific descriptions classified into major categories and subcategories. We then created sample codes for the major categories, and classification items for the subcategories based on the KJ method classifications. Hayashi's quantification Method-III (quantification method-III) and cluster analysis using the Ward method were conducted with the HAD Ver. 17 software to analyze the data structure further. The process was undertaken collaboratively by a university professor specializing in clinical psychology and a graduate student majoring in clinical psychology to minimize the risk of arbitrary or subjective data interpretation during the KJ method analysis.

3. Results

3.1 Classification of Action Plans for Promoting Inclusive Education

The analysis of the action plans revealed that the most frequently addressed category was "Activities to Promote Inclusive Education," with 149 descriptions (39.9%). This was followed by "Responding to the Educational Needs of Individuals" with 102 descriptions (27.3%), "Building Support Systems" with 45 descriptions (12.1%), "Raising Awareness" with 39 descriptions (10.5%), "Improving Teachers' Teaching Skills" with 22 descriptions (5.9%), and "Involving Parents" with 16 descriptions (4.3%). Some content overlapped across categories (Table 1).

Table 1 Classification of action plans for promoting inclusive education

	Classification of Action Plans	Descriptions	%
1	Activities to Promote Inclusive Education	149	39.9
2	Responding to the Educational Needs of Individuals	102	27.3
3	Building Support Systems	45	12.1
4	Raising Awareness	39	10.5
5	Improving Teachers' Teaching Skills	22	5.9
6	Involving Parents	16	4.3
Total		373	100.0

3.2 Sample Codes and Classification Items

To analyze the structure of the content of inclusive education in Japan as seen by educators from other countries, we then created sample codes for the major categories, and classification items for the subcategories. Table 2 shows that the analysis identified 18 items under "Activities to Promote Inclusive Education" (IE Promotion 1–18), 14 items under "Responding to the Educational Needs of Individuals" (Individual Needs 1–14), 8 items under "Building Support Systems" (Support System 1–8), 6 items under "Raising Awareness" (Raising Awareness 1–6), 5 items under "Improving Teachers' Teaching Skills" (Teaching Skills 1–5), and 4 items under "Involving Parents" (Involving Parents 1–4).

3.3 Structural Analysis by Quantification Method III

We performed a quantification method–III analysis for each item listed in Table 2 by assigning each sample code a score of 0 (if not present) or 1 (if present). The analysis considered two axes as interpretative criteria. The correlation coefficients were .826 for the first axis and .790 for the second axis. Using the category scores calculated from the quantification Method III, the first axis was represented as the vertical axis and the second axis as the horizontal axis, producing a two-dimensional scatterplot of actions to promote inclusive education (Fig. 1).

Items related to the "Promotion of Understanding and Awareness" were predominant in the positive direction of the first axis. Examples include 'Understanding of disability,' 'Understanding of Inclusive Education (IE),' 'Teachers' awareness,' and 'Parents' awareness.'

In the negative direction of the first axis, items associated with the "Development of Education System" were clustered, such as 'Model making,' 'Acceptance in regular schools (RS),' and 'Cooperation and collaboration with related organizations.'

The positive direction of the second axis included items related to "Movement Toward Inclusion," such as 'Training/Workshop (WS) on IE,' 'Advice from special schools (SS) to regular schools,' 'Social Model,' and 'Early Intervention & Developmental Support.'

Items associated with "Individual Support" were concentrated in the negative direction of the second axis. These included 'Provide education that meets individual needs,' 'Assessment,' and 'Promote school enrollment for children with disabilities (CWDs).'

A cluster analysis of category scores using Ward's method was conducted but did not identify distinct clusters. Therefore, the scatterplot displays all categorical items (Fig. 1), with the classification items in the scatterplot matching those listed in Table 2.

The scatterplot revealed that many classification items were plotted in the second quadrant, where the first axis represents "Promotion of Understanding and Awareness" and the second axis represents "Individual Support." These items included content related to understanding and raising awareness about disabilities and inclusive education, individualized education plans (IEPs), and support for CWDs.

In the first quadrant, where the first axis represents "Promotion of Understanding and Awareness" and the second axis represents "Movement Toward Inclusion," items such as 'Importance of IE' and 'Concrete actions for IE' were plotted.

In the third quadrant, where the first axis represents "Development of Education System" and the second axis represents "Individual Support," items such as 'Provide education that meets individual needs' and 'Education for CWDs' were located.

In the fourth quadrant, where the first axis represents "Development of Education System" and the second axis represents "Movement Toward Inclusion," items such as 'Teaching practice' and 'Curriculum' were plotted.

Table 2 Sample codes and classification items

Sample Code	Classification Items	Description in the Fig. 1
IE Promotion1	Training/Workshop on IE	Training/WS
IE Promotion2	Environmental improvement	Environment
IE Promotion3	Concrete action for IE	Concrete action
IE Promotion4	Interaction among children	Interaction
IE Promotion5	Sharing learning from KCCP	Sharing
IE Promotion6	Monitoring & Evaluation	Monitoring
IE Promotion7	Curriculum	Curriculum
IE Promotion8	Understanding of IE	Understanding of IE
IE Promotion9	Cooperation and collaboration with related organizations	Related organizations
IE Promotion10	Monitoring and evaluation of training results	Training results
IE Promotion11	Early Intervention & Developmental Support	Early Intervention
IE Promotion12	Model making	Model making
IE Promotion13	Event	Event
IE Promotion14	Ensure accessibility	Accessibility
IE Promotion15	Importance of IE	Importance of IE
IE Promotion16	Social Model	Social Model
IE Promotion17	Reporting	Reporting
IE Promotion18	Advice from special schools to regular schools	Advice from SS
Individual Needs1	Reasonable accommodation	RA
Individual Needs2	Assessment	Assessment
Individual Needs3	Support for CWDs	Support for CWDs
Individual Needs4	Individualized education plans	IEP
Individual Needs5	Resource Room	Resource Room
Individual Needs6	Identification of CWDs	Identification
Individual Needs7	Education for CWDs	Education for CWDs
Individual Needs8	Provide education that meets individual needs	Individual needs
Individual Needs9	Promote school enrollment for CWDs	School enrollment
Individual Needs10	Teaching CWDs	Teaching CWDs
Individual Needs11	Understanding of disability	Understanding of disability
Individual Needs12	Data	Data
Individual Needs13	Case conference	Conference
Individual Needs14	Autism	Autism
Support System1	Strengthening of cooperation	Cooperation
Support System2	Support system development	Support system
Support System3	Policy	Policy
Support System4	Accepted in regular schools	Acceptance in RS
Support System5	Utilization of volunteers	Volunteers
Support System6	International Classification of Functioning, Disability and Health:ICF	ICF
Support System7	Professional Staffing	Staffing
Support System8	Service	Service
Raising Awareness1	Community awareness	Community awareness
Raising Awareness2	Parents awareness	Parents awareness
Raising Awareness3	Educators awareness	Educators awareness
Raising Awareness4	Children awareness	Children awareness
Raising Awareness5	Promoting Community Understanding	Community Understanding
Raising Awareness6	Teachers awareness	Teachers awareness
Teaching Skills1	Teachers' teaching skills	Teaching skills
Teaching Skills2	Teaching material development	Teaching material
Teaching Skills3	Teaching practice	Teaching practice
Teaching Skills4	Using teaching materials and tools	Materials and tools
Teaching Skills5	Disability type guidebook	Guidebook
Involving Parents1	Promoting Parental Understanding	Parental Understanding
Involving Parents2	Support for parents	Support for parents
Involving Parents3	Hearing from parents	Hearing from parents
Involving Parents4	Working with Parents	Working with Parents

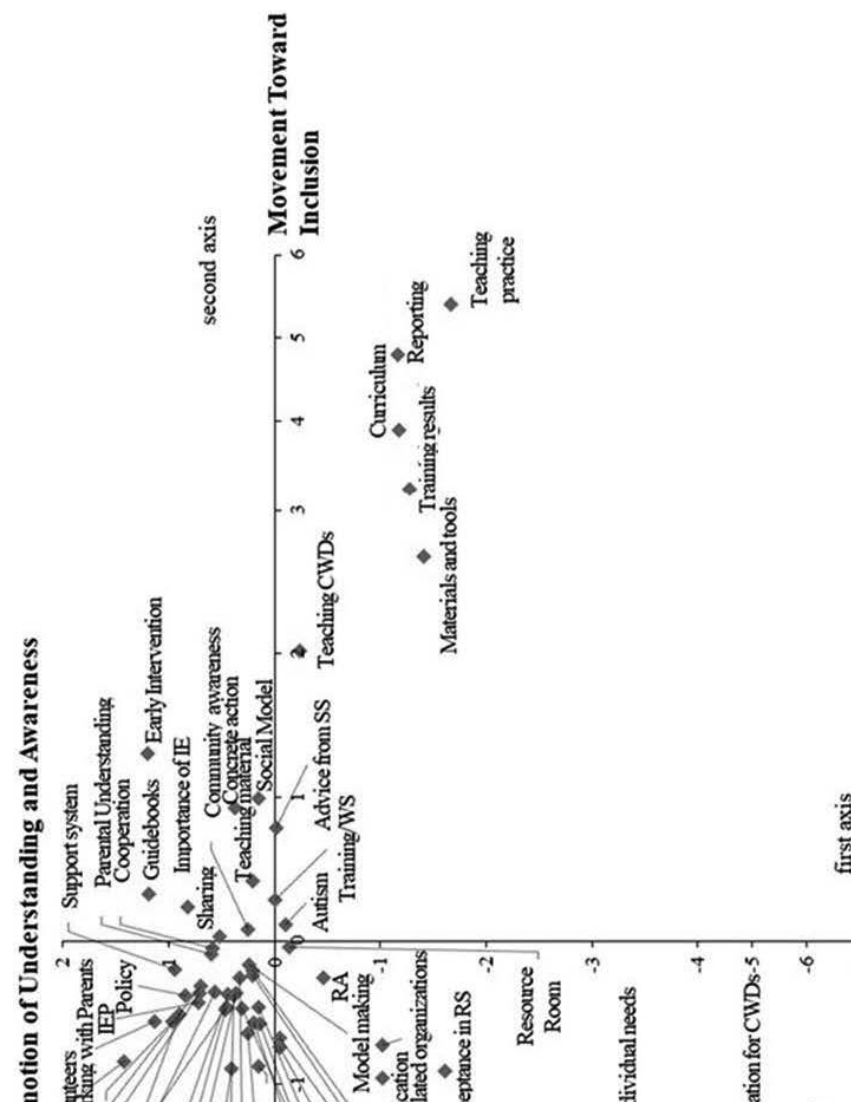

Figure 1 Perspectives of inclusive education in Japan as seen by international educators

4. Discussion

4.1 "Movement Toward Inclusion" and "Individual Support"

Perspectives of inclusive education in Japan as seen by international educators were organized into four quadrants based on two axes: the first axis, "Promotion of Understanding and Awareness" and "Development of Education System," and the second axis, "Movement Toward Inclusion" and "Individual Support." The Ministry of Education, Culture, Sports, Science and Technology (MEXT, 2012) defines an "Inclusive Education System" as one in which children with and without disabilities learn together. Within such a system, it is crucial to promote learning in shared environments while developing a diverse and flexible framework that provides instruction tailored to the specific educational needs of individual children, ultimately supporting their independence and social participation.

The second axis of the four quadrants—"Movement Toward Inclusion" and "Individual Support"—aligns with Japanese educational policies. The structure observed in the scatterplot reflects this alignment, and the correlation coefficients for the axes support the validity of this interpretation.

4.2 "Promotion of Understanding and Awareness"

As noted above, the contents of the scatterplot included items related to "Movement Toward Inclusion," such as 'Training/Workshop on Inclusive Education (IE)' and 'Social Model,' as well as items related to "Individual Support," such as 'Individualized Education Plans (IEPs)' and 'Providing education that meets individual needs.' These findings align with the "Inclusive Education System" principles outlined by MEXT.

Furthermore, when international educators examined Japan's inclusive education initiatives, one of the prominent perspectives they identified was the emphasis on "Promotion of Understanding and Awareness" among teachers, parents, children, and the community.

In Japan, the 2020 Tokyo Olympic and Paralympic Games provided an opportunity to advance public infrastructure and transportation systems with universal design principles on a global scale, alongside efforts to foster "barrier-free minds." The Japanese government formalized the "Universal Design 2020 Action Plan" in February 2017, which promotes initiatives to cultivate "barrier-free minds." This focus on "Promotion of Understanding and Awareness" is a unique feature of Japan's inclusive education efforts.

Additionally, among the disorder classifications, only "Autism" appeared explicitly. This finding may reflect the significant challenges in promoting inclusive education for children with autism in other countries. Educators from these countries seem to have drawn inspiration from Japan's initiatives to address these challenges.

5. Conclusion

The United Nations adopted the Convention on the Rights of Persons with Disabilities in 2006, establishing a shared global philosophy of inclusion. However, efforts to implement inclusive education vary across countries, shaped by their unique historical backgrounds and cultural contexts. UNESCO (2024) has called on national ministries of education to convene stakeholders, lead cross-sectoral collaboration, and engage school leaders and influential community members to drive change at the local level in support of inclusive education.

This study explored educators' perspectives regarding Japan's inclusive education system from

diverse international contexts. While the number of program participants and action plans analyzed may not fully represent the global population of educators, the analysis of action plans developed by those who visited educational sites and studied educational policies in Japan provided valuable insights. The study identified what these educators aimed to incorporate into their own countries' initiatives and classified the key perspectives of Japan's inclusive education system as seen by international educators. These findings contribute to an objective understanding of Japan's efforts in inclusive education and offer guidance for further improvements.

Educators frequently highlighted two key perspectives—"Promotion of Understanding and Awareness" and "Individual Support"—as defining features of inclusive education in Japan. These findings align closely with the policies outlined by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

It will be essential to build on these strengths by further advancing the "Movement Toward Inclusion" and "Development of Education Systems" in the future. By leveraging these strengths, Japan can continue to refine and expand its inclusive education initiatives to pursue increased equity and inclusion.

Note

This study builds upon and summarizes the work presented by the authors in the following reference: Moriya, K., & Hashimoto, S. (2024). Characteristics of Japan's inclusive education from educators' perspectives in other countries. The Program and Abstract of the 59th Conference, Japanese Association for the Study of Developmental Disabilities,135. (in Japanese)

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[Paper]

Promotion and Dissemination of Inclusive Education in Mongolia by Utilizing the Japanese Educational Practice of In-school Committees

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Abstract

Purpose: This study aims to report on and examines the results and effectiveness of in-school committees in Mongolia by referring to Japanese educational practice, which was one of initiatives of "Project for Strengthening Teachers' Ability and Reasonable Treatments of Children with Disabilities" (START1, 2015-2019) and its phase 2 (START2, 2020-2024) implemented by Japan International Cooperation Agency.

Methods: The subject of this study was 36 kindergartens and 35 schools in Ulaanbaatar and five provinces (Dornod, Tuv, Umnugovi, Khuvsgul and Khovd). The survey period was 2021-2024. In the first year of in-school committee implementation, a total of 558 activities were carried out by the committees in kindergartens and 340 activities in schools.

Findings: Based on the results of the implemented activities, a questionnaire administered to teachers, and interviews with principals, it can be concluded that in-school committees led to the establishment of school-wide support systems for children with special educational needs. The effects are summarized as follows. (1) The roles of teachers were organized under the leadership of managers. (2) Information sharing among teachers was facilitated. (3) Both homeroom teachers and managers took responsibility for supporting parents and creating positive relationships with them. (4) Attention has been paid to environmental improvement. (5) Teacher training in inclusive education

has been organized. These effects have been observed in many target kindergartens and schools, suggesting that in-school committees can play an important role in promoting inclusive education in Mongolia.

Keywords: inclusive education, regular kindergarten and school, in-school committee, Mongolia

1. Introduction

Goal 4 of the Sustainable Development Goals (SDGs) adopted by all United Nations Member States in 2015 is "Ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, n.d.). It aims to provide a safe, nonviolent, inclusive, and effective learning environment for all. UNICEF (n.d.) describes inclusive education, which realizes SDG 4, as the most effective way to give all children a fair chance to go to school, learn, and develop the skills they need to thrive. This entails real learning opportunities for groups who have traditionally been excluded, such as children with disabilities and speakers of minority languages.

Mongolia, the subject of this study, has an area of 1,564,100 km^2 and a population of 3,505,000 (2023), of which 1,735,000 (49.5% of the total population) live in the capital city of Ulaanbaatar. The ethnic composition is 95% Mongolian, followed by Kazakhs and other groups. Its official language is Mongolian; however, Kazakh is also spoken in the western part of the country. The majority practice Tibetan Buddhism (Ministry of Foreign Affairs of Japan, 2024). The main industries are mining and cattle raising, and according to IMF statistics, the GDP per capita in 2023 was 5,796 USD, ranking 111th out of 193 countries in the world (GLOBAL NOTE, 2024).

According to the National Statistics Office of Mongolia, the total number of persons with disabilities in 2023 was 111,228 (3.3% of the total population). A total of 63,798 were men (3.8% of the total male population) and 47,430 were women (2.8% of the total female population). Among the types of disabilities, 21,396 (19.2%) were living with intellectual disabilities, 20,018 (18.0%) with physical disabilities, 12,053 (10.8%) with visual impairments, 7,800 (7.0%) with hearing impairments, 3,618 (3.3%) with speech impairments, 7,409 (6.7%) with multiple disabilities, and 38,934 (35.0%) with other disabilities including internal disorder.

There are six special schools in the capital city, Ulaanbaatar, with specialized curricula that differ from those of regular schools. Special classes in regular schools are very rare, and their curriculum has the same lesson hours as regular classes, but teaching content is adapted to the actual situation of the child. Inclusive education in Mongolia aims to provide education in regular classes in regular schools.

One of the main challenges in promoting inclusive education in Mongolia is that children with disabilities are accepted into regular kindergartens and schools only through the efforts of individuals and international nongovernmental organizations (NGOs), and school-wide support systems for children with special educational needs have not been established.

The authors worked on the "Project for Strengthening Teachers' Ability and Reasonable Treatments of Children with Disabilities" (START1, 2015-2019) and its phase 2 (START2, 2020-2024) implemented by Japan International Cooperation Agency (JICA) in Mongolia. These projects focused on inclusive education for children with special educational needs. In order to solve the above-mentioned issue, START1 introduced the Japanese "In-school Committee on Special Needs Education" to Mongolia and START2 supported its implementation and nationwide dissemination (Tajima et al., 2023). An in-school committee aims to establish a school-wide educational support

system, understand the actual condition of children with special educational needs, and determine the necessary support for children. According to nationwide surveys in the academic year 2023-2024, in-school committees were established in 655 out of 737 kindergartens (88%) *1 and in 592 out of 720 schools (82%) *2.

Through coordination and cooperation with Mongolian stakeholders, the authors aimed to build inclusive education models and systems appropriate for Mongolia by referring to Japanese educational practices. In this paper, we report on one part of the initiatives—the implementation of in-school committees in Mongolia—and examine its results and effectiveness. This paper is based on the authors' analysis and does not represent the views of JICA.

2. Initiatives to promote inclusive education in Mongolia

2.1 Initiatives by Mongolian government agencies, donor organizations and international NGOs

Education for children with disabilities began in Mongolia in 1962, when a special class for visual and hearing impairments was established in School No.1 in Ulaanbaatar City. By 1989, 26 special schools were established throughout Mongolia. However, many closed in the 1990s owing to the transition to a market economy. Their numbers were reduced to two special kindergartens and six special schools (one for visual impairment, one for hearing impairment, and four for intellectual and physical disabilities) in Ulaanbaatar City.

In the 1990s, the Danish International Development Agency (DANIDA) and Save the Children UK implemented integrated education projects. In 2003, an inclusive education unit was established in Ministry of Education, Culture, and Science in Mongolia. Moreover, the "National Program on Inclusive Education" (2003-2008) was implemented, but has been evaluated as not been fully implemented because of a lack of coordination among related organizations and insufficient budgetary measures. Although projects by DANIDA and Save the Children UK have no direct impact on the introduction of in-school committee that we are going to discuss in this paper, the human resources trained by these initiatives have contributed to the promotion of inclusive education from 2015 onwards.

Mongolia acceded to the Convention on the Rights of Persons with Disabilities in 2009, and the Education Law and other related laws were amended to promote education for children with special educational needs. The pre-service training of special needs education teachers started at the State University of Education in 2013. Since 2015, when START1 was launched, various regulations and other measures promoting inclusive education have been approved, and donor organizations and international NGOs, such as the Asian Development Bank, Save the Children Japan, and Global Partnership for Education, have started their projects. Based on the various pilot activities implemented by START1, the "Guideline for Comprehensive Early Childhood Development for Children with Disabilities" was drafted and approved by Joint Ministerial Order of Labour and Social Protection, Education, Culture and Science, and Health in 2018. This served as a guideline for supporting children with disabilities in health, education, and social protection. In 2023, the Education Law and the Pre-School and General Education Law were amended and provisions on inclusive education were included in the laws (JICA, 2024; Suzuki et al., 2018).

2.2 Challenges in promoting inclusive education in Mongolia

Data Collection Survey on Special Needs Education in Mongolia conducted by JICA in 2013 concluded challenges in promoting inclusive education in Mongolia into "challenges on access to

education" and "challenges on quality of education." It summarized the causes of limited access as: (1) lack of a system for the early identification of disabilities, (2) lack of developmental support, and (3) limited acceptance in regular schools. The report presented five school cases that were proactive in accepting children with disabilities, but three of the five stopped accepting the children for the following reasons: changes in school management, termination of international NGO project, and insufficient teachers' treatment for their increased workload (JICA, 2014).

2.3 Introduction of Japanese "In-school Committee on Special Needs Education" in Mongolia

To promote inclusive education, START1 and START2 introduced and supported the implementation and nationwide dissemination of the in-school committee.

In Japan, in-school committee was required to be established in each kindergarten and school by Notification "About Promotion of Special Needs Education" issued in 2007, by the Director-General, Elementary and Secondary Education Bureau, Ministry of Education, Culture, Sports, Science and Technology Japan (MEXT). The committee aims to establish a school-wide educational support system under the leadership of the principal, understand the actual conditions of children with special educational needs, and determine the necessary support.

During START1, the authors introduced the practices of the in-school committee in Fujisawa City, Kanagawa Prefecture, Japan, to 16 Mongolian representatives who visited Japan in 2018. Six representatives from regular schools adopted in-school committees in their schools.

The establishment of in-school committee in regular schools was decreed in the "Guideline for Comprehensive Early Childhood Development for Children with Disabilities" approved by Joint Ministerial Order of Labour and Social Protection, Education, Culture and Science, and Health in 2018 and the "Regulation for Inclusive Education in Regular Schools" approved by Ministerial Order of Education, Culture and Science in 2019. As for kindergartens, the "Regulation for Provision of Pre-School Education Services to Children with Disabilities" approved in 2021 provided for the establishment of in-school committee.

The "Procedural Manual for Comprehensive Early Childhood Development for Children with Disabilities" (2021) (a revised version of the "Guideline for Comprehensive Early Childhood Development for Children with Disabilities"), stipulates that, "In-school committee is established in each kindergarten and school to ensure the right of children to develop and learn based on their needs and health conditions" with seven to nine members including manager, social worker, school doctor, teacher representatives, and parent representatives. Its role is to identify children in need of support; conduct health and environmental assessments of the children; develop an individualized education plan (IEP) ; monitor progress and report results; provide the necessary reasonable accommodations; promote understanding and provide training for teachers, parents, and the public.

3. Purpose of this study

In this paper, we report on and examine the results and effectiveness of in-school committees in Mongolia by referring to Japanese educational practice, which was one of the initiatives by START1 and START2.

4. Methods

4.1 Subjects of this study

This study covered 36 kindergartens and 35 schools, including 25 kindergartens and 25 schools in Ulaanbaatar City, and 11 kindergartens and 10 schools in five provinces (Dornod, Tuv, Umnugovi, Khuvsgul, and Khovd).

The target kindergartens accommodated children aged two to five years. Among the 25 kindergartens in Ulaanbaatar City, the lowest number of enrollees was 94, the highest was 1,137, and the median number was 340. The number of enrollees with certified disabilities ranged from zero to 12 children per kindergarten. For the 11 kindergartens in five provinces, the lowest number of enrollees was 125, the highest was 721, and the median was 240. Enrollees with certified disabilities ranged from zero to eight children per kindergarten (academic year 2023–2024).

The target schools were 12-year schools (five year elementary, four year lower secondary, and three year upper secondary schools). For the 25 schools in Ulaanbaatar City, the lowest number of enrollees was 669, the highest was 4,738, and the median was 2,312. Enrollees with certified disabilities ranged from one to 31 children per school. For ten schools in five provinces, the lowest number of enrollees was 288, the highest was 3,776, and the median was 1,423. Enrollees with certified disabilities ranged from five to 33 children per school (academic year 2023–2024 year).

4.2 Survey period and data collection

The survey was conducted between September 2021 and June 2024. As the Mongolian academic year begins in September and ends in June, the target period covered three consecutive academic years (2021–2022, 2022–2023, and 2023–2024).

The data used in this study were based on activity reports prepared by the target kindergartens and schools, information obtained during the authors' visits to each kindergarten and school, and the project's endline survey. The data on implemented activities led by the in-school committees in Ulaanbaatar City were collected for 2021–2022, and the data for the five provinces were collected for 2022–2023. Data on the committee's effectiveness were collected in 2023–2024.

This study was approved by the Research Ethics Committee of Tokyo Gakugei University (Receipt No. 868).

4.3 Target activities of this study

In the target kindergartens and schools in Ulaanbaatar City, activities led by in-school committees to create inclusive kindergartens and schools began in the academic year 2021–2022. For the five provinces, the activities began in 2022–2023, by referring to the practices in Ulaanbaatar City. In the first year of implementation, START2 provided five million Tugrug (approximately 1,500 USD) to each kindergarten and school to support their activities.

The main activities at each target kindergarten and school and the support by START2 are summarized in Table 4. In the "monitoring" from November to December and March to April, the authors as START2 experts visited the target kindergartens and schools to provide advice on their activities, in cooperation with Mongolian experts from Ministry of Education, Metropolitan and Provincial Department of Education, universities, special kindergartens and schools.

Table 1 Main activities at each kindergarten and school and support by START2

Month	Activities at each kindergarten and school	Support by START2
August		• Selecting target kindergartens and schools • Conducting training for the kindergarten and school managers and teachers in inclusive education and in-school committee
September	• Formulating an annual plan to create inclusive kindergartens and schools led by in-school committees • Starting the activities	• Supporting the formulation of the annual plan • Starting disburses of five million Tugrug
November-December	• Receiving START2 monitoring team and improving activities	• Conducting the monitoring and teacher training
March-April	• Receiving START2 monitoring team and improving activities	• Conducting the monitoring and teacher training
May	• Preparing an activity report	• Receiving an activity report
June	• Participating in and presenting at a debriefing session	• Holding a debriefing session among target kindergartens and schools

5. Results

5.1 Implemented activities led by In-school Committee

At the beginning of the academic year, the target kindergartens and schools formulated an annual plan to create inclusive kindergartens and schools led by an in-school committee, implemented activities according to the plan, and prepared an activity report at the end of the academic year. Based on this activity report, we analyzed the activities implemented by the kindergartens and the schools.

A total of 558 activities were implemented by 36 kindergartens, with a mean of 15.50 per kindergarten (standard deviation = 8.71) and a median of 15.5. A total of 340 activities were conducted by 35 schools, with a mean of 9.71 per school (standard deviation = 9.02) and a median of nine.

These activities were divided into six categories, as shown in Table 2: (1) In-school committees/

Table 2 Number of activities by category to create inclusive kindergartens and schools led by in-school committees

Category	In-school committee/ IEP	Instruction and teaching materials	Support for children and parents	Environmental improvement	Support for teachers	Collaboration with external organization	Total
Kindergarten	172 (30.8%)	107 (19.2%)	101 (18.1%)	89 (15.9%)	55 (9.9%)	34 (6.1%)	558
School	118 (34.7%)	38 (11.2%)	85 (25.0%)	54 (15.8%)	40 (11.8%)	5 (1.5%)	340
Total	290 (32.3%)	174 (16.1%)	164 (20.7%)	143 (16.0%)	83 (10.6%)	53 (4.3%)	898

IEP, (2) instruction and teaching materials, (3) support for children and parents, (4) environmental improvement, (5) support for teachers, and (6) collaboration with external organizations. A chi-square test was conducted to examine the difference in the frequency of each category of activities between kindergartens and schools, and the results showed that the chi-square value was 25.34 with five degrees of freedom and a p-value of less than 0.05, which indicated that there were statistically significant differences between the activities in kindergartens and schools. In particular, the results indicated that more kindergartens than schools implemented the activities with regard to "instruction and teaching materials" and "collaboration with external organizations."

The implemented activities are shown in the figures below for each category, and we compared

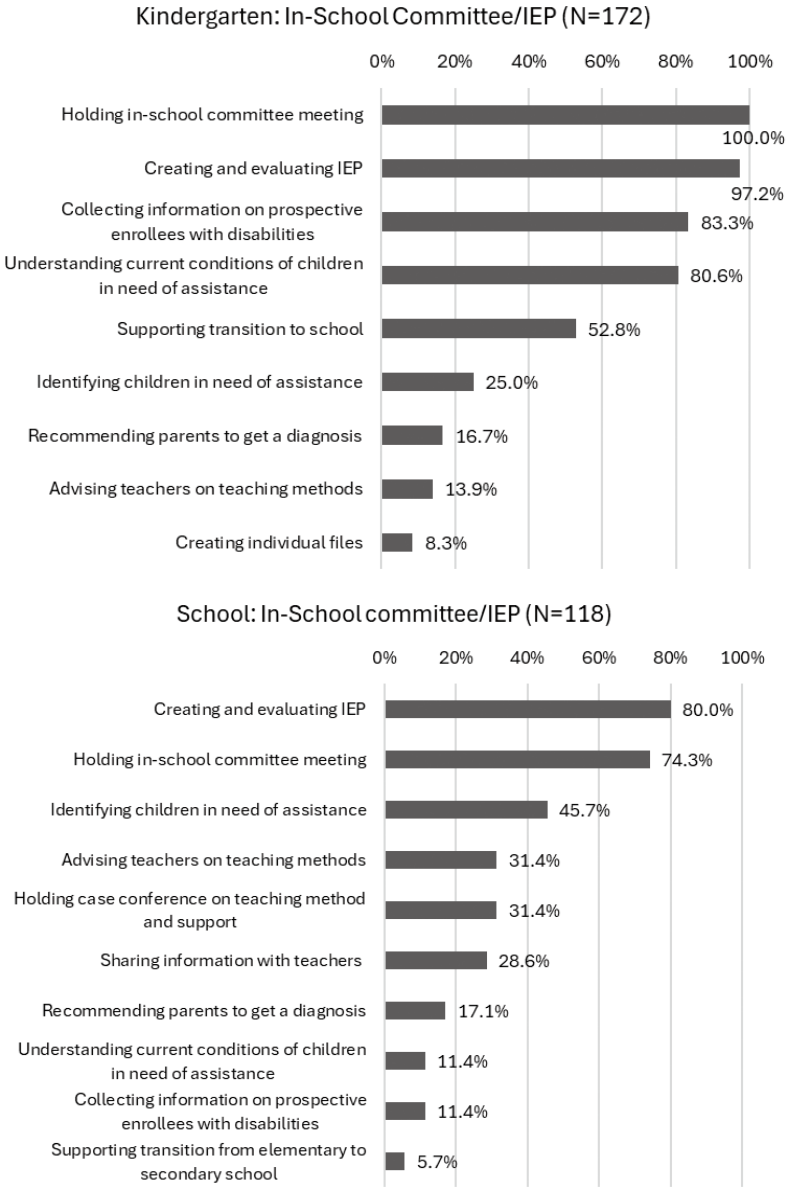

Figure 1 Implemented activities of in-school committee/IEP

the activities in the kindergarten and the schools.

For the category "In-school committee/IEP", many from both kindergartens and schools implemented "Holding in-school committee meeting" and "Creating and evaluating IEP." On the other hand, 30 out of 36 kindergartens (83.3%) implemented "Collecting information on prospective enrollees with disabilities," while only 4 out of 35 schools (11.4%) implemented the same activity.

Regarding the category "Instruction and teaching materials," both the kindergartens and the schools show similar trends in that "Creating teaching materials" and "Purchasing and preparing teaching materials and equipment" are the top activities implemented. However, the percentage of the kindergartens and the schools that implemented these activities differed. "Creating teaching materials" was implemented by 34 out of 36 kindergartens (94.4%) and 13 out of 35 schools (37.1%), while "Purchasing and preparing teaching materials and equipment" was implemented by 29 out of 36 kindergartens (80.6%) and 13 out of 35 schools (37.1%). In other words, more kindergartens implemented these activities than schools.

Regarding the category "Support for children and parents," the top four activities (73 out of 101, 72.3%) in the kindergartens were activities targeting parents, while only 28 activities (27.7%) were focusing on children. In contrast, 48 of 85 activities (56.5%) in the schools targeted parents, whereas 37 activities (43.5%) targeted children. More types of activities were implemented in the schools

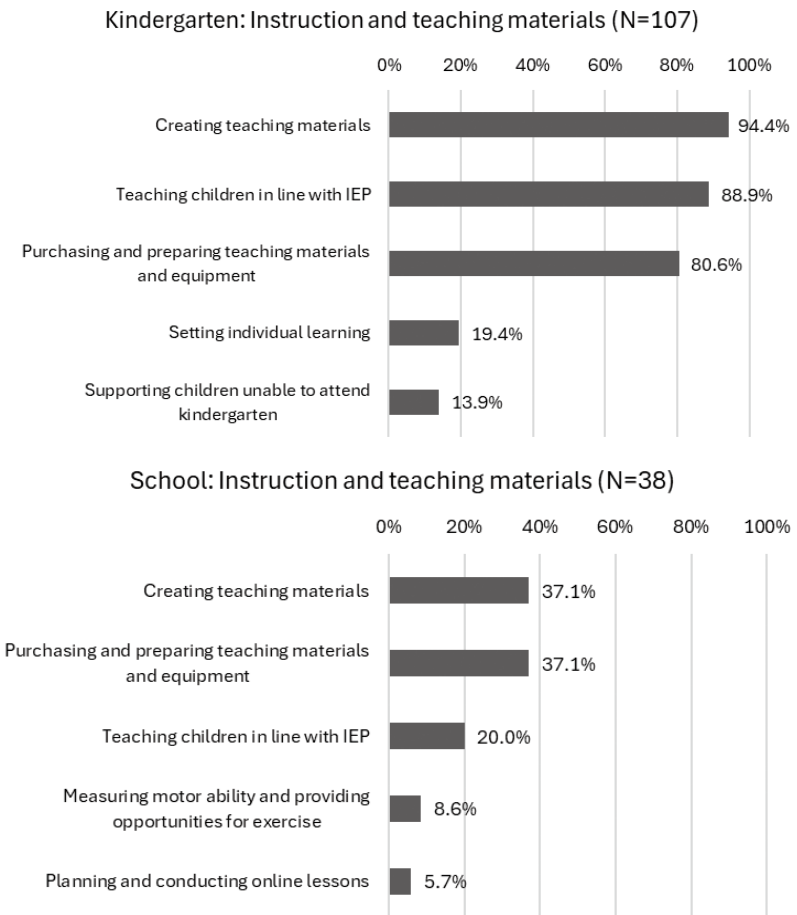

Figure 2 Implemented activities of instruction and teaching materials

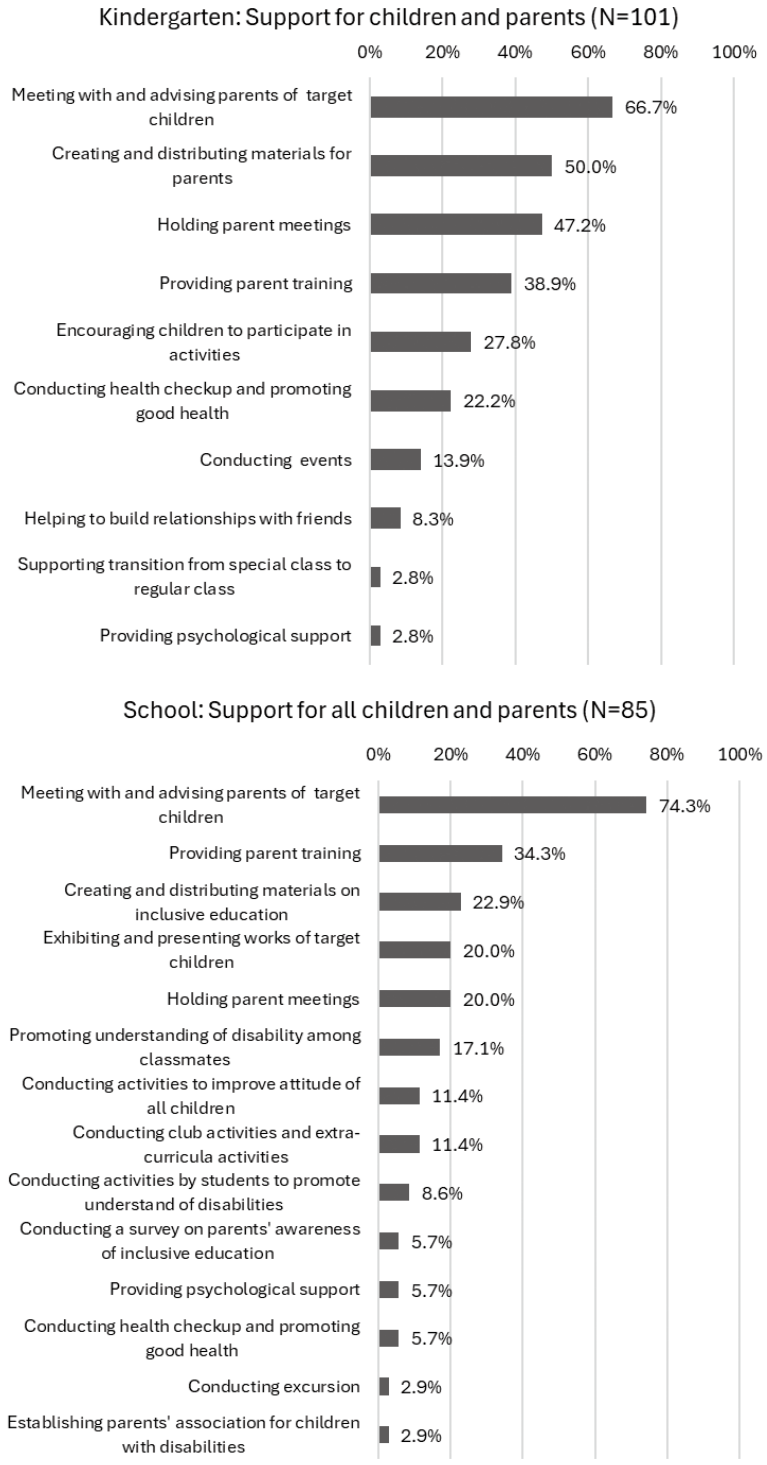

Figure 3 Implemented activities of support for children and parents

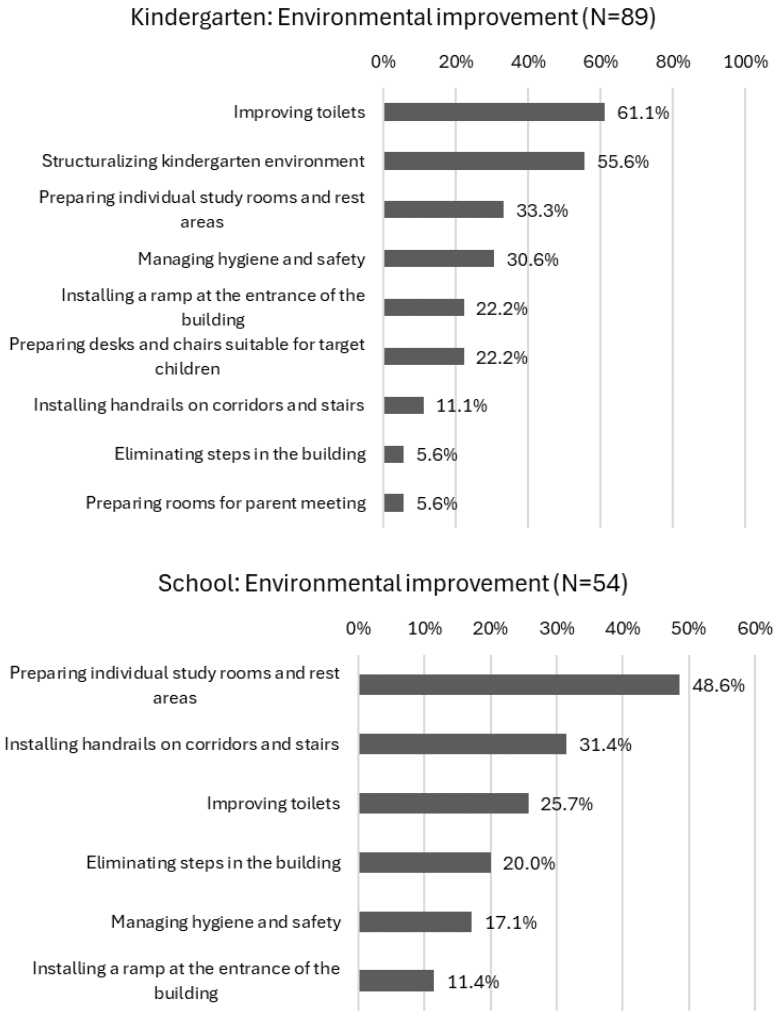

Figure 4 Implemented activities of environmental improvement

than in the kindergartens.

Regarding the category "Environmental improvement," many kindergartens and schools implemented "Improving toilets" and "Preparing individual study rooms and rest areas." A distinctive activity implemented in the kindergartens was "Structuralizing kindergarten environment" (20 out of 36 kindergartens, 55.6%). The activity included putting illustrations and marks on children's lockers in classrooms so that children know where to place their belongings and arranging teaching materials and equipment into classroom corners. In kindergartens, it was found that efforts were made to create an environment that is easy for children to understand and participate in daily activities.

With regard to the category "Support for teachers," many kindergartens and schools conducted "Teacher training," 35 out of 36 kindergartens (97.2%) and 29 out of 35 schools (82.9%). The teacher-training instructors were not only in-school teachers but also teachers from universities, special kindergartens, special schools, and NGOs. The content included how to create an IEP and how to teach according to the type of disability.

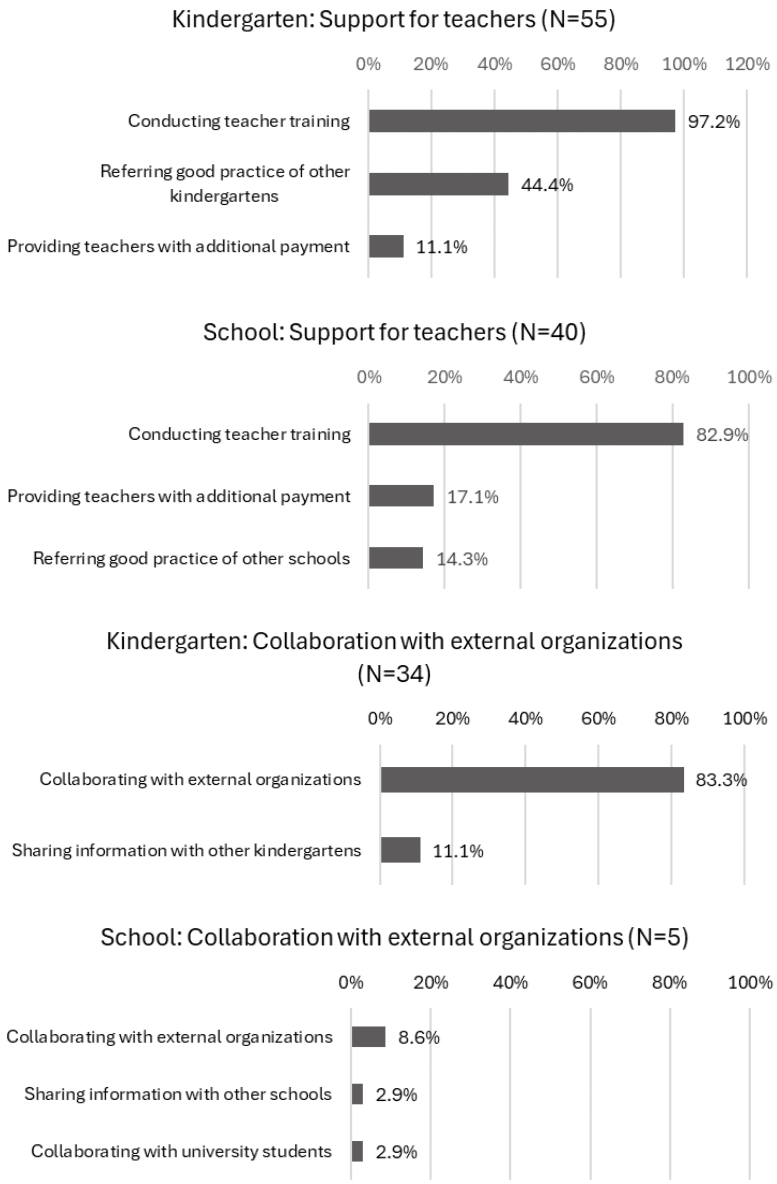

Figure 5 Implemented activities of support for teachers (first and second figure) and collaboration with external organizations (third and fourth figure)

In the category "Collaboration with external organizations," 30 out of 36 kindergartens (83.3%) implemented any activities, while only 3 out of 35 schools (8.6%) did so. As same as the category "Instruction and teaching materials," more kindergartens implemented this category of activities than schools. Specific examples of collaboration between kindergartens and external organizations include collecting information on prospective enrollees with disabilities in cooperation with the local government, and educational activities in cooperation with NGOs.

5.2 Effectiveness of In-school Committee

For the target kindergartens and schools in Ulaanbaatar City, we observed activities to create

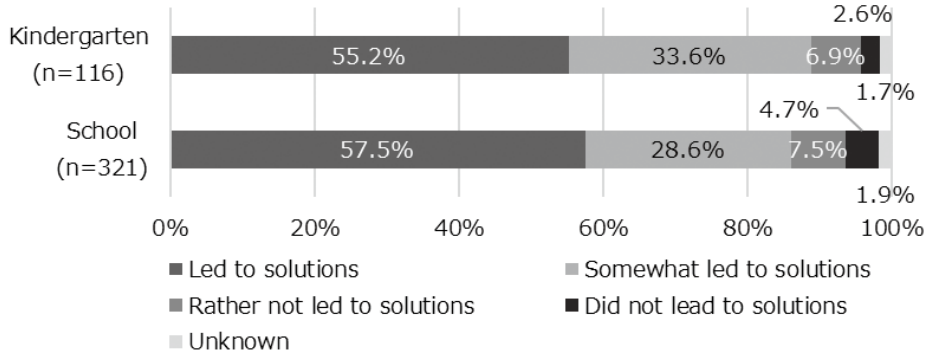

Figure 6 Answer of a question "Did in-school committee lead to solutions to problems on education for children with disabilities in the academic year 2023-2024?"

inclusive kindergartens and schools led by in-school committees for three years, from the academic year 2021-2022 to 2023-2024. For the five provinces, activities were observed for two years: during 2022-2023 and 2023-2024.

To examine the effectiveness of in-school committees, we asked teachers of the target kindergartens and schools, "Did the in-school committee lead to solutions to problems on education for children with disabilities in the academic year 2023-2024?" The results are presented in the figure below. More than 85.0% of respondents in both the kindergartens and the schools indicated that the committees "Led to solutions" or "Somewhat led to solutions."

Two interviews were conducted with the principal of a target kindergarten and school in Ulaanbaatar regarding the committee's specific effects.

Principal of target kindergarten A in Ulaanbaatar City

The mother of the boy B who is living with intellectual disabilities became impatient and anxious by comparing the developmental status of B with that of other children. Therefore, the in-school committee held meetings, and the members assigned roles to teachers to support her. The homeroom teacher shared with the mother what the child was able to do in the kindergarten through the communication notebook, and I, as a principal, listened to her anxious feelings. The other teachers casually praised her own efforts in daily conversation. Gradually, the mother's anxiety eased, and she was able to rejoice with the kindergarten teachers over B's daily progress. I confirmed the importance of the in-school committee to exchange information among teachers and to assign respective roles to teachers while supporting the children and their parents.

Principal of target school C in Ulaanbaatar City

I have seen the benefits of having parents as members of the in-school committee. Some parents are unaware that there are children with special educational needs in their child's class, and others are unaware of the importance of inclusive education. Parent representatives who participated in the in-school committee shared our activities with these parents and introduced their opinions to the committee. Through these communications, teachers began preparing materials that are easy for the parents to understand.

Another benefit is that the division of roles within the school has become clearer. Before the establishment of the in-school committee, it was unclear who would make plans and who would

implement what in promoting inclusive education. However, after the establishment of the in-school committee, the members formulated a plan, assigned roles, implemented activities, checked progress, organized teacher training and reported on activities at the end of the academic year, which promoted inclusive education as a team.

Another benefit of the in-school committee is that teachers got new knowledge and skills from their daily activity and teacher training organized by the in-school committee. Now, they give advice to each other and share their newly acquired knowledge and skills with other teachers. I feel that the instruction skills of the teachers have also improved.

6. Discussion

6.1 Implemented activities led by In-school Committee

The introduction and implementation of in-school committees in Mongolia were facilitated by national policies promoting inclusive education.

A total of 558 activities were implemented in the target kindergartens and 340 were implemented in the target schools. The average number of activities implemented per kindergarten was 15.50 and per school was 9.71, indicating that more activities were implemented in kindergartens than in schools. These activities were categorized into six: In-school committees/IEP, Instruction and materials, Support for children and parents, Environmental improvement, Support for teachers, and Collaboration with external organizations, and the characteristics of the implemented activities were discussed.

In the category "In-school committee/IEP," many from both kindergartens and schools implemented "Holding in-school committee meeting" and "Creating and evaluating IEP." Kindergartens were characterized by the fact that 30 out of 36 kindergartens (83.3%) implemented "Collecting information on prospective enrollees with disabilities." This is because kindergartens, in cooperation with the local government, focus on identifying toddlers with disabilities and recommending their enrollment.

More kindergartens than schools conducted activities in the category "Instruction and teaching materials." The reason for the low number of schools that prepared new teaching materials may be that Mongolian schools mainly use textbooks for instruction and thus have less room to devise teaching materials than kindergartens. At the same time, this also suggests that schools may depend on existing teaching materials and that there is a need to tailor instruction according to children's needs.

The analysis of implemented activities in the category "Support for children and parents" revealed that 72.3% of kindergartens and 56.5% of schools implemented activities for parents, whereas 27.7% of kindergartens and 43.5% of schools implemented activities for children. These results indicate that the main focus is on supporting parents in kindergartens, while the focus is not only on parents but also on children in schools, with a variety of activities being implemented.

It is evident that in-school committees have led to increased awareness of "Environmental improvement", and various efforts have been made. Since many kindergartens and schools were working on "Improving toilets" and "Preparing individual study rooms and rest areas," it can be inferred that these two points needed to be improved in terms of inclusive education promotion in Mongolia.

As for the category "Support for teachers," most kindergartens and schools conducted "Teacher training," with 35 out of 36 kindergartens (97.2%) and 29 out of 35 schools (82.9%). This result

shows that most kindergartens and schools had high demand for capacity building of teachers as they were newly implemented inclusive education. Teacher training is essential to strengthening teachers' knowledge and skills as well as to develop their confidence especially in the initial stages of promoting inclusive education.

In the category "Collaboration with external organization," many more kindergartens collaborated with external organizations compared to schools. As mentioned above, many kindergartens tried to identify toddlers with disabilities and recommended their enrollment, and cooperation with external organization is essential for those activities. This indicates that collaboration with external organizations in kindergartens is an important factor in promoting the enrollment of toddlers with disabilities.

6.2 Effectiveness of In-school Committee

As mentioned above, prior to the establishment of in-school committees, the inclusion of children with disabilities in regular kindergartens and schools was often implemented through the efforts of individuals and international NGOs, not a school-wide effort. In most cases, homeroom teachers alone created the IEP and were also responsible for daily instruction and support for parents; there was little collaboration with managers or other teachers.

Based on the results of activities led by the in-school committees, a questionnaire for teachers, and interviews with principals, it can be concluded that in-school committees have led to the establishment of school-wide support systems for children with special educational needs. The effects are summarized in the following five points. (1) The roles of teachers were organized under the leadership of managers. (2) Information sharing among teachers was facilitated. (3) Both homeroom teachers and managers took responsibility for supporting parents and creating positive relationships with them. (4) Attention has been paid to environmental improvement. (5) Teacher training in inclusive education has been organized. These effects have been observed in many target kindergartens and schools, suggesting that in-school committees can play an important role in promoting inclusive education in Mongolia.

6.3 Further study recommendation

To further analyze the effects of in-school committee, the following two perspectives are considered necessary: The first is to analyze the differences between teachers who felt and those who did not feel that the in-school committee was effective. Since the five points of effects of in-school committees were identified in this study, further analysis using these points as indicators will clarify areas for improvement of the committee.

The second objective is to conduct a qualitative study on the impact of each activity. By identifying and analyzing activities that are considered particularly impactful on inclusive education, effective and efficient activities for promoting inclusive education will be identified.

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creating inclusive schools for their children.

Note

*1 Number of kindergartens responded to a survey by General Agency for Education, Mongolia targeting 21 provinces (there are 1,410 kindergartens in Mongolia at the time of the survey).

*2 Number of schools responded to surveys by General Agency for Education targeting 21 provinces and by Metropolitan Department of Education targeting nine districts (there are 871 schools in Mongolia at the time of the survey).

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[Paper]

Poor Motor Coordination in Japanese Children with Developmental Dyslexia

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Abstract

To clarify the relationship between poor motor coordination and learning and cognitive impairments in Japanese children with developmental dyslexia (DD), we investigated these characteristics with a battery of learning and cognitive tasks. The subjects were 46 children with DD (32 males and 14 females; age: 6.9–12.7 years). Ten children had autism spectrum disorder (ASD), and 28 had attention-deficit/hyperactivity disorder (ADHD). We defined children as having poor motor coordination based on the results of the Japanese version of the Developmental Coordination Disorder Questionnaire (DCDQ-J). Eleven children were judged to have poor motor coordination, and all of these were diagnosed with developmental coordination disorder (DCD): therefore the rate of DCD in children with DD was 24%. There was a significant difference between the DCD and Non-DCD groups in the Eye-hand Coordination General Index of the Wide-range Assessment of Vision-related Essential Skills (WAVES). Through logistic regression analysis, comorbidity of ASD and PSI of the WISC-IV was found to have a significant relation with DCD, but the results of learning tasks associated with reading and writing were not significantly related to DCD. This study does not support the theory that motor coordination is directly related to reading ability in children with DD. Although there was no significant relation with the products of the writing tasks, the DCD group is thought to have poorer handwriting speed and accuracy and therefore requires more reasonable accommodation tailored to their characteristics. We propose that poor motor coordination in children with DD is a symptom associated with comorbid ASD and/or DCD.

Keywords: developmental dyslexia, developmental coordination disorder, autism spectrum disorder,

Japanese version of the Developmental Coordination Disorder Questionnaire (DCDQ-J), Wide-range Assessment of Vision-related Essential Skills (WAVES)

1. Introduction

Developmental dyslexia (DD) is defined by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) as a specific learning disability caused by neurological impairment (American Psychiatric Association, 2013). The International Dyslexia Association defines DD as characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities, and these difficulties typically result from a deficit in the phonological component of language (International Dyslexia Association, 2025). Various factors besides phonological impairment have been proposed as contributing factors to the pathophysiology of DD. For example, the involvement of an attentional mechanism (Shaywitz and Shaywitz, 2008), visual magnocellular deficit (Stein et al., 2000), deficits in detecting rapidly presented or rapidly changing sensory stimuli (Tallal, 2000), and cerebellar dysfunction (Nicolson et al., 2001) have been proposed as the pathophysiological basis of DD. DD is often comorbid with other neurodevelopmental disorders such as autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD), which can cause variations in the cognitive characteristics of DD.

Developmental coordination disorder (DCD) is characterized by severely impaired motor ability, including fine and gross motor skills, postural control, and movement coordination. The diagnosis of DCD is made by a clinical integration of the patient's history (developmental and medical), physical examination, school or workplace reports, and individual assessments using psychometrically sound and culturally appropriate standardized tests (American Psychiatric Association, 2013). The prevalence of DCD in children aged 5 to 11 years is thought to be 5 to 6% (American Psychiatric Association, 2013), which is almost as high as that of ADHD. Children with DCD can have handwriting deficits, and cause impaired academic achievement (Biotteau et al., 2019). DCD leads to impaired functional performance in activities of daily living, and can cause poor self-esteem and sense of self-worth, emotional and/or behavior problems.

Previous studies have suggested that cerebellar dysfunction is one of the important neural substrates of DCD. Similarly, cerebellar dysfunction has been reported as one of the neural bases of DD. As reading requires the integration of visual, auditory, motor, and language systems, it is mediated by network-interconnected brain regions. It has been reported that the left hemispheric language network, including the occipitotemporal region, is involved in the orthographic processing of word forms; that the temporoparietal region plays a role in visuo-auditory association and phonological processing; and that the inferior frontal gyrus is important for articulation (Pugh et al., 2001). These regions are thought to be closely connected with the cerebellum (Kujala et al., 2007). Additionally, the cerebellum is probably involved in various aspects of reading, including eye movements, language processing and spatial processing, working memory, and skill acquisition and automaticity (Peterson & Pennington, 2012; Stoodley & Stein, 2013). In typically developing readers, neuroimaging studies have revealed that the cerebellum is an important part of the reading network (Fulbright et al., 1999; Alvarez & Fiez, 2018).

As poor motor coordination is observed in many children and adults with DD, Nicolson and Fawcett proposed the cerebellar deficit hypothesis of DD (Nicolson & Fawcett, 1990; Nicolson et al., 1999). They also argued that the deficit in automaticity and procedural learning system via cortico-cerebellar language circuits could account for the specific impairments in DD (Nicolson & Fawcett,

2007; Nicolson & Fawcett, 2011). Accordingly, it has been suggested that motor coordination and reading ability are closely interconnected within the neural network (Nicolson et al., 2001; O'Hare & Khalid, 2002).

While it is recognized that the cerebellum is involved in the reading process in typically developing readers, the theory that motor coordination is directly related to reading ability in children with DD has been questioned. In a relatively recent study on the relationship between motor coordination and reading ability, as well as structural differences of the cerebellum using MRI between adults with and without DD, no significant relationships were found between motor coordination and reading ability, and structural differences of the cerebellum between the two groups were not observed (van Oers et al., 2018). In summary, various hypotheses have been proposed regarding the close relationship between motor coordination and reading ability, but no clear conclusion has been established.

For Japanese children with DD, no reports have been made on the relationship between motor coordination and learning abilities such as reading and writing, and both the prevalence of DCD in Japanese children and its comorbidity rate in children with DD are still unclear. The aim of the present study was to clarify how poor motor coordination affects Japanese children with DD and the relationship between motor coordination and learning and cognitive abilities associated with reading and writing.

In this study, "motor coordination" is refers to motor ability, such as fine and gross motor skills, postural control, and coordinated movement. The term "poor motor coordination" encompasses these impairments and is also commonly used in previous studies.

2. Subjects and Methods

2.1 Subjects

The subjects of this study were 46 school-aged children (32 males and 14 females; age:6.9-12.7 years), who were diagnosed with DD at the Department of Child Neurology, Okayama University Hospital. The diagnosis of DD was undertaken by one of the authors [M.O] using the DSM-5 criteria and the diagnostic procedure of DD in accordance with the 2010 Japanese Practical Guidelines for the Diagnosis and Treatment of Specific Developmental Disorders (Inagaki et al., 2010). This study only included children who had an intelligence quotient (IQ) score of > 80 in the Full-scale IQ (FSIQ) and/or Verbal Comprehension Index (VCI) and/or Perceptual Reasoning Index (PRI) in the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV). Some subjects were also diagnosed with other neurodevelopmental disorders such as ASD and ADHD according to the DSM-5 criteria.

This study was approved by the Ethics Committee of Okayama University.

2.2 Methods

We investigated the subject characteristics and the rate of DCD in children with DD.

2.2.1 Assessment of DCD

(1) Japanese version of the Developmental Coordination Disorder Questionnaire (DCDQ-J)

The DCDQ is a parent rating scale for screening pediatric DCD. The DCDQ 2007 is a 15-item parent questionnaire designed to screen for DCD in children aged 5 to 15 years (Wilson et al., 2009). The descriptions of each item are scored with a 5-point scale, with higher scores indicating better coordination based on a comparison between the child and other children.

The DCDQ-J was developed and adapted to the Japanese culture and reports gender-segregated, grade-specific normative scores of the DCDQ-J, total score, and three subscales, namely, Control during movement (six subitems), Fine motor (four subitems), and General coordination (five subitems). The raw scores of the DCDQ-J total score were transformed into z-scores using the means and standard deviations (SDs) of the data in the previous study (Nakai et al., 2011).

We defined children with z-scores of DCDQ-J total scores ≤ -1.5 as having poor motor coordination. Children with poor motor coordination were subsequently diagnosed with DCD by one of the authors [M.O] based on the DSM-5 criteria. The diagnostic assessment included evaluation of clumsiness and soft neurological signs such as diadochokinesis, repetitive finger tapping, and tandem gait, and standing on one leg with eyes closed. We classified subjects into those with DD and DCD (DCD group) and those with DD without DCD (Non-DCD group).

(2) Wide-range Assessment of Vision-related Essential Skills (WAVES)

The WAVES is designed to assess visual perception abilities and eye-hand coordination skills of Japanese elementary school children, which consists of nine subtests such as line tracing, form tracing, number comparisons I and II, discrimination speed, figure-ground speed, visual closure speed, discrimination accuracy, visual memory, and copying (Okumura et al., 2020). We examined four index scores derived from these subtests, which are Eye-hand Coordination General Index (ECGI), Eye-hand Coordination Accuracy Index (ECAI), Visual Perception Index (VPI), and Visual Perception and Eye-hand Coordination Index (VPECI). All index scores were standardized as age-specific and gender-segregated. A higher index score on this test indicates better visual perception and eye-hand coordination.

2.2.2 learning and cognitive tasks

(1) Japanese version of the Kaufman Assessment Battery for Children, Second Edition (KABC-II)

The KABC-II provides separate measures of children's cognitive abilities and basic scholastic aptitude (Kaufman & Kaufman, 2004). Since the Japanese version of the KABC-II (Kumagami & Kumagami, 2014) was used to evaluate learning ability in this study, we examined only four of the eight subscales measuring academic achievement (i.e., Vocabulary, Reading, Writing, and Mathematics). The scores of these subscales were standardized in an age-specific and gender-segregated manner. Higher scores on this assessment battery are associated with better basic scholastic aptitude.

(2) Reading task

The Reading task consists of four kana reading tests, namely, the Monomoraic syllable task, Word task, Non-word task, and Short sentence task. The Reading task was already established for the diagnosis of reading disorders in Japan, in accordance with the method previously reported by the 2010 Japanese Practical Guidelines for the Diagnosis and Treatment of Specific Developmental Disorders (Inagaki et al., 2010; Ogino et al., 2011). Measuring reading time allows an evaluation of reading fluency, which reflects reading ability well. Based on gender-segregated, grade-specific normative times required for comparable reading tasks (Inagaki et al., 2010), the reading times of the four tasks were transformed into z-scores using the means and SDs of the reading times in each task.

Monomoraic syllable task: 50 monomoraic syllables (5 rows, 10 columns), including 20 contracted sounds (CjV), were used. A mora usually consists of a consonant and a vowel, and the term 'monomoraic syllables' denotes syllables containing one mora.

Word and non-word tasks: 30 words, each composed of three or four morae, were printed in hiragana on a card (10 rows, three columns). The subjects were also instructed to read 30 non-

words, each composed of three or four morae, printed on another card.

Short sentence task: Subjects were shown three cards in succession, on each of which a short sentence composed of 23 to 27 morae was printed. Each card displayed one sentence written in a mixture of hiragana and kanji; some words in the sentence were written in hiragana while others were written in kanji. Above the kanji letters, however, there were hiragana indicating the correct pronunciation of the kanji letters.

(3) Das-Naglieri Cognitive Assessment System (DN-CAS), Japanese version

The DN-CAS is an assessment battery of the cognitive processing of individuals between the ages of 5 and 17 years that has been standardized in different languages, including Japanese (Naglieri, 1999; Maekawa et al., 2007). The DN-CAS consists of four independent cognitive factors: Planning, Attention, Simultaneous Processing, and Successive Processing, known collectively as the PASS model (Naglieri, 1999). All PASS scale scores were standardized as age-specific and gender-segregated. Higher scores on this assessment battery are associated with better cognitive processing skills.

The WISC-IV, KABC-II, Reading task, and DN-CAS are approved for health care services in the Japanese health insurance system and are commonly used for children with neurodevelopmental disorders, including DD in Japan. The WAVES has been used in Japan, particularly for children with poor motor coordination and/or learning difficulty. These tests were performed for the assessment of DD within one year before or after the evaluation of motor coordination of subjects by the DCDQ-J.

2.3 Data analysis

The Mann-Whitney U test was performed to compare the four index scores of the WAVES between the DCD and Non-DCD groups. Subject characteristics and the results of learning and cognitive tasks that predicted DCD in DD were investigated through logistic regression analysis with backward stepwise elimination. All statistical analyses were performed with SPSS version 28 (IBM Corporation, Armonk, NY, USA).

3. Results

3.1 Subject characteristics

Forty-four children were elementary school students and two were in the first year of junior high school. The children were classified into lower graders (1st-3rd graders at elementary school) and upper graders (4th-6th graders at elementary school and 1st-year students at junior high schools). Twenty-three children (16 males and 7 females) were in the lower grade and 23 children (16 males and 7 females) were in the upper grade. Ten children with DD had ASD (ASD alone in 4), and 28 had ADHD (ADHD alone in 22). Six children had comorbid ASD and ADHD.

3.2 Rate of DCD in DD, and the characteristics of DD with DCD

Eleven children out of 46 with DD were judged to have poor motor coordination based on the results of the DCDQ-J. These 11 children were clinically diagnosed with DCD, and the prevalence of DCD among children with DD was 24%. Figure 1 illustrates the overlap and distribution of children with ASD, ADHD, and DCD. The details and characteristics of the DCD and Non-DCD groups are shown in Table 1.

Figure 2 shows a comparison of the four index scores of the WAVES between the DCD and Non-DCD groups. There was a significant difference between the two groups in ECGI ($p = 0.041$),

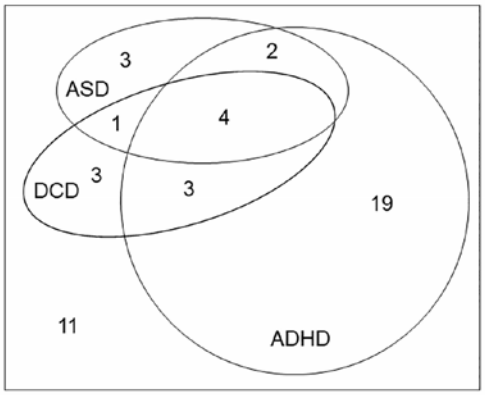

Figure. 1. Distribution of 46 children with developmental dyslexia (DD) in terms of comorbidities.
ADHD: attention-deficit/hyperactivity disorder; ASD: autism spectrum disorder; DCD: developmental coordination disorder

Table 1 Demographic and clinical characteristics of children with DD according to DCD status

	Total	DCD group	Non-DCD group
N	46	11 (24%)	35 (76%)
Gender			
Male	32	5	27
Female	14	6	8
Age			
Median (range)	9.6 (6.9-12.7)	8.9 (7.7-11.5)	9.8 (6.9-12.7)
School grade			
Lower	23	6	17
Upper	23	5	18
Comorbidity			
ASD	10	5	5
ADHD	28	7	21
DCDQ-J total score (z-score)			
Median (range)	-0.7 (-2.4-0.6)	-1.8 (-2.4 - -1.6)	-0.4 (-1.2-0.62)

In the DCDQ-J, the descriptions of each item are scored as follows based on the comparison between the child and other (children): "Not at all like your child (1 point)," "A bit like your child (2 points)," "Moderately like your child (3 points)," "Quite a bit like your child (4 points)," and "Extremely like your child (5 points)," with higher scores indicating better coordination.

but no significant differences were observed in other index scores.

Table 2 shows the results of the learning and cognitive tasks in the DCD and Non-DCD groups.

3.3 Predictors of DCD in children with DD

We investigated whether each of the subject characteristics (gender, age, and comorbidity) and the results of each test (WISC-IV, KABC-II, reading tasks, and DN-CAS) were related to DCD in children with DD through the univariate logistic regression analysis (Table 3). Comorbid ASD had a significant relationship with DCD in DD ($p=0.038$).

The multivariate logistic regression analysis indicated two significant relationships between comorbid ASD and DCD ($p=0.013$; odds ratio: 14.522; 95% confidence interval [CI]: 1.75-120.87), and between PSI of WISC-IV and DCD ($p=0.025$; odds ratio: 0.914; 95% CI: 0.85-0.99) (Table 3).

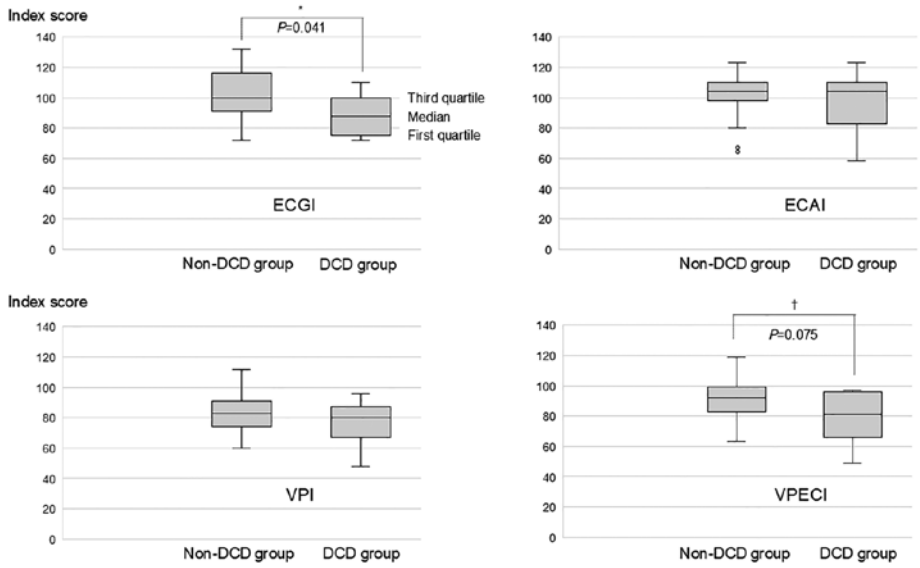

Figure. 2. Box plots comparing four index scores of the Wide-range Assessment of Vision-related Essential Skills (WAVES) between the DCD and Non-DCD groups.
Outliers are plotted beyond the end of the lower whisker.
*p < 0.05, † p< 0.1 (Mann-Whitney U test)

4. Discussion

The present study investigated the rate of DCD in Japanese children with DD based on the results of the DCDQ-J and clinical findings. We further investigated the relationship between DCD in DD and subject characteristics and results of several learning and cognitive tasks associated with reading and writing.

We used the DCDQ-J in this study because it allows accurate evaluation of poor motor coordination and has been reported to have a significant correlation with the Movement Assessment Battery for Children, Second Edition (MABC-2) (Pannekoek et al., 2012; Hirata et al., 2015). The MABC-2 is widely used to evaluate motor coordination, and was developed based on a normative sample in the UK (Henderson et al., 2007). The MABC-2 consists of three components: Manual Dexterity, Aiming and Catching, and Balance. Unfortunately, the Japanese version of the MABC-2 had not yet been officially released at the time of writing and the normative data for Japan has not been established. As illustrated in Fig.2, there was a significant difference between the DCD and Non-DCD groups in ECGI of the WAVES. ECGI is measured by subtests such as line tracing and form tracing, which are designed as a general indicator of eye-hand coordination speed (including some aspects of accuracy) (Okumura et al., 2020).

Eleven out of 46 children with DD were diagnosed with DCD, and the rate of DCD in DD was 24% in the present study. To the best of our knowledge, no similar research has been carried out in Japanese children. In the United Kingdom (UK), 52% or 59% of children with DD were reported to show impairments on tests that evaluate motor coordination. (Ramus et al., 2003; Haslum & Miles, 2007). Other studies reported in Norway that 60% of children with DD had DCD (Iversen et al., 2005). The 24% rate reported in this study is substantially lower than those reported in previous studies. Our study did not use the same evaluative tasks as the UK studies, so it is not possible to

Table 2 Results of assessments in the DCD and Non-DCD groups

	N	Total 46	DCD group 11	Non-DCD group 35
		Median (range)		
WISC-IV				
FSIQ		88 (72-109)	85 (77-100)	88 (72-109)
VCI		90.5 (72-111)	91 (82-99)	90 (72-111)
PRI		89.0 (71-120)	89 (76-109)	89 (71-120)
WMI		85 (65-123)	85 (76-94)	85 (65-123)
PSI		94 (70-132)	86 (73-115)	96 (70-132)
KABC-II				
Vocabulary		86 (67-103)	86 (73-94)	86 (67-103)
Reading		77 (60-101)	79 (71-89)	75 (60-101)
Writing		74 (61-96)	79 (71-84)	71 (61-96)
Mathematics		84 (70-115)	90 (77-115)	84 (70-113)
Reading task (z-scores)				
Monomoraic syllable task		2.3 (-0.4-7.9)	1.7 (-0.1-6.0)	2.5 (-0.4-7.9)
Word task		3.2 (0.1-13.1)	2.5 (0.1-11.7)	3.4 (0.3-13.1)
Non-word task		1.8 (-0.2-8.1)	1.5 (0.2-4.7)	1.9 (-0.2-8.1)
Short sentence task		2.6 (-1.4-31.4)	2.8 (-1.4-7.5)	2.5 (-1.0-31.4)
DN-CAS				
Planning		89 (68-128)	83 (70-111)	89 (68-128)
Simultaneous		87 (67-122)	85 (72-122)	89 (67-116)
Attention		91 (63-130)	76 (66-110)	93 (63-130)
Successive		82 (58-115)	81 (58-108)	83 (66-115)
WAVES				
ECGI		97 (72-132)	72 (86-110)	100 (72-132)
ECAI		104 (58-123)	104 (58-123)	104 (64-123)
VPI		83 (48-112)	80 (48-96)	83 (60-112)
VPECI		90 (49-119)	81 (49-97)	92 (63-119)

FSIQ: Full-scale IQ; VCI: Verbal Comprehension Index; PRI: Perceptual Reasoning Index; WMI: Working Memory Index; PSI: Processing Speed Index
ECGI: Eye-hand Coordination General Index; ECAI; Eye-hand Coordination Accuracy Index; VPI: Visual Perception Index; VPECI; Visual Perception and Eye-hand Coordination Index

make a direct comparison. However, this 24% rate is close to our impression of the frequency of DCD in children with DD that we have observed in our clinical experience here in Japan.

Many children with ASD are thought to have poor motor coordination (Ming et al., 2007), and it has been reported that DCD coexists with ASD at a frequency of almost 80% (Green et al., 2009). In the present study, 10 out of 46 children with DD had ASD (22%), and five out of 10 children with ASD had DCD (50%). These rates were much lower than those reported by Green et al. (2009). In Japan, Miyachi et al. (2014) reported that the rate of poor motor coordination in boys with high-function pervasive developmental disorder was almost 40%, which is lower than the rate mentioned above for other countries.

We investigated whether various subject characteristics and test results were related to DCD in children with DD. A logistic regression analysis revealed that only ASD and PSI of the WISC-IV had a significant relationship with DCD in DD. Nicolson et al. (2001) reported a close relationship

Table 3 Logistic regression analysis of factors associated with DCD in children with developmental dyslexia (DD)

	N	Odds ratio	95% CI	*p*-Value		N	Odds ratio	95% CI	*p*-Value
Univariate analysis									
Gender (Male)	32	0.247	0.06–1.03	0.054	Reading task (z-scores)				
Age		0.819	0.51–1.30	0.399	Monomoraic syllable task		0.773	0.50–1.20	0.255
Comorbidity					Word task		0.877	0.70–1.10	0.254
ASD	10	5.000	1.10–22.82	0.038*	Non-word task		0.902	0.63–1.30	0.575
ADHD	28	1,167	0.29–4.74	0.829	Short sentence task		0.923	0.75–1.13	0.442
					DN-CAS				
WISC-IV					Planning		0.971	0.92–1.03	0.299
FSIQ		0.976	0.90–1.06	0.570	Simultaneous		0.990	0.93–1.06	0.777
VCI		1.024	0.94–1.12	0.606	Attention		0.967	0.92–1.02	0.208
PRI		0.994	0.94–1.05	0.840	Successive		0.991	0.94–1.05	0.769
WMI		1.002	0.94–1.07	0.959					
PSI		0.942	0.88–1.01	0.071	*Multivariate analysis*				
KABC-II					Gender (Male)	32	0.135	0.02–1.00	0.050
Vocabulary		0.967	0.90–1.05	0.403	Comorbidity				
Reading		1.045	0.96–1.14	0.303	ASD	10	14.522	1.75–120.87	0.013*
Writing		1.067	0.98–1.16	0.135	WISC-IV				
Mathematics		1.028	0.98–1.08	0.294	PSI		0.914	0.85–0.99	0.025*
					KABC-II				
					Writing		1.112	0.98–1.26	0.105

FSIQ: Full-scale IQ, VCI: Verbal Comprehension Index, PRI: Perceptual Reasoning Index, WMI: Working Memory Index, PSI: Processing Speed Index CI: confidence interval *$p<0.05$

between poor motor coordination and reading difficulty in DD, but several studies have argued that poor motor coordination in DD is not due to DD itself but to coexisting ADHD and/or DCD (Ramus et al., 2003; Wimmer et al., 1999). Although, the relationship between poor motor coordination and ADHD in children with DD is recognized, there have been no reports regarding the relationship between ASD and poor motor coordination in children with DD. It appears that our study is the first to report this relationship.

Motor impairments and clumsiness are often observed in children with ASD, and it has been reported that there is a close relationship between social impairments and poor motor coordination in children with ASD (Green et al., 2008; Holloway et al., 2018). In investigating poor motor coordination in DD, the coexistence of ASD must have a strong influence. In Western countries, children with ASD are well known to have poor reading comprehension, but there have been few detailed reports on the coexistence of DD and ASD (Nation et al., 2006). We previously reported that the rate of reading disability in children with pervasive developmental disorder was 26% (Oka et al., 2012), and it is not uncommon for children with DD to have ASD. Regarding poor motor coordination in children with DD, not only ADHD but also ASD should be considered as possible comorbidities.

PSI of the WISC-IV is measured by the subtests such as the coding and symbol search, which require appropriate eye-hand coordination skills, visual attention and motor speed. Because motor coordination and visual perception including eye-hand coordination are considered to be directly and strongly related to each other (Wilson & McKenzie, 1998), it is to be expected that the results of PSI were significantly related to DCD in DD in the present study. In contrast, there were no significant relationships found between DCD and results of reading and writing tasks. The results of this study do not support the previously reported the theory proposed by Nicolson et al. (2001) that motor

coordination is directly related to reading ability in children with DD.

Evaluating handwriting skills requires examining its product (i.e., legibility and accuracy of the written trace), its process (i.e., movements that generate the trace), or both. There was no significant relationship between the product of the writing task and comorbid DCD in children with DD, but this may be because the Writing subtest of the KABC-II is evaluated by its product and not the handwriting process or speed. The DCD group can have poorer handwriting speed and accuracy and therefore requires more reasonable accommodation tailored to their characteristics (i.e., additional time, reduced handwriting tasks, exemption from copying what is written on the blackboard, etc.).

Our study has some possible limitations. First, the sample size was small, which could have hampered the statistical power of our results. Future studies with larger sample sizes could identify even more differences between the DCD and Non-DCD groups. Second, another important issue related to poor motor coordination is the possibility of skill improvement through learning or training (Sigmundsson et al., 2017). Development of skill may be possible in children with DD with or without DCD, but this issue is beyond the scope of the present study and requires well-designed future studies.

5. Conclusion

Various factors are considered to play a role in the occurrence of DD. This study focused on poor motor coordination in children with DD, but the results did not support the theory that motor coordination is directly related to reading abilities (Nicolson et al., 2001). Motor coordination is not considered to be a core factor in reading and writing ability, but poor motor coordination may be a symptom associated with comorbid ASD and/or DCD. The consideration in this study was similar to the theory on Ramus et al. (2003), which focused on the comorbidities of DD. However, unlike previous reports, comorbid ADHD was not significantly related to DD in children with DD. Taking into account the difference in the rate of DCD in DD, the results of this study may be due to the difference in the characteristics of DD and/or DCD between people using Japanese and those using alphabetic languages. This issue requires further study in the future.

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Conflicts of interest

None to report.

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[Paper]

Effects of Functional Assessment Learning for After-School Day Service Staff: Using an Original Card Game

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Abstract

Objective: This study was designed to enhance the quality of support provided in after-school day services by implementing a functional assessment training program using an originally developed card game. The study examined how this training influenced both the quantity and quality of support ideas generated by participants when presented with hypothetical case scenarios. Method: We used a pre-post design to evaluate the training's effectiveness. The participants included 37 staff members from four after-school day service facilities. The intervention consisted of a role-playing card game designed to teach functional assessment principles and creative idea generation. The training lasted between 1.5 and 2 hours. Outcome Measures: The dependent variables included the number and quality of support ideas generated for hypothetical case scenarios, as well as the social validity of the training. Results: Participants generated more support ideas after the training, and their ideas' quality improved. Additionally, social validity assessments indicated that participants found the training understandable and beneficial. Conclusion: Utilizing the card game as a training tool created an environment that reinforced idea generation and facilitated the generalization of learned concepts to hypothetical case scenarios. However, challenges remained in sharing the acquired knowledge with others and applying it to real-world problems. These findings highlight the need for additional support and follow-up training.

Keywords: Functional Assessment, Behavioral Problems, After-school Day Services, Card Games, Staff Training

1. Introduction

After-school day services provide continuous welfare support for school-aged children with disabilities by offering learning programs designed to enhance their daily living skills during after-school hours and extended vacations. These services aim to promote the independence of children with disabilities while complementing their formal education. The primary objective is to facilitate after-school support tailored to individual needs. According to the After-School Day Service Guidelines issued by the Ministry of Health, Labour and Welfare (MHLW, 2015), service providers must recognize the diversity of support needs and continuously improve the quality of care by adapting their approaches based on each child's circumstances. In particular, the guidelines mandate the development of Individualized Support Plans (ISPs), which require service providers to assess each child's needs and document key issues, specific support strategies, and important considerations for effective intervention (MHLW, 2015). Children utilizing after-school day services have a variety

of disabilities, including intellectual and physical disabilities as well as developmental disorders. Their ages range widely, from elementary school students to high school. Consequently, facilities may encounter a variety of behavioral challenges that require a high level of expertise.

Common challenges include difficulty following instructions, an inability to participate in group activities, conflicts with other children, strong fixations that make it hard to adapt to schedule changes, and impulsive behaviors such as shouting loudly or leaving one's seat. Therefore, when developing an ISPs to improve a child's overall quality of life, it is important to understand the reasons behind their behaviors. Functional assessment is an effective evaluation method for this purpose (O'Neill et al., 1997). Functional assessment analyzes behavioral problems by identifying the functional relationship between antecedent and consequent events. Based on this analysis, interventions can be designed to modify the antecedents and consequences that reinforce or maintain the behavior (Hirasawa and Fujiwara, 2002).

This type of assessment employs one or a combination of three primary methods: (1) interviews with relevant individuals, including the person exhibiting the behavior; (2) descriptive analysis through direct observation; and (3) experimental analysis by manipulating environmental conditions (O'Neill et al., 1997). While the effectiveness of functional assessment is widely recognized, applying it in practice requires specialized knowledge.

Bareford (2023) conducted a systematic review on the use of analog board games in higher education, revealing that such games are widely implemented as effective tools to foster active learning, collaboration, and problem-solving. The review highlighted that board games not only enhance students engagement and motivation but also contribute to the development of 21st-century skills, including communication, critical thinking, and teamwork. In recent years, analog game-based learning (GBL) has emerged as a promising pedagogical approach that integrates the motivational and interactive qualities of games with educational objectives. Unlike traditional lecture-based methods, analog GBL—such as the use of board and card games—provides learners with hands-on, collaborative experiences that promote active participation and deeper understanding through play. Nguyen (2024) investigated the effects of incorporating board games into STEM education using four distinct games designed to enhance cognitive understanding, motivation, and engagement. The findings showed that the introduction of board games significantly increased students' motivation and engagement while deepening their comprehension of STEM concepts. Similarly, Szilagyi (2025) examined the use of a non-digital card game, Blue Yeti, among first-year computer science students, and reported that analog card-based GBL produced measurable short-term improvements in learning performance and knowledge acquisition. Drawing on the demonstrated effectiveness of analog GBL in promoting active and experiential learning (e.g., Bareford, 2023; Nguyen, 2024; Szilagyi, 2025), its potential applications may extend beyond formal education to practical fields such as vocational training and welfare services. Currently, training in welfare settings faces challenges such as time constraints and personnel shortages, highlighting the need for training methods that can efficiently and effectively enhance the professional expertise of field staff (MHLW, 2020; MHLW, 2024). Nevertheless, practical research on staff training that utilizes GBL tools such as card games within the welfare sector remains limited.

This study aims to enhance the quality of support provided in after-school day services by implementing a functional assessment learning program using an original card game (hereafter, "card game learning"). Specifically, the study examines how this learning influences the quantity and quality of support ideas generated by staff members when presented with hypothetical case scenarios.

2. Method

2.1 Participants

We recruited staff members from four after-school day service facilities (n = 37): 4 from Facility A, 17 from Facility B, 7 from Facility C, and 9 from Facility D.

2.2 Procedure

The learning sessions were conducted over six months at four after-school day service facilities, each session lasting 1.5 to 2 hours. At the beginning of each session, participants were provided with printed descriptions of Hypothetical Cases 1 and 2 and were instructed to write their support ideas freely on blank A4-sized paper. Response time was approximately 10 minutes. Following this, the facilitator explained the five functions of behavior in functional assessment, after which the participants received an overview of the card game. They then engaged in the card game for approximately one hour. In the latter half of the training, two types of support tools were introduced to facilitate consideration of support based on the function of behavior. One tool was a questionnaire (BAC) for organizing the function of the behavior, and the other was a Support Strategy Planning Sheet for devising and organizing specific support strategies tailored to the identified function. The facilitator spent approximately 10 minutes explaining these tools before asking participants to generate support ideas for Hypothetical Cases 3 and 4 under the same conditions as the initial task. After the session, participants completed a social validity questionnaire to evaluate their perceptions of the learning.

2.3 Materials

2.3.1 Behavioral Assessment for Children (BAC)

We developed a customized questionnaire based on the Motivation Assessment Scale (MAS; Carr and Durand, 1985), a 16-item rating scale for estimating the function of a target behavior across four domains: sensory stimulation, escape, attention, and tangible reinforcement (demand for objects or activities).

The Behavioral Assessment for Children (BAC) incorporates the four functional domains of the MAS and introduces an additional function: prevention (Ito and Takeuchi, 2022). Prevention refers to behaviors that prevent participation in activities that may lead to failure or discomfort. For example, a child may feign illness to avoid physical education class, anticipating the possibility of failure. After-school day services often include small group activities for students from elementary to high school. Since tasks are frequently assigned to elementary school students, preventive behaviors are often implemented, which is why this was added. The BAC was explicitly designed for after-school day service settings and consists of 10 items, with two questions per function. Participants rated each item on a six-point Likert scale ranging from 0 (never) to 5 (always). We calculated the mean score for each function to determine the dominant function of the target behavior.

2.3.2 Support Strategy Planning Sheet.

Support Strategy Planning Sheet is a tool developed to facilitate the consideration of specific support methods for individuals based on functions identified through MAS and other methods (Takeuchi, 2023). Takeuchi (2023) emphasized that the sheet is a practical resource for caregivers and support staff, enabling them to develop targeted behavioral interventions.

The Support Strategy Planning Sheet required participants to document intervention strategies according to the function of the behavior. We classified these strategies into five categories: Alternative Behavior Learning, which involves teaching a new behavior that serves the same

function as the problem behavior; Enhancing Daily Activities, which provides opportunities for the individual to fulfill the function of the behavior in a structured, adaptive way; Environmental Modifications, which aim to remove triggers that may elicit problem behaviors; Psychoeducation, which fosters understanding of the behavior's function and encourages self-regulation within feasible limits; and Self-Management Learning, which teaches individuals strategies to fulfill the function of their behavior independently.

In this study, we added the function "prevention of anxiety-inducing activities!" to Takeuchi (2023) independently created sheet (see Figure 1). The learning session included sample sheets with pre-filled intervention ideas to enhance participants' understanding of using the tool effectively.

2.3.3 Behavioral Support Trial-and-Error Card Game

The learning incorporated a role-playing card game designed to provide an experiential learning opportunity for generating support strategies based on functional assessment principles. This game allowed participants to actively engage with different behavioral scenarios and develop intervention strategies in a dynamic and interactive format. The card game follows this flow: (1) Define the action (what is the child role doing?), (2) Present the context and infer what function the action serves, (3) Generate as many support ideas as possible to address the problematic behavior.

As shown in Figure 2, the game consisted of three types of cards: Behavior Cards (16), Function

		Behavioral Functions				
		Sensory Stimulation / Self-Stimulation	Escape from Aversive Situations	Attention Seeking	Demand for Objects or Activities	Prevention of Anxiety-Inducing Activities
Support Methods	Alternative Behavior (Teaching alternative behaviors with the same function)					
	Enrichment of Daily Life (Creating opportunities in daily life to fulfill the desired function)					
	Environmental Considerations (Removing stimuli that may trigger inappropriate behavior)					
	Psychoeducation (Showing understanding of the function, encouraging patience and effort)					
	Self-Coping (Allowing them to fulfill the desired function on their own					

Figure 1 Support strategy planning sheet used in learning

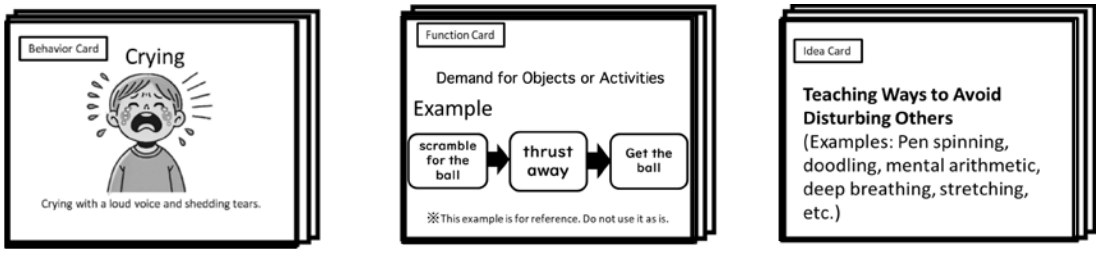

Figure 2 Examples of the three types of cards used in the games

Cards (5), and Idea Cards (36). Behavior Cards depicted behavioral problems through illustrations and written descriptions, helping participants recognize specific problematic behaviors. Function Cards identified one of five behavioral functions—sensory stimulation, escape, attention, tangible reinforcement, and prevention—and included examples of behaviors along with their antecedents and consequences. Idea Cards provided commonly used support strategies for addressing behavioral challenges, guiding participants in brainstorming intervention approaches.

Participants played the game in groups of three to five, with one person assigned a child's role and the remaining participants acting as support providers. The participant playing the child's role began by drawing a Behavior Card, reviewing its content privately, and acting out the described behavior using gestures (e.g., running around, spitting, etc.). The support providers then identified the problem behavior based on the gestures. If they guessed correctly, the participant playing the child's role confirmed it with the sound "Ping-Pong!" If they guessed incorrectly, teach the correct answer.

Next, the participant playing the child's role drew a Function Card, again reviewing it privately. Based on the function described on the card, they imagined a storyline explaining how the behavior was being maintained and expressed this narrative through gestures. This procedure required incorporating contextual cues to represent the antecedents and consequences of the behavior. For instance, if the function was attention, the participant might add gestures such as looking around before and after performing the behavior to indicate an attempt to gain social attention.

After observing the gestures, the support providers discussed the possible function of the behavior—whether it was driven by sensory stimulation, escape, attention, tangible reinforcement, or prevention. Once they reached a consensus, they presented their conclusion. If their guess was correct, the participant playing the child's role confirmed with the sound "Ping-Pong!" If incorrect, they provided the correct function as written on the card.

Next, one of the support providers draws an Idea Card and shows its content to the group (e.g., Praise them for what they're already enduring, Use partitions, etc.). Using the suggested strategy on the card as a reference, the support providers brainstorm intervention ideas tailored to the behavior and function previously acted out by the participant playing the child's role. Once they decide on an idea, the participant playing the child's role reenacts the behavior while the support providers role-play the intervention they devised. In some cases, the content of the Behavior Card, Function Card, and Idea Card may not match perfectly. In such cases, we instructed the participants to adapt and refine their intervention ideas through trial and error, using the drawn Idea Card as a guiding framework instead of drawing a new card.

At the end of the round, the participant playing the child's role evaluates the effectiveness of the intervention by rating their satisfaction—specifically, how much the intervention made them feel they could stop the behavior—on a 100-point scale. If the rating is below 100, the support providers continue to refine their approach by drawing additional Idea Cards and incorporating new strategies until the total score reaches 100. Participants are also encouraged to combine multiple ideas (e.g., two 30-point strategies and a 40-point strategy) rather than relying on a single perfect solution, a guideline explicitly explained during the learning.

2.3.4 Developing Hypothetical Case Scenarios

We adopted the method used by Okubo et al (2015) to evaluate the effectiveness of the learning, in which we asked participants to generate support ideas based on hypothetical case scenarios. Following this approach, we developed original case scenarios and asked participants to describe their intervention ideas. The first author, Certified Public Psychologist and Clinical Psychologist,

and the second author, a university faculty member specializing in applied behavior analysis, collaboratively developed four hypothetical case scenarios (see Figure 3).

The participants received a one-page summary of each case scenario before and after the learning. The scenarios did not explicitly describe the behavior's function to encourage them to analyze the behavioral functions independently.

Case	School Year/Age	Sex	Behavioral Function	Behavioral Pattern	Antecedent events	Behavioral information	Consequences	Others
1	4th Grade Elementary school Student	Male	Attention	Hit another child	More likely to occur when each individual is engaged in separate tasks, when a specific friend is present, or during free time	In addition to hitting other children, the child also uses harsh language and destroys others' belongings. Different children are targeted	He glances at a friend repeatedly. The surrounding children laugh, reprimand, or show fear	No communication delays are observed
2	5th Grade Elementary school Student	Male	Escape	Break objects	More likely to occur while engaging in a highly challenging activities. It can also be triggered by an adult pointing out corrections or by teasing from other children	The child breaks items that are being made, tears up worksheets, and throws objects placed in the room	When encouraged to continue the task, the child's excitement increases, and once excited, it takes time for him to calm down	Clumsy with hands. Likes trains. Shows a tendency toward sensory hypersensitivity
3	1th Grade Elementary school Student	Female	Attention	Atypical vocalization	Often occurs when she is engaged in an activity alone, slightly apart from the group, and the direct cause is unclear	The child tends to say whatever comes to mind immediately and, in addition to shouting 'Waa' or 'Kyaa,' also utters inappropriate words such as 'pee'	When an adult approaches and tells the child to stop, she may stop making unusual vocalizations, but she may also get into conflicts with the child who reprimanded her	Talks frequently. Eager to raise their hand and answer adults' questions
4	2th Grade Elementary school Student	Female	Escape	Sprawl out	More likely to occur in situations where people around are noisy or when a specific adult repeatedly speaks to her	The child sometimes lies down on the floor or sprawls across the desk	The child does not move on to the next activity for a while, but may get up when those around stop prompting	Has difficulty expressing their feelings in words

Figure 3 List of hypothetical case scenarios

2.4 Dependent Variables

2.4.1 Number of Ideas

We counted the number of support ideas generated by participants for each hypothetical case scenario. For example, if a participant wrote the following intervention: "To reduce the need for repeated verbal prompts, write instructions on paper or a board, place an instructional picture card nearby, and use pointing gestures when necessary," this statement would be broken down into three distinct ideas: (1) writing instructions on paper or a board, (2) placing an instructional picture card nearby, and (3) using pointing gestures to communicate the instructions. We counted each of these as a separate support idea.

2.4.2 Quality of Ideas

We asked two third parties, who were not involved in this research, to evaluate the quality of the support ideas. We randomly selected 50% of the participants for qualitative assessment to reduce the evaluators' workload.

The evaluation focused on three criteria: (1) Diversity – Does this support idea reflect a variety of approaches? (2) Effectiveness – Is this support idea likely to improve the target behavior? (3) Positivity – Does this support idea reflect a positive, reinforcement-based approach? The evaluator rated each idea using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The final quality score was determined by the sum of the ratings across these three dimensions.

2.5 Reliability Assessment

We calculated interrater agreement for the number of support ideas generated by participants to evaluate reliability. The second author independently counted the ideas generated for each hypothetical case scenario. The interrater agreement rates were 87.8% for Case 1, 86.3% for Case 2, 84.9% for Case 3, and 85.5% for Case 4, indicating a high level of consistency in the scoring process.

2.6 Ethical Considerations

Participants received a written explanation of the study and provided informed consent in writing. The study received prior approval from the Institutional Review Board (IRB) of the authors affiliated university (Approval No. 2020-034).

2.7 Social Validity

The participants completed a six-question questionnaire evaluating their perceptions of the learning to assess the social validity of the study. The questions included items such as "Did you understand the content of the learning?" and "Did the learning provide you with a new perspective?" Participants also had the opportunity to provide open-ended feedback about their experiences. Each question was rated on a five-point Likert scale, ranging from "Strongly Agree" to "Strongly Disagree." The specific questions are presented in Table 2.

Additionally, we conducted a follow-up survey one month after the learning with participants from Facility B to examine how the participants applied the learning content in real-world settings. This survey consisted of 10 questions assessing the practical implementation of learning concepts, including items such as "Do you find yourself assessing children's behaviors with a clearer understanding of their functions compared to before the learning?" and "Do you consider behavioral functions more frequently when discussing cases with colleagues?" Participants rated their responses using the same five-point Likert scale.

3. Results

3.1 Number and Quality of Ideas Before and After learning

Table 1 presents the number of support ideas generated for hypothetical cases, categorized by facility, before and after the learning. In Facility A, participants generated 61 ideas for Cases 1 and 2 before and 67 for Cases 3 and 4 after the learning. In Facility B, the number of ideas increased from 169 to 225. In Facility C, participants initially generated 54 ideas, which increased to 63 post-learning. In Facility D, the number of ideas rose from 69 to 79. Across all participants, the total number of ideas recorded was 157 for Case 1, 196 for Case 2, 206 for Case 3, and 228 for Case 4. Overall, the card game learning increased 81 additional ideas, indicating that participants generated more intervention strategies following the learning.

To examine qualitative changes in ideas before and after card game learning, we calculated the average scores for each of the "diversity," "effectiveness," and "positivity" categories by summing the evaluation points from two observers for each of Cases 1 and 2, and Cases 3 and 4 (see Table 1). The average scores for the two observers in each case are as follows. Diversity scores were 3.66 for Case 1, 4.25 for Case 2, 4.24 for Case 3, and 4.22 for Case 4. Effectiveness scores were 3.37 for Case 1, 4.00 for Case 2, 3.92 for Case 3, and 3.92 for Case 4. The positivity scores were 3.53 for Case 1, 4.28 for Case 2, 4.18 for Case 3, and 4.28 for Case 4.

Comparing the pre- and post-learning cases indicated that the average scores increased. Diversity improved by 0.13 points, effectiveness increased by 0.19 points, and positivity improved by 0.24 points. These results suggest that participants also proposed higher-quality interventions after the learning in addition to generating more ideas.

3.2 Social Validity of the learning

Table 2 presents the results of the social validity assessment of the learning All participants reported understanding the learning content, responding "Agree" or "Strongly Agree." Additionally, most participants expressed interest in attending another session of the card game learning, although a small number selected "Neutral." Furthermore, many participants indicated they planned to apply what they learned in their professional practice.

Table 3 shows the results of the follow-up social validity assessment conducted one month after the learning. Many participants still expressed interest in additional learning using the card game, even after a month. Some also reported successfully applying the learning concepts in their work settings. However, a notable number of participants stated that they found incorporating discussions about behavioral functions challenging when communicating with colleagues or parents.

Table 1 Number and quality of support ideas before and after card game learning

		Case 1 + Case 2 (Before card game)	Case 3 + Case 4 (After card game)
Number of ideas	Facility A	61	67
	Facility B	169	225
	Facility C	54	63
	Facility D	69	79
Qualitative evaluation	Diversity	3.95	4.23
	Effectiveness	3.68	3.92
	Positivity	3.89	4.23

Table 2 Post- learning evaluation of the card game learning

	Questions about the training	Strongly agree (5)	Agree (4)	Neither agree nor disagree (3)	Disagree (2)	Strongly disagree (1)
1.	Did you understand the content of the training?	17	22	0	0	0
2.	Were you able to gain new perspectives through the training?	12	24	3	0	0
3.	Do you think it has become easier to come up with support ideas than before after taking the training?	11	26	2	0	0
4.	Would you like to have another assessment training using the card game with other staff members?	15	19	5	0	0
5.	Do you intend to put the assessment you learned in the training into practice?	18	18	3	0	0
6.	If a training session like this is held again, would you like to participate?	18	18	3	0	0

Table 3 One-month follow-up evaluation of the card game learning

	Results of one-month follow-up evaluation of card game learning	Strongly agree (5)	Agree (4)	Neither agree nor disagree (3)	Disagree (2)	Strongly disagree (1)
1.	Do you think you are assessing the children attending your facility with a better image of their functions compared to before the learning?	0	5	4	0	0
2.	Do you think you can now discuss while considering functions when having meetings with other staff members?	0	3	5	1	0
3.	Do you think you can now share information with parents while considering functions?	0	2	6	1	0
4.	Do you feel you can understand current issues more clearly than before the training?	0	7	2	0	0
5.	Do you feel that you can apply what you learned from the card game to your daily support?	0	7	2	0	0
6.	Do you think learning assessment through the card game is a simple method?	1	6	2	0	0
7.	Would you like to receive more assessment training through card games in the future?	2	7	0	0	0
8.	When you encountered challenging behaviors, did you feel you could apply what you learned from the card game?	0	5	4	0	0
9.	Did you make any new discoveries through the card game?	4	5	0	0	0
10.	If new card games related to assessment become available, would you like to try them?	3	4	2	0	0

4. Discussion

This study was designed to enhance the quality of support provided in after-school day services by implementing a functional assessment learning program using an original card game. The study's primary objective was to examine how the learning influenced the quantity and quality of support ideas generated by participants when presented with hypothetical case scenarios. Based on the results, the discussion focuses on two key aspects: (1) changes in the number and quality of ideas and (2) the validity of the learning.

4.1 Changes in the Number and Quality of Ideas

The findings revealed increased support ideas across all participating facilities after the learning. It is possible that the use of card games and tools may have generalization to fictitious cases, as the environment reinforced the generation of ideas. Two specific factors likely contributed to this effect. First, the learning provided an environment with minimal aversive stimuli, reducing the cognitive burden associated with generating completely new ideas from scratch. Since participants could reference predefined strategies from the Idea Cards, the process was less intimidating and more structured, allowing for more fluid and confident idea generation.

Additionally, because participants worked with predetermined ideas, the environment was less likely to present punishment feedback. Second, the game's mechanics functioned as an establishing operation, reinforcing participants' responses. The card game allowed participants to test their intervention ideas immediately and receive feedback from their peers in real-time. In contrast, practitioners often deliberate on behavioral interventions long after the problematic behavior in typical case discussions, which may weaken the learning and reinforcement process. However, in this learning, participants observed problem behaviors immediately before generating ideas, enabling real-time evaluation and reinforcement of their responses. This frequent, immediate reinforcement likely contributed to the increased idea generation. A unique aspect of the Behavioral Support Trial-and-Error Card Game—its "100-point system"—may have further contributed to this effect. This mechanism encouraged participants to accumulate reinforcement gradually rather than attempt to develop a perfect solution. By rewarding partial successes (e.g., implementing a 20-point idea and later supplementing it with a 40-point idea), participants experienced repeated reinforcement opportunities, strengthening their ability to generate and refine ideas over time. This process likely played a crucial role in enhancing the quantity and quality of support ideas.

The qualitative evaluation of ideas showed that the average post-learning scores for Cases 3 and 4 were higher across all dimensions than the pre-learning scores for Cases 1 and 2. The most notable improvement was observed in positivity, indicating that participants proposed more reinforcement-based and supportive intervention strategies following the learning.

Participants' open-ended feedback further supported this finding. Some comments included: "Knowing that a 30- or 40-point solution was acceptable made me feel less pressured," "I was able to break out of rigid thinking patterns," and "The card game helped me visualize and explore a variety of intervention strategies." These reflections suggest that the learning enabled the participants to generate more diverse and practical support ideas after completing the session. Together, these results indicate that the card game learning improved the quality of participants' intervention strategies.

However, variability was observed in the quality scores across the different case scenarios. Specifically, Case 1 received a lower score overall compared to the other cases, suggesting that

specific contextual factors may have influenced participants to generate ideas. Furthermore, since the pretest was administered to upper elementary student cases (fourth and fifth graders) and the posttest to lower elementary student cases (first and second graders), it cannot be ruled out that grade level influenced idea generation. Based on the above, this finding implies that procedure content, nature of the hypothetical cases may have affected the number and quality of responses. Future studies should carefully examine case selection, content structure, and the sequencing of case presentations to optimize learning effectiveness.

4.2 Validity of the Learning

The findings suggest that a functional assessment learning program incorporating a card game effectively improves support quality in after-school day services. The main reasons supporting this conclusion include the increased number and quality of ideas and the high level of participant comprehension and engagement with the learning content.

Social Validity of the Learning. The social validity assessment's results indicated that all the participants understood the learning content, as every respondent selected "Agree" or "Strongly Agree." Additionally, a large proportion of participants expressed interest in attending another session of the card game learning, suggesting that they found the content both accessible and beneficial. Furthermore, a one-month follow-up survey at Facility B provided additional insights into participants' perceptions of the learning. Many participants responded positively to questions such as "Did you gain new insights through the card game?" and "Would you be interested in trying a new assessment-related card game?" selecting "Agree" or "Strongly Agree." These responses suggest that the learning effectively met the participants' needs and engaged their interest in further learning opportunities.

However, certain aspects of practical application remained challenging. When asked, "Do you actively consider behavioral functions when discussing cases with colleagues?" and "Do you incorporate behavioral function analysis when sharing information with parents?" many participants responded "Neutral" or "Disagree." One possible factor is that the perspectives and terminology related to the function of behavior may not be widely understood or shared among staff members and parents who are not participating in the training program. Support based on functional assessment relies heavily on specific knowledge and conceptual frameworks. Without such a shared perspective, it becomes difficult to incorporate the functional viewpoint naturally into everyday conversations and information sharing (O'Neill et al., 1997). Against this backdrop, participants may have found it challenging to engage in discussions or share insights based on the functional aspects of behavior in their work settings. Furthermore, after-school day service settings often face structural challenges, such as chronic staff shortages and excessive workloads. These challenges make it difficult to secure sufficient time and mental bandwidth to carefully examine the background of behaviors. Consequently, a single learning opportunity is insufficient to effectively apply the functional perspective in practice. A continuous support system and mechanisms for sharing within the workplace are necessary. Similarly, when asked, "Do you feel the learning has helped you manage challenging behaviors in real-life situations?" Many participants also selected "Neutral."

These findings indicate that while the learning was well-received and conceptually valuable, participants struggled to apply the learned skills in real-world professional contexts. This finding suggests the need for additional support and follow-up learning to reinforce learning outcomes and facilitate practical implementation. Rather than conducting the learning as a one-time intervention, offering annual or regularly scheduled sessions within the workplace may be necessary to ensure

long-term retention and application of functional assessment skills.

4.3 Limitations and Future Directions

This study's learning program consisted of a combination of elements, including a card game, a Behavioral Assessment for Children (BAC), and a Support Strategy Planning Sheet. While the results suggest that this learning package was adequate, the study was not designed to isolate the specific effects of the card game alone. Future research should compare it with similar learning programs that do not incorporate the game to determine the independent impact of the card game.

Several areas require further investigation. Firstly, long-term effects need to be examined. This study found that the number and quality of intervention ideas improved immediately after learning, but it remains unclear how these improvements translated into real-world practice over time. Future studies should incorporate regular follow-up learning sessions and longitudinal tracking to assess whether changes in case discussions and support quality persist beyond the initial learning period. Secondly, learning delivery methods should be explored. Comparing the effectiveness of online versus in-person learning and examining differences between facilitator-led and participant-led sessions could help identify the most sustainable and accessible learning formats. Thirdly, the learning content should be diversified. Since the knowledge and skills required for adequate support vary based on individual children and specific intervention settings, the card game's structure should remain flexible while expanding the range of behaviors and idea cards to accommodate a wider variety of needs. Doing so would enhance the applicability of the learning across different contexts, increasing its potential for widespread implementation.

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[Paper]

Current State of Inclusive Early Childhood Education in Japan: Examining Early Childhood Educators' Support, Burden, and Self-Efficacy

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Abstract

Approximately ten years have passed since Japan ratified the Convention on the Rights of Persons with Disabilities. However, Japan has not established a clear definition or methodology for Inclusive Early Childhood Education, despite local nursery schools and kindergartens generally operating under inclusive principles. Consequently, early childhood educators implement diverse, inclusive practices but often encounter problems and dilemmas. This study investigates the types of support early childhood educators provide in inclusive early childhood education and explores their perceptions of these practices. A survey assessed the implementation of support, educators' associated burdens, and self-efficacy. The findings identified five general trends across 19 support items, including practices educators find easy to implement, those implemented despite high burden levels, and others. Specifically, educators were familiar with classroom environment design and instructional material adaptation. However, they perceived support requiring specialized expertise and individualized engagement as burdensome. Furthermore, many educators were unfamiliar with using ICT tools and Augmentative and Alternative Communication (AAC), underscoring the need for additional initiatives to promote these assistive technologies in early childhood education.

Keywords: Inclusive education, early childhood education, early childhood educators

1. Problem and purpose

Recently, interest in inclusive education has been increasing in Japan. Moreover, Japan signed the Convention on the Rights of Persons with Disabilities in 2007, which was enacted in 2014 (Ministry of Foreign Affairs, 2024). In response, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) defined the "inclusive education system" (the tentative translation at the time of signing was "embracing education system"). MEXT describes this system as one in which individuals with and without disabilities learn together, intending to enhance respect for human diversity and enable persons with disabilities to develop their mental and physical abilities to the fullest extent possible. This approach will allow them to participate effectively in a free society. The inclusive education system ensures persons with disabilities stay in mainstream education. It provides access to local primary and secondary schools and offers tailored 'reasonable accommodations' as needed. Furthermore, the system emphasizes the importance of diverse and flexible mechanisms that provide appropriate guidance to preschoolers, children, and students with specific educational needs. These mechanisms should promote independence and social participation

while ensuring a continuum of "diverse learning environments," including regular elementary and junior high school classes, special needs classes, resource room instruction, and special needs schools (MEXT, 2012).

How does this system apply to early childhood education in Japan? Since the postwar period, Japan has transitioned from segregated to integrated childcare, primarily due to advocacy from parents of children with disabilities. Although special needs schools for preschool-aged children and child development support centers still exist, many children living in local communities attend nursery schools or kindergartens within their areas (National Institute of Special Needs Education, 2024). Structurally, this indicates that inclusion is being practiced. Despite this structural shift, clear definitions and methodologies for inclusive early childhood education (hereafter, "inclusive childcare") have not been thoroughly examined. Consequently, nursery schools and kindergartens have adopted a variety of approaches. While this diversity enriches childcare practices, some nursery and kindergarten teachers (hereafter, "early childhood educators") face concerns and dilemmas. According to the Tokyo Metropolitan Bureau of Social Welfare and Public Health (2023), early childhood educators expressed a strong desire to acquire knowledge and skills related to interacting with children requiring special support, developmental psychology, and childcare practices. This desire suggests they may experience uncertainty and hesitation in implementing inclusive childcare practices.

Approximately ten years have passed since the Convention on the Rights of Persons with Disabilities came into effect in Japan, making it an appropriate time to evaluate the support system. Therefore, this study aims to clarify the types of support provided by Japanese early childhood educators in inclusive childcare settings and to explore their subjective experiences with these practices. Specifically, this research investigates the implementation status of various support strategies and examines their perceived burden and associated sense of efficacy. In this study, 'early childhood educators' refers to staff at nursery schools, kindergartens, and certified childcare centers responsible for five-year-old classes.

2. Method

2.1 Participants

One thousand nursery schools, kindergartens, and certified childcare centers were randomly selected across Japan. The study targeted early childhood educators responsible for five-year-old classes in these institutions.

2.2 Survey Period

The survey was conducted from July to September 2024.

2.3 Survey Procedure

A request letter detailing the survey content and providing a URL link to a web-based questionnaire was sent to the 1,000 randomly selected institutions. Participation was voluntary, and responses were collected through the web-based questionnaire after obtaining informed consent.

2.4 Ethical Considerations

The purpose, methods, and measures for protecting personal information were explained to participants, including their right to withdraw from the study at any time without experiencing any disadvantage. Consent was obtained from all participants prior to participation. Additionally, this

study received prior approval from the Research Ethics Committee of Tokyo Gakugei University (Approval No. 696).

2.5 Survey Content

2.5.1 Demographic Information

Participants provided information about their current workplace, years of experience, and the number of children in their class. They were also asked to recall one child in their class with a diagnosed or suspected disability and to report the diagnosis or suspected condition.

2.5.2 Implementation of Support in Inclusive Childcare

The status of implementing support strategies in inclusive childcare was assessed using 19 items. Participants rated the extent to which each support strategy was implemented on a five-point scale ("Not implemented," "Slightly implemented," "Moderately implemented," "Fully implemented," "Uncertain"). They also rated each support strategy's perceived burden and sense of efficacy on a six-point scale. These 19 items were developed based on observations of kindergartens in Tokyo and interviews with early childhood educators. The final items were refined through discussions with supervisors knowledgeable in special needs education and clinical psychology.

2.6 Analysis Method

Responses for each survey item were aggregated. Additionally, categorical principal component analysis (quantification method Type III) was performed using HAD (Shimizu, 2016).

3. Results

3.1 Participants' Demographics

Responses were received from 118 of the one thousand nursery schools, kindergartens, and certified childcare centers contacted via mailed request letters (response rate of 11.8%). After excluding incomplete responses, data from 74 participants were included in the analysis. The respondents worked at 20 nursery schools, 36 kindergartens, and 17 certified childcare centers. Their experience ranged from less than one year to 38 years, with an average of 12.5 years. The number of children under their care varied between 2 and 35, with an average of 18.5 children per class.

The participants reported 11 cases of intellectual disabilities, 32 cases of autism spectrum disorder (ASD), 19 cases of attention-deficit/hyperactivity disorder (ADHD), 1 case of developmental delay, 1 case of speech delay, 2 cases of hearing impairment, and 3 cases categorized as other among the diagnosed disabilities among children in their classes. They also reported 14 cases of intellectual disabilities, 32 cases of ASD, 38 cases of ADHD, 2 cases of motor disabilities, and 2 cases categorized as other among suspected disabilities.

3.2 Implementation of Support in Inclusive Childcare

Participants were asked to recall one child in their class with a diagnosed or suspected disability (hereafter referred to as the "target child") and to evaluate the support and interactions provided for that child. They rated the extent to which each support strategy was implemented on a five-point scale ranging from "Not implemented" to "Fully implemented," with an additional option of "Uncertain." Participants also rated the perceived burden they experienced and their sense of efficacy in implementing these support strategies on a six-point scale ranging from 0 to 5. Tables 1 and 2 show how respondents rated each support strategy's implementation, burden, and efficacy.

Table 1 Implementation Status of Support Strategies [Number of Respondents (%)]

Support Strategy	Implementation Status of Support				
	Fully Implemented	Slightly Implemented	Moderately Implemented	Not Implemented	Uncertain
1. A full-time counselor is assigned to provide guidance.	8 (10.8)	21 (28.4)	3 (4.1)	39 (52.7)	3 (4.1)
2. The child's favorite characters or motifs are incorporated into activities.	19 (25.7)	35 (47.3)	11 (14.9)	6 (8.1)	3 (4.1)
3. Materials are prepared in advance to enable child-initiated activities.	12 (16.2)	44 (59.5)	18 (24.3)	0	0
4. Daily schedules and procedures are visualized using picture cards or similar tools.	41 (55.4)	20 (27.0)	3 (4.1)	5 (6.8)	5 (6.8)
5. Visual teaching materials are prepared to enhance child understanding.	25 (33.8)	34 (45.9)	10 (13.5)	2 (2.7)	3 (4.1)
6. Information and communication technology (ICT) devices are installed and used.	8 (10.8)	19 (25.7)	15 (20.3)	28 (37.8)	4 (5.4)
7. Augmentative and Alternative Communication (AAC) devices are installed and used.	1 (1.4)	2 (2.7)	8 (10.8)	56 (75.7)	7 (9.5)
8. A cool-down space with mats or partitions is available inside the classroom.	14 (18.9)	25 (33.8)	12 (16.2)	22 (29.7)	1 (1.4)
9. A cool-down space is available outside the classroom.	27 (36.5)	21 (28.4)	13 (17.6)	12 (16.2)	1 (1.4)
10. The classroom can be partitioned to create a quiet environment for focused activities.	7 (9.5)	29 (39.2)	20 (27.0)	17 (23.0)	1 (1.4)
11. The classroom layout is designed to facilitate movement and organization.	30 (40.5)	32 (43.2)	12 (16.2)	0	0
12. Various toys and materials are provided to expand play and interests for children with limited play preferences.	17 (23.0)	44 (59.5)	12 (16.2)	0	1 (1.4)
13. Each child's locker is marked with a symbol or photo for identification.	35 (7.3)	19 (25.7)	9 (12.2)	10 (13.5)	1 (1.4)
14. Daily activities are explained in advance or the day before to enhance predictability.	49 (66.2)	21 (28.4)	3 (4.1)	1 (1.4)	0
15. Time allocation is adjusted to allow the child to complete activities fully.	27 (36.5)	36 (48.6)	11 (14.9)	0	0
16. The number of activities is adjusted to ensure the child can complete them fully.	24 (32.4)	39 (52.7)	11 (14.9)	0	0
17. Individual time is allocated to support the child's developmental tasks (e.g., communication, fine motor skills, physical movement).	14 (18.9)	35 (47.3)	21 (28.4)	4 (5.4)	0
18. Play materials allow children to express themselves freely during free play.	22 (29.7)	40 (54.1)	12 (16.2)	0	0
19. The play environment is structured to support free expression during free play.	22 (29.7)	38 (51.4)	14 (18.9)	0	0

Table 2 Perceived Burden and Self-Efficacy in Support Strategies [Number of Respondents (%)]

Item		0 None	1	2	3	4	5 Extremely
1. A full-time counselor is assigned to provide guidance.	Burden	10 (13.5)	12 (16.2)	5 (6.8)	24 (32.4)	15 (20.3)	8 (10.8)
	Self-efficacy	5 (6.8)	7 (9.5)	20 (27.0)	31 (41.9)	11 (14.9)	0
2. The child's favorite characters or motifs are incorporated into activities.	Burden	15 (20.3)	24 (32.4)	14 (18.9)	16 (21.6)	4 (5.4)	1 (1.4)
	Self-efficacy	2 (2.7)	6 (8.1)	21 (28.4)	36 (48.6)	8 (10.8)	1 (1.4)
3. Materials are prepared in advance to enable child-initiated activities.	Burden	6 (8.1)	14 (18.9)	11 (14.9)	31 (41.9)	11 (14.9)	1 (1.4)
	Self-efficacy	0	11 (14.9)	17 (23.0)	37 (50.0)	8 (10.8)	1 (1.4)
4. Daily schedules and procedures are visualized using picture cards or similar tools.	Burden	22 (29.7)	12 (16.2)	11 (14.9)	18 (24.3)	9 (12.2)	2 (2.7)
	Self-efficacy	1 (1.4)	7 (9.5)	10 (13.5)	35 (47.3)	17 (23.0)	3 (4.1)
5. Visual teaching materials are prepared to enhance child understanding.	Burden	8 (10.8)	11 (14.9)	15 (20.3)	25 (33.8)	13 (17.6)	2 (2.7)
	Self-efficacy	2 (2.7)	6 (8.1)	18 (24.3)	37 (50.0)	9 (12.2)	2 (2.7)
6. Information and communication technology (ICT) devices are installed and used.	Burden	19 (25.7)	11 (14.9)	11 (14.9)	16 (21.6)	12 (16.2)	5 (6.8)
	Self-efficacy	14 (18.9)	14 (18.9)	20 (27.0)	22 (29.7)	4 (5.4)	0
7. Augmentative and Alternative Communication (AAC) devices are installed and used.	Burden	33 (44.6)	3 (4.1)	8 (10.8)	15 (20.3)	6 (8.1)	9 (12.2)
	Self-efficacy	38 (51.4)	14 (18.9)	9 (12.2)	12 (16.2)	1 (1.4)	0
8. A cool-down space with mats or partitions is available inside the classroom.	Burden	22 (29.7)	17 (23.0)	9 (12.2)	14 (18.9)	11 (14.9)	1 (1.4)
	Self-efficacy	4 (5.4)	11 (14.9)	12 (16.2)	37 (50.0)	8 (10.8)	2 (2.7)
9. A cool-down space is available outside the classroom.	Burden	18 (24.3)	18 (24.3)	15 (20.3)	14 (18.9)	8 (10.8)	1 (1.4)
	Self-efficacy	5 (6.8)	8 (10.8)	14 (18.9)	35 (47.3)	11 (14.9)	1 (1.4)
10. The classroom can be partitioned to create a quiet environment for focused activities.	Burden	15 (20.3)	11 (14.9)	14 (18.9)	22 (29.7)	11 (14.9)	1 (1.4)
	Self-efficacy	3 (4.1)	8 (10.8)	18 (24.3)	33 (44.6)	11 (14.9)	1 (1.4)
11. The classroom layout facilitates movement and organization.	Burden	17 (23.0)	17 (23.0)	14 (18.9)	22 (29.7)	4 (5.4)	0
	Self-efficacy	1 (1.4)	5 (6.8)	16 (21.6)	38 (51.4)	13 (17.6)	1 (1.4)
12. Various toys and materials are provided to expand play and interests for children with limited play preferences.	Burden	11 (14.9)	12 (16.2)	12 (16.2)	29 (39.2)	10 (13.5)	0
	Self-efficacy	1 (1.4)	5 (6.8)	17 (23.0)	39 (52.7)	10 (13.5)	1 (1.4)
13. Each child's locker is marked with a symbol or photo for identification.	Burden	23 (31.1)	17 (23.0)	13 (17.6)	16 (21.6)	5 (6.8)	0
	Self-efficacy	1 (1.4)	4 (5.4)	15 (20.3)	34 (45.9)	15 (20.3)	4 (5.4)
14. Daily activities are explained in advance or the day before to enhance predictability.	Burden	24 (32.4)	18 (24.3)	12 (16.2)	15 (20.3)	3 (4.1)	2 (2.7)
	Self-efficacy	0	2 (2.7)	11 (14.9)	29 (39.2)	25 (33.8)	6 (8.1)
15. Time allocation is adjusted to allow the child to complete activities fully.	Burden	12 (16.2)	22 (29.7)	10 (13.5)	20 (27.0)	7 (9.5)	3 (4.1)
	Self-efficacy	1 (1.4)	7 (9.5)	15 (20.3)	33 (44.6)	17 (23.0)	1 (1.4)
16. The number of activities is adjusted to ensure the child can complete them fully.	Burden	11 (14.9)	19 (25.7)	15 (20.3)	22 (29.7)	5 (6.8)	2 (2.7)
	Self-efficacy	0	9 (12.2)	15 (20.3)	36 (48.6)	12 (16.2)	2 (2.7)
17. Individual time is allocated to support the child's developmental tasks (e.g., communication, fine motor skills, physical movement).	Burden	6 (8.1)	13 (17.6)	15 (20.3)	23 (31.1)	15 (20.3)	2 (2.7)
	Self-efficacy	1 (1.4)	14 (18.9)	15 (20.3)	32 (43.2)	9 (12.2)	2 (2.7)
18. Play materials allow children to express themselves freely during free play.	Burden	12 (16.2)	13 (17.6)	14 (18.9)	22 (29.7)	12 (16.2)	1 (1.4)
	Self-efficacy	0	8 (10.8)	18 (24.3)	36 (48.6)	10 (13.5)	2 (2.7)
19. The play environment is structured to support free expression during free play.	Burden	10 (13.5)	18 (24.3)	13 (17.6)	23 (31.1)	8 (10.8)	2 (2.7)
	Self-efficacy	0	9 (12.2)	20 (27.0)	32 (43.2)	11 (14.9)	2 (2.7)

The results showed that more than 50% of respondents indicated they had "achieved" the implementation of support strategies such as "Visualizing the daily flow and procedures with picture cards" and "Communicating the content of activities before or the day before to provide an overview." These findings suggest that these practices are widely adopted in early childhood education settings.

In addition to these two items, more than 50% of respondents answered they had 'achieved' or "somewhat achieved" for 13 other support strategies. These included incorporating children's favorite characters or motifs, preparing materials to ensure activities could be carried out when children showed interest, and using visual aids to support children's understanding. Other widely implemented strategies were providing a cool-down space within the classroom separated by partitions or mats and offering a cool-down space outside the classroom.

Additionally, many respondents reported designing the classroom layout to facilitate the flow of preparation tasks, providing various toys and materials to broaden the interests of children who find it challenging to expand their play activities, and labeling each child's locker with a mark or photo for easy identification. Strategies such as giving children enough time to complete activities by considering time distribution and adjusting the number of activities to ensure children could fully complete them were also commonly implemented. Furthermore, participants frequently provided individual engagement time to address developmental challenges like communication, fine motor skills, and physical activities. They also designed materials and environments to enable children to express themselves freely during free play.

On the other hand, specific support strategies were less commonly implemented. More than 50% of respondents reported "not achieved" for strategies such as "Assigning a full-time counselor for advice" and "Setting up and utilizing Augmentative and Alternative Communication (AAC) devices," with the latter being particularly low at 86.5%. Additionally, over half of the respondents selected "not achieved" or "not much achieved" for strategies such as "Installing and utilizing ICT equipment" and "Creating a quiet environment within the classroom by partitioning during concentration-required activities."

In terms of perceived burden, respondents indicated that specific strategies were more challenging to implement. Items associated with a relatively high burden—where a significant number of respondents selected ratings of 3-5 on the six-point scale—included "Assigning a full-time counselor for advice," "Preparing materials in advance so activities could be carried out at any time when children showed interest," and "Using visual aids to support children's understanding." Additionally, respondents reported a high burden for "Providing various toys and materials to broaden the interests of children who find it difficult to expand their play activities" and "Providing individual engagement time to address developmental challenges, such as communication, fine motor skills, and physical activities." More than 50% of respondents rated each of these five strategies as burdensome.

Regarding self-efficacy, some strategies were associated with lower confidence levels among respondents. In particular, "Installing and utilizing ICT equipment" and "Setting up and utilizing AAC devices" were associated with low self-efficacy. Specifically, 64.9% of respondents reported low self-efficacy for implementing ICT equipment, while 82.4% reported low self-efficacy for utilizing AAC devices.

3.3 Structure of Implementation, Burden, and Self-Efficacy

For the 19 survey items, responses of "achieved" and "somewhat achieved" were combined into

the category of "achieved," whereas "not much achieved" and "not achieved" were grouped as "not achieved." For perceived burden, responses of 0–2 were categorized as "low burden" and 3–5 as "high burden." Similarly, for self-efficacy, responses of 0–2 were classified as "low self-efficacy," while 3–5 were categorized as "high self-efficacy." Based on the aggregated number of respondents for each category, categorical principal component analysis (quantification method Type III) was conducted using HAD (Shimizu, 2016).

The analysis revealed that the correlation coefficient for the first axis was 0.307, whereas the second axis had a correlation coefficient of 0.118. The contribution rates were 0.835 for the first axis and 0.123 for the second axis. Category scores calculated using the quantification Method III were used to create a two-dimensional scatter plot, illustrating the relationship between the implementation of inclusive education support and the associated burden and self-efficacy. In this scatter plot, the positive direction of the first axis corresponded to a higher burden, whereas the negative direction indicated a lower burden. Similarly, the positive direction of the second axis represented higher implementation and self-efficacy, while the negative direction reflected lower

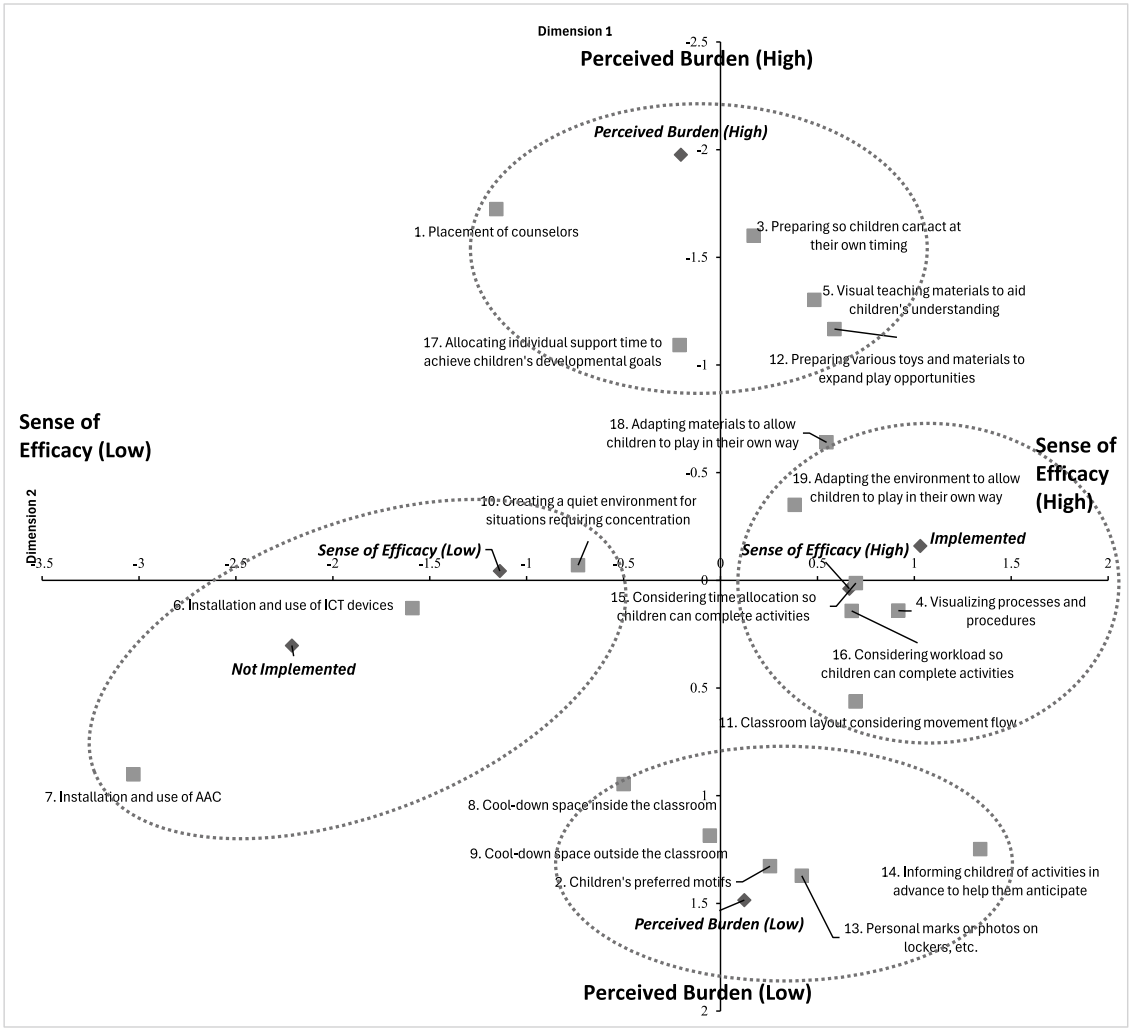

Figure 1 Scatter Plot of Support Implementation Status, Burden, and Self-efficacy

implementation and self-efficacy.

Items associated with higher burden were positioned in the positive direction of the first axis. These included "Assigning a full-time counselor for advice," "Preparing materials in advance so activities can be carried out at any time when children show interest," "Using visual aids to support children's understanding," "Providing various toys and materials to broaden the interests of children who find it difficult to expand their play activities," and "Providing individual engagement time to address developmental challenges."

Conversely, items associated with lower burden were positioned in the negative direction of the first axis. These included "Incorporating children's favorite characters or motifs," "Providing a cool-down space within the classroom separated by partitions or mats," "Providing a cool-down space outside the classroom," "Labeling each child's locker with their mark or photo for easy identification," and "Communicating activity content beforehand to give children an overview."

For the second axis, items associated with higher implementation and self-efficacy were positioned positively. These included "Visualizing the daily flow and procedures with picture cards," "Designing the classroom layout with consideration for the flow of preparation tasks," "Adjusting time distribution to ensure children can fully complete activities," "Adjusting the number of activities to ensure children can fully complete them," "Designing materials to enable children to express themselves and play freely during free play," and "Designing the setting to enable children to express themselves and play freely."

On the other hand, items associated with lower implementation and self-efficacy were positioned in the negative direction of the second axis. These included "Installing and utilizing ICT equipment," "Setting up and utilizing AAC devices," and "Creating a quiet environment within the classroom by partitioning during concentration-required activities."

4. Discussion

This study investigated the implementation of support strategies and involvement in inclusive early childhood education and the associated feelings of burden and efficacy among early childhood care providers. The results showed that many early childhood educators could implement a high proportion of the 19 items surveyed. However, the findings can be categorized into five groups based on implementation status, burden, and efficacy.

The first group includes items with a high implementation rate, relatively low burden, and high efficacy. Early childhood educators can quickly implement these support strategies daily. They included incorporating children's favorite characters or motifs, visualizing the daily flow and procedures using picture cards, and providing designated cool-down spaces inside and outside the classroom, separated by partitions or mats. This group also included designing classroom layouts to facilitate movement and organization, labeling children's lockers with individual marks or photos, and informing children about activity contents beforehand to give them an overview. Additionally, early childhood educators frequently adjusted time distribution to help children complete activities, considered the number of activities to ensure children could finish them, and designed free play environments and materials that allowed children to express themselves freely. A total of 11 items fell into this category, demonstrating high implementation rates, low burden, and high efficacy.

The second group consists of items with a high implementation rate and burden. These support strategies were effectively implemented by early childhood educators but required considerable effort. They included preparing materials in advance so that activities could be conducted whenever

children showed interest, using visual materials to aid children's understanding, providing various toys and materials to help children expand their interests and play when they found it difficult, and scheduling individual time to address developmental challenges such as communication, fine motor skills, and physical movement. Notably, these items did not show low efficacy, indicating that early childhood educators felt confident implementing them despite the perceived burden. The third group includes items with a high percentage of "not implemented" responses and a high burden. An example is "Assigning a full-time counselor for advice and support," which many early childhood educators found challenging to implement, likely due to resource limitations. The fourth group includes items with a high percentage of "not implemented" responses and low efficacy. These included "Installing and utilizing ICT devices" and "Setting up and utilizing AAC (Augmentative and Alternative Communication) devices." The low implementation rate and efficacy suggest that early childhood educators may have lacked the necessary skills, knowledge, or resources to use these tools effectively. Finally, the fifth group consists of items that were not implemented at a high rate but did not show either high burden or low efficacy. An example is "Creating a quiet environment within the classroom by partitioning during concentration-required activities." This result suggests that while early childhood educators did not frequently use this strategy, they did not perceive it as burdensome or challenging to implement.

These trends were also evident in the Quantification Theory Type III structural analysis. Overall, the findings indicate that classroom environmental settings and materials were familiar to early childhood educators, making it easier for them to implement these practices naturally in daily support activities. However, more specialized support strategies and highly individualized interactions were associated with a higher burden. This finding suggests that individualized support remains a significant challenge in early childhood education settings such as kindergartens and nurseries.

It is necessary to enhance resources by increasing the number of support staff and strengthening external partnerships with specialized organizations to address this challenge. Further discussions are needed on how Japan can establish effective policies and systems tailored to its inclusive education model. Moreover, using ICT devices and AAC (Augmentative and Alternative Communication) devices appeared less familiar to early childhood educators. Implementing these support strategies may require involvement not only from individual early childhood educators but also from the entire institution. Municipal-level subsidies and training programs may be necessary to facilitate effective adoption. Therefore, addressing this challenge requires a comprehensive approach beyond the framework of nurseries and kindergartens.

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[Paper]

Intellectual Functioning and Adaptive Behavior in Special Needs Students: Insights from Revised Suzuki-Binet Intelligence Scale and the Social Maturity Scale Third Edition

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Abstract

This study explores the relationship between intellectual functioning and adaptive behavior in students with intellectual disabilities at a special-needs school in Tokyo. Studies using the Revised Suzuki-Binet Intelligence Scale and the Social Maturity Scale-Third Edition found moderate to strong correlations between the Intelligence Quotient and Social Quotient and between both assessments' subscales. Significant differences emerged across educational divisions, with students in the elementary division displaying lower scores than those in the secondary and high school divisions. A substantial proportion of students demonstrated severe to moderate intellectual functioning and adaptive behavior limitations, underscoring the need for individualized support strategies. These findings highlight the importance of tailored educational interventions. Further research with a more extensive and diverse sample is recommended to validate and extend these results.

Keywords: Intellectual Disabilities, Intellectual Functioning, Adaptive Behavior, Educational Support

1. Introduction

1.1 Definition of Intellectual Disability

The American Association on Intellectual and Developmental Disabilities (AAIDD) defines intellectual disability in its 12th edition as being "characterized by significant limitations in both intellectual functioning and adaptive behavior, which are expressed in conceptual, social, and practical adaptive skills." Intellectual disability originates during the developmental period and is operationally defined as occurring before age 22. Nevertheless, the developmental period is typically understood as occurring before age 18. Additionally, the criteria for intellectual functioning and adaptive behavior limitations require standardized measures yielding scores approximately two standard deviations

below the mean (Schalock, Luckasson, & Tassé, 2021).

1.2 Basic Assumptions in Implementing the Definition

There are five basic assumptions guiding the implementation of this definition. One key principle emphasizes that "the essential purpose of describing limitations is to develop a profile of needed support." This principle underscores the significance of assessing each individual's intellectual functioning and adaptive behavior using standardized measures to devise effective intervention strategies and support systems tailored to their limitations. Another foundational assumption highlights that "with appropriate, individualized, and sustained support over an extended period, the life functioning of individuals with intellectual disabilities generally improves." This perspective shifts the focus from viewing intellectual disability as a fixed "impairment" to recognizing it as a "limitation" that can be mitigated through effective and responsive support customized to individual needs.

1.3 Theoretical Framework for Understanding Intellectual Limitations

Intellectual limitations are typically associated with difficulties in reasoning, learning, problem-solving, planning, and acquiring knowledge from experience. One influential theoretical model addressing these aspects is the Cattell-Horn-Carroll (CHC) theory of intelligence (Cattell, 1941; Cattell, 1963; Horn & Cattell, 1967). Carroll (1993) conducted a meta-analysis of CHC intelligence theory, proposing a hierarchical intelligence structure. In this model, intelligence is conceptualized as comprising three levels: the first level consists of over 70 narrow abilities; the second level includes eight broad cognitive abilities, although some researchers suggest 10 to 16 broad abilities; and the third and highest level represents general intelligence. In recent years, intelligence test batteries have increasingly aligned with the broad abilities at the second level of the CHC theory (Flanagan & Kaufman, 2009; McGrew, 2009).

1.4 Assessment and Support for Children with Intellectual Disabilities

To develop a comprehensive and multi-faceted understanding of a child's intellectual abilities in daily life and to design more effective and responsive support strategies, it is crucial to employ assessment tools focusing on specific cognitive aspects and categorizing cognitive abilities into broader domains. In Japan, intelligence tests such as the Japanese versions of the Wechsler Intelligence Scale for Children-Fifth Edition (WISC-V), Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV), and Kaufman Assessment Battery for Children-Second Edition (KABC-II) are widely used to assess overall intellectual development in children, following the CHC theory.

However, the Revised Suzuki-Binet Intelligence Scale (SB-R; Furuichi Publishing, 2007) is considered a viable alternative for individuals with moderate to severe intellectual disabilities who may struggle with task execution or score computation. Additionally, the Social Maturity Scale-Third Edition (S-M Scale; Ueno, Nagoshi, & Asahide Gakuen Educational Research Institute, 2016) is widely utilized as an adaptive behavior assessment reflecting Japanese cultural and daily life contexts.

1.5 Importance of Support Profiles for Children with Intellectual Disabilities

As outlined in the basic assumptions of the AAIDD definition, creating a support profile is essential when assisting children with intellectual disabilities. This profile involves identifying their strengths and areas of significant limitation, which can inform two key educational and support approaches: (1) a strength-based approach that emphasizes and nurtures their areas of

competence and (2) an intervention-focused approach aimed at compensating for and improving areas of significant limitation through targeted training and support (Mizuta, 1978; Hashimoto, 2010). However, current standardized assessments vary in categorizing developmental domains, and some do not explicitly define specific domains. Consequently, conducting a detailed profile analysis of a child's intellectual characteristics and developmental areas can be challenging.

1.6 Purpose of This Study

This study aims to examine the functions assessed by the SB-R and to explore the relationship between intellectual functioning and adaptive behavior in children with intellectual disabilities. The study classifies test items based on the content and scope of the CHC theory to achieve this. It also investigates the relationship between intellectual functioning and adaptive behavior in students attending a special-needs Tokyo school, using the SB-R and the S-M Third Edition.

2. Research Methods

2.1 Participants

The study included 54 students (29 boys and 25 girls) and their parents. We selected students from three educational divisions at a special-needs school located in the suburbs of Tokyo: the elementary school division (n = 14), the secondary school division (n = 18), and the high school division (n = 22). All participants voluntarily agreed to participate in the study to gather norms for adaptive behaviors and intellectual abilities.

2.2 Procedure

Data were collected between December 2024 and January 2025 using two main methods: (1) administration of the SB-R (Komiya, Shiomi, Sueoka, & Okita, 2007) and several supplementary tasks to the 54 students, and (2) a parent survey using the S-M Scale Third Edition (S-M; Ueno, Nagoshi, & Asahide Gakuen Educational Research Institute, 2016). A graduate clinical psychology student from Tokyo Gakugei University administered the SB-R under the supervision of a professor. Each assessment session lasted approximately 20-30 minutes.

Before participation, the study protocol, including ethical considerations, was thoroughly explained to the participants, and informed consent was obtained. We assured the participants that their confidentiality would be protected and that their data would be used solely for anonymous statistical analysis. The Research Ethics Committee of the institution affiliated with the first author approved the study.

2.3 Measurements

2.3.1 Revised Suzuki-Binet Intelligence Scale-Revised (the SB-R)

The SB-R, revised in 2007, includes 72 tasks initially developed by Suzuki (1936). Participating students were instructed to complete the tasks as quickly as possible. Responses were recorded as "Pass" or "No Pass" and then converted into Mental Age (MA) and Intelligence Quotient (IQ) scores according to the SB-R manual. In addition to the SB-R, we administered several supplementary tasks to further assess the students' intellectual abilities. The goal was to develop intellectual ability profiles for each participant, categorized into four subscales: Knowledge-Language (KL), Perception-Operation (PO), Memory-Recollection (MR), and Concept-Mathematics (CM).

2.3.2 Social Maturity Scale Third Edition (the S-M)

The S-M Scale consists of 129 items that evaluate social maturity and adaptive behaviors in children aged 1-13 years. The scale includes six subscales: Self-Help (SH), Locomotion (L), Occupation (O), Communication (C), Socialization (S), and Self-Direction (SD). Parents of the participating students completed the survey via Google Forms, selecting items relevant to their children. Parents' responses were scored and then converted into Social Age (SA) and Social Quotient (SQ) scores according to the guidelines in the S-M Scale manual.

All statistical tests were conducted at a significance level of $p < .05$. Statistical analyses were performed using IBM SPSS Statistics software version 27.

3. Result

3.1 Demographic Data

After accounting for missing values, we included data from 52 special-needs school students and their parents in the analysis. The mean chronological age (CA) of the students was 9 years and 7 months (SD = 20.87) for the elementary school division, 14 years and 2 months (SD = 10.10) for the secondary school division, and 17 years and 3 months (SD = 10.87) for the high school division. Medical diagnosis data, including Intellectual Developmental Disabilities (IDD), Down Syndrome (DS), Autism Spectrum Disorder (ASD), and other conditions, are presented in Table 1.

3.2 Correlation Between Intellectual Abilities and Adaptive Behaviors

IQ and MA were calculated based on the SB-R test scores, while the four subscale scores were derived from the SB-R and additional intellectual abilities tasks. The S-M Scale obtained the SQ, SA, and the six subscale scores. Tables 2 and 3 present the means and standard deviations for IQ, MA, SQ, and SA.

The results indicated a statistically significant moderate Pearson correlation between IQ and SQ ($r = .55$, $p < .01$). Additionally, we observed moderate to strong correlations between the four subscales of the SB-R and the six subscales of the S-M Scale ($r = .57$ to $.78$). A stronger correlation

Table 1 Number of responses by disability types

	IDD	DS	ASD	Others	Total
Elementary school division	4	6	3	1	14
Secondary school division	6	5	2	4	17
High school division	5	11	2	3	21

Table 2 Average MA, and SA for each school division

	MA		SA	
	Average	SD	Average	SD
Elementary school	48.86	17.48	44.00	10.88
Secondary school	72.35	21.75	84.94	28.82
High school	85.19	25.35	98.52	26.79

Table 3 Average IQ, and SQ

IQ		SQ	
Average	SD	Average	SD
42.21	13.55	46.31	14.27

Table 4 Correlation between subscales of SB-R and S-M

	KL score	PO score	MR score	CM score	SH score	L score	O score	C score	S score
PO score	.800**								
MR score	.851**	.859**							
CM score	.884**	.841**	.893**						
SH score	.583**	.574**	.592**	.570**					
L score	.724**	.694**	.708**	.679**	.814**				
O score	.660**	.738**	.717**	.677**	.847**	.863**			
C score	.779**	.696**	.745**	.743**	.755**	.847**	.770**		
S score	.696**	.582**	.633**	.683**	.758**	.828**	.734**	.814**	
SD score	.658**	.615**	.680**	.636**	.819**	.824**	.733**	.848**	.805**

All correlations are significant at the 0. 001 level.

was found between tasks within the same test (Table 4).

3.3 Comparison of Educational Divisions on SB-R and S-M Scale Subscales

To examine differences in the mean SB-R scores across the three educational divisions (elementary: n = 14; secondary: n = 17; high school: n = 21), a one-way analysis of variance (ANOVA) was conducted. The independent variable was educational division, and the dependent variables were the four subscales of the SB-R. The results showed statistically significant main effects of educational division ($F(2; 49) = 11.6$, $p<.001$) ; with the elementary school division (M=12.79, SE=2.17) presented significantly lower scores on the four subscales than the secondary (M=23.65, SE=2.4) and high school divisions (M=28.9, SE=2.31).

A similar analysis was conducted for the six subscales of the S-M Scale, with educational division as the independent variable. The results showed a significant main effect of educational division ($F(2; 49) = 22.77$, $p<.001$) and a lower score of elementary school divisions (M=55.43, SE=3.3) than the other two divisions (M=88.18, SE=5.2 for secondary and M=97.48, SE=4.25 for high school division). A similar pattern was observed for IQ and SQ across the three educational divisions.

3.4 Intellectual Abilities and Adaptive Behavior Levels

Intellectual abilities and adaptive behaviors were measured using well-standardized methods, incorporating the standard error of measurement (SEM). SEM quantifies score variability and provides a statistical confidence interval within which an individual's actual score is likely to fall (AAIDD, 2021). In this study, significant intellectual abilities and adaptive behavior limitations were operationally defined as scores approximately two standard deviations below the population average on both measurements

IQ (representing intellectual abilities) and SQ (representing adaptive behavior) were categorized into four levels: profound (IQ ≤ 19, SQ ≤ 24), severe (IQ 20-35, SQ 25-45), moderate (IQ 36-50, SQ 46-55), and mild (IQ 51-70, SQ 56-75) (Table 5). A chi-square test revealed a significant association between intellectual abilities and adaptive behavior ($\chi^2(9) = 43.61$, $p < .001$). The

Table 5 Classification of Limitations in Intellectual Ability and Adaptive Behavior

IQ \ SQ		Profound	Severe	Moderate	Mild	Total
Profound	Number	2	0	0	0	2
	Percentage	3.84	0	0	0	3.84
Severe	Number	2	9	6	0	17
	Percentage	3.84	17.31	11.54	0	32.7
Moderate	Number	0	8	8	5	21
	Percentage	0	15.84	15.84	0	40.38
Mild	Number	0	3	1	8	12
	Percentage	0	7.77	1.92	13.39	23.08

results also indicated a substantial number of students with severe to moderate intellectual abilities and adaptive behavior limitations.

4. Discussion

This study explored the relationship between intellectual abilities and adaptive behavior in Japanese students attending special-needs schools, using the SB-R and S-M Scale assessments along with supplementary tasks to examine their developmental characteristics and educational needs.

4.1 The Relationship Between Intellectual Abilities and Adaptive Behavior

The study found a statistically significant moderate correlation between intellectual abilities and adaptive behavior, consistent with previous research findings (Alexander & Reynolds, 2020; Harrison, 1987; Saleem et al., 2019). However, the moderate correlation suggests that intellectual abilities and adaptive behavior should be considered equally when diagnosing intellectual disabilities.

Moderate to strong correlations were observed between the subscales of the two measures, particularly between the KL subscale of the SB-R and the C subscale of the S-M, as well as between the PO subscale of the SB-R and the O subscale of the S-M. KL, analogous to the Comprehension-Knowledge factor in the CHC model, represents an individual's breadth and depth of acquired knowledge of language, information, and cultural concepts, as well as the application of this knowledge (McGrew, 2009). This ability is closely linked to verbal communication skills, including reading, writing, and other verbal interpersonal abilities.

PO, similar to the Fluid Reasoning factor in the CHC model, involves the ability to engage in deliberate and controlled mental operations to solve novel problems that cannot be resolved automatically (McGrew, 2009). Occupation behaviors may correspond to PO abilities, ranging from simple physical movements (e.g., finger gripping) to more complex internal operations (e.g., using a personal computer). However, Occupation behaviors could be viewed as the aggregation of various intellectual abilities, potentially leading to pseudo-correlations between these subscales.

4.2 Intellectual Abilities and Adaptive Behavior in Three Educational Divisions

Significant differences were observed in SB-R and S-M Scale scores across the three educational divisions, particularly between the elementary and other divisions. The elementary school division showed statistically lower scores on both tests, suggesting that the six-year curriculum positively

influences students' development in both intellectual abilities and adaptive behaviors. These improvements may be reflected in increased task completion on the SB-R related to specific academic subjects and enhanced adaptive behaviors in daily life contexts, including school and home environments.

In contrast, no significant differences were found in SB-R and S-M Scale scores between the secondary and high school divisions, suggesting that the curriculum's impact on students' development may have already occurred by this stage. This could indicate a slower rate of change in intellectual abilities and adaptive behaviors in later educational stages.

4.3 Classification of Limitations in Intellectual Ability and Adaptive Behavior

Using the concept of the standard error of measurement (SEM), limitations in intellectual abilities and adaptive behavior were categorized into four levels for each measurement. The results revealed a significant proportion of students with moderate to severe limitations in both areas, emphasizing the need for appropriate support strategies. Additionally, some students displayed mild limitations in intellectual abilities but moderate to severe limitations in adaptive behavior, indicating the necessity for individualized and context-specific support within the school environment and in other settings.

4.4 Study Limitations and Future Directions

This study focused on a relatively small sample of students from a single special-needs school in Tokyo, which may limit the generalizability of the findings. Variations in educational curriculum, school culture, and local education systems could significantly influence the characteristics of the study's sample. Furthermore, the participants were not exclusively students with IDD; some had coexisting conditions, such as ASD. Consequently, the study could not fully explore the relationships between disorder characteristics, intellectual abilities, and adaptive behaviors.

Future research should involve more extensive and diverse samples to enhance the reliability and generalizability of the findings. It is also essential to distinguish clearly between specific disorders to better understand the complex interactions between intellectual abilities and adaptive behavior in children with varying developmental profiles.

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