研究論文

鳴門教育大学情報教育ジャーナル No. 19 pp. 71-78 2022

# Survey of ICT use for students with developmental disabilities by type of disability and class

Yuhei Oi*, Tetsuya Bando**, Ryuta Shaura*

This study was conducted to investigate whether information and communication technology (ICT) devices are used differently for students with developmental disabilities in elementary schools, depending on the type of disability (learning disabilities, attention deficit hyperactivity disorder, and autism spectrum disorder) and class (regular classes, resource rooms, and classes for special needs education). A questionnaire survey was administered to elementary school teachers to identify the extent of use of different ICT devices for students with developmental disabilities in their schools by type of disability and class. Results did not show differences in the extent of ICT device use by type of disability, although relative ICT scarcity in resource rooms was found. For supporting students with developmental disabilities, a need exists for more effective use of ICT devices depending on different types of developmental disability and class.

［**Keywords**：information and communication technology, assistive technology, developmental disabilities, inclusive education］

## 1. Introduction

Today, more than a billion people in the world are estimated to live with some form of disability (World Health Organization [WHO], 2021). Information and communication technology (ICT) has been found to be beneficial for people with disabilities. Various ICT devices are now available depending on the type of disability. For example, people with visual impairments can access information through screen readers on computing devices (Szpiro et al., 2016; Verma et al., 2012). People with communication difficulties such as hearing loss and neurological disorders can readily communicate with people without disabilities using smartphones with mobile applications (Abdallah & Fayyoumi, 2016; Lancioni et al., 2020).

Also, ICT devices promise to support students with developmental disabilities including learning disabilities (LD), attention deficit hyperactivity disorder (ADHD), and autism spectrum disorder (ASD). For example, students with LD in reading can compensate for difficulty in reading and understanding printed text by the use of reading pens (Higgins & Raskind, 2005) or tablet computers with text-to-speech systems (Svensson et al., 2021) such as Daisy (Leas et al., 2008). Tablet computers can be an effective instructional tool also for students with LD in writing (Corkett & Benevides, 2016) and mathematics (Kaur et al., 2017). ICT devices are useful not only to overcome difficulties with learning but also to reduce behavioral problems of students with developmental disabilities. Computer-assisted interventions are reportedly more motivating for students with ADHD, resulting in extended time and increased work completion (DuPaul & Eckert, 1998; Lewandowski et al., 2016). For auditory hypersensitivity observed in ASD, noise-canceling headphones might be helpful for students with ASD to address noise sounds in the classroom (Ikuta et al., 2016).

In Japan, an estimated 7.7% of students in regular classes of elementary schools have some LD, ADHD, or ASD (Ministry of Education Culture Sports Science and Technology [MEXT], 2012). Elementary school teachers increasingly need to use ICT devices to provide quality education. Among various ICT devices, teachers must select appropriate and effective devices to compensate for students' difficulties, which typically vary depending on their type of developmental disability. Handbooks for teachers can guide people in how to use ICT devices for students with LD, ADHD, and ASD in regular classes, resource rooms, and classes

* Faculty of Education, Tokoha University, Shizuoka, Japan
** Graduate School of Education, Naruto University of Education, Naruto, Japan

for special needs education (MEXT, 2014). Nevertheless, it remains unclear whether elementary school teachers use ICT devices effectively for students with developmental disabilities. Many teachers seem not to introduce ICT devices for special needs education because of their own lack of ICT knowledge and skills, even though they want to use such devices (Ono & Saito, 2017).

For this study, we conducted a survey to investigate what ICT devices are used for students with developmental disabilities in elementary schools in Japan. This study particularly emphasized the question of whether ICT devices are used differently depending on the type of disability. Additionally, this study investigated differences in the use of ICT devices for students with developmental disabilities between regular classes, resource rooms, and classes for special needs education. An earlier study reported a lack of ICT devices in resource rooms and classes for special needs education compared to regular classes (National Institute of Special Education Needs [NISE], 2016), implying that the use of ICT devices for students with developmental disabilities can differ by the type of class.

## 2. Method

### 2.1 Participants

We asked 502 public elementary schools to participate in a mail survey. It required the teacher who is the most familiar with the situation of special needs education at each school to respond to a paper-and-pencil questionnaire. In all, 137 questionnaires were returned, yielding a response rate of 27.3%. Written informed consent was obtained from all participants. This survey was administered in February of 2018.

To examine differences in the use of ICT devices for students with developmental disabilities by the type of disability (i.e., LD, ADHD, and ASD) and by the type of class (i.e., regular classes, resource rooms, and classes for special needs education), only data from forms on which participants responded about disabilities of all types and/or classes were used. Of the 137 questionnaires obtained, 70 were eventually included in the analysis of the type of disability, and 18 in the analysis of the type of class. Descriptive characteristics of these samples are presented in Table 1.

**Table 1** Descriptive characteristics of samples for analyses of type of disability and class

| | Sample for type of disability ($n$ = 70) | Sample for type of class ($n$ =18) |
|---|---|---|
| **School characteristics** | | |
| (Number of classes in school) | | |
| Regular classes | 16.0 ± 8.2 | 17.8 ± 7.0 |
| Resource rooms | 0.8 ± 1.2 | 1.8 ± 0.9 |
| Classes for special needs education | 2.1 ± 1.3 | 2.6 ± 0.8 |
| **Respondent characteristics** | | |
| Age (yr) | 49.3 ± 9.3 | 49.5 ± 10.0 |
| Gender (Female : Male : Unknown) | 30 : 39 : 1 | 9 : 9 : 0 |
| Teaching career (yr) | 25.1 ± 10.7 | 25.8 ± 11.4 |
| Special needs education coordinator (%) | 70.0 | 72.2 |

Mean ± standard deviation are shown for Regular classes, Resource rooms, and Classes for special needs education (number of classes), Age, and Teaching career.

### 2.2 Questionnaire survey

Respondents to the questionnaire were asked to describe the extent of use of ICT devices in their schools when teaching or supporting students with developmental disabilities (LD, ADHD, and ASD). The ICT devices specifically described in the questionnaire were selected by reference to earlier studies (Higgins & Raskind, 2005; Ikuta et al., 2016; NISE, 2016): Electronic blackboard, Large display, Projector, Document camera, Laptop computer, Tablet computer, Digital camera, Voice recorder, Reading pen, and Noise-canceling headphones. Respondents used a four-point scale to rate the extent to which each ICT device was used for students with LD, ADHD, and ASD respectively (1 = never, 2 = sometimes, 3 = moderately often, 4 = often). When a certain ICT device was not available, participants were required to answer “not available” for the device. Similarly, respondents were asked to report the extent of use of the ICT devices for students with developmental disabilities (irrespective of the type of disability) in regular classes, resource rooms, and classes for special needs education.

### 2.3 Data analysis

To distinguish situations in which ICT devices were not used from those in which ICT devices were not set up, the “not available” responses were counted; other responses (i.e., from 1 = never, to 4 = often) were aggregated as the number “available” for each device. Based on “not available” responses and other responses,

i.e., “available”, availability of each ICT device was analyzed. Subsequently, excluding the “not available” responses, the extents of use of the respective ICT devices were compared between the disabilities of different types and between the classes of different types.

Data were analyzed using the Cochran’s Q test to assess differences in availability. The Friedman test was used to assess differences in the use of the ICT devices. Alpha level of significance was set at .05; significance levels were corrected using the Bonferroni method for multiple comparisons after the Cochran’s Q test and the Holm–Bonferroni method for multiple comparisons after the Friedman test. Analyses were performed using SPSS (ver. 25.0; SPSS Inc., Chicago, IL) and HAD (ver 17.0; Shimizu, 2016). Effect sizes for the Cochran’s Q test were calculated according to Berry et al. (2007).

## 3. Results

### 3.1 Availability of ICT devices

Table 2 shows the ratio of “available” responses for the respective ICT devices by type of disability and class. No significant difference was found in availability for any device among different types of developmental disability (*p*s > .05). For differences by type of class, the Cochran’s Q test with Bonferroni post hoc pairwise comparison revealed that large displays, projectors, and document cameras were less available in resource rooms than in regular classes (*p*s < .05). Large displays and digital cameras were less available in resource rooms than in classes for special needs education (*p*s < .05).

### 3.2 Use of ICT devices

Table 3 shows the use of the ICT devices by type of disability. Results of the Friedman test did not reveal differences in use for all ICT devices among different types of developmental disability (*p*s > .05).

For differences in the use of the ICT devices by type of class (Table 4), the Friedman test revealed significant differences for Large display, Projector, Document camera, Laptop computer, Digital camera, and Voice recorder ($\chi^2_2$s > 6.47, *p*s < .04). However, post hoc comparisons conducted using the Holm–Bonferroni method revealed that only large displays and document cameras were used less in resource rooms than in regular classes (*p*s < .01), and large displays were also less used in resource rooms than in classes for special needs education ($p < .05$). Projectors, laptop computers, and digital cameras appeared to be less used, but voice recorders were used more in resource rooms. Nevertheless, differences were not significant by post hoc comparison.

## 4. Discussion

This study was conducted to investigate whether ICT devices are differently used for students with developmental disabilities in elementary schools depending on the type of disability and class. Results did not demonstrate significant differences in the extent of use for all ICT devices by type of disability, suggesting that elementary school teachers do not use ICT devices in different ways depending on the type of developmental disability a student has. At least, no such differences are perceived by teachers. This result was somewhat unexpected because elementary school teachers devise teaching approaches for students with different special educational needs depending on their type of developmental disability (MEXT, 2017; Osada & Tsuzuki, 2015). While the enhancement of ICT education is proceeding as “Global and Innovation Gateway for All (GIGA) school initiative” (MEXT, 2019), effective use of ICT devices for students with developmental disabilities of different types should be increasingly considered.

The results showing that some ICT devices differed in their respective degrees of availability and use by type of class. In resource rooms, large displays, document cameras, projectors, and digital cameras were less available. The first two devices were less used than devices of other types of classes. This result is unsurprising because large displays and document cameras are generally used to present information to many students simultaneously. However, an earlier survey by NISE (2016) revealed that not only large displays and document cameras but also other ICT devices were less available in resource rooms and classes for special needs education. The relative ICT scarcity in resource rooms might have appeared on specific devices as the significant differences in the results of this study. In contrast, although the difference was not found to be significant, voice recorders are apparently more used in resource rooms where individualized learning is more often provided. More variation in the use of ICT devices depending on the type of class with effective allotment of the devices is

**Table 2** ICT device availability by disability type and class type

| | Device availability by disability type ($n$ = 70) | | | | Device availability by class type ($n$ =18) | | | |
|---|---|---|---|---|---|---|---|---|
| | **LD** | **ADHD** | **ASD** | **Statistics** | **RC** | **RR** | **CS** | **Statistics** |
| **Electronic blackboard** | 31.4% | 30.0% | 31.4% | Q = 1.00, $p$ = .61, $\mathcal{R}$= .10 | 16.7% | 11.1% | 22.2% | Q = 3.00, $p$ = .22, $\mathcal{R}$= .04 |
| **Large display** | 62.9% | 64.3% | 62.9% | Q = 2.00, $p$ = .37, $\mathcal{R}$= .30 | 61.1% | 16.7% | 61.1% | Q = 12.80, $p$ = .00, $\mathcal{R}$= .30 Post hoc test: RC > RR** RR < CS** |
| **Projector** | 61.4% | 61.4% | 61.4% | Q = 0.00, $p$ = 1.00, $\mathcal{R}$= .28 | 61.1% | 27.8% | 55.6% | Q = 8.86, $p$ = .01, $\mathcal{R}$= .23 Post hoc test: RC > RR* |
| **Document camera** | 68.6% | 68.6% | 68.6% | Q = 0.00, $p$ = 1.00, $\mathcal{R}$= .35 | 77.8% | 33.3% | 55.6% | Q = 10.67, $p$ = .01, $\mathcal{R}$= .31 Post hoc test: RC > RR** |
| **Laptop computer** | 72.9% | 72.9% | 72.9% | Q = 0.00, $p$ = 1.00, $\mathcal{R}$= .40 | 83.3% | 66.7% | 77.8% | Q = 2.80, $p$ = .25, $\mathcal{R}$= .43 |
| **Tablet computer** | 51.4% | 51.4% | 51.4% | Q = 0.50, $p$ = .78, $\mathcal{R}$= .20 | 33.3% | 44.4% | 50.0% | Q = 3.50, $p$ = .17, $\mathcal{R}$= .15 |
| **Digital camera** | 78.6% | 80.0% | 78.6% | Q = 2.00, $p$ = .37, $\mathcal{R}$= .48 | 88.9% | 66.7% | 94.4% | Q = 7.00, $p$ = .03, $\mathcal{R}$= .58 Post hoc test: RR < CS * |
| **Voice recorder** | 28.6% | 28.6% | 28.6% | Q = 0.00, $p$ = 1.00, $\mathcal{R}$= .09 | 22.2% | 44.4% | 22.2% | Q = 4.57, $p$ = .10, $\mathcal{R}$= .11 |
| **Reading pen** | 4.3% | 4.3% | 4.3% | Q = 0.00, $p$ = 1.00, $\mathcal{R}$= .01 | 0.0% | 0.0% | 0.0% | Q = 1.00, $p$ = .61, $\mathcal{R}$= .00 |
| **Noise-canceling headphones** | 4.3% | 4.3% | 4.3% | Q = 0.00, $p$ = 1.00, $\mathcal{R}$= .01 | 0.0% | 5.6% | 0.0% | Q = 2.00, $p$ = .37, $\mathcal{R}$= .00 |

LD, learning disabilities; ADHD, attention deficit hyperactivity disorder; ASD, autism spectrum disorder; RC, regular classes; RR, resource rooms; CS, classes for special needs education.

Bonferroni post hoc tests were applied in cases of significant differences in the Cochran's Q test ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$).

**Table 3** ICT device use by disability type

| $n$ = 70 | LD | ADHD | ASD | Statistics[b] |
|---|---|---|---|---|
| **Electronic blackboard** | 1.34 ± 0.80 (1.0)[a] | 1.33 ± 0.79 (1.0)[a] | 1.31 ± 0.77 (1.0)[a] | $\chi^2_2 = 0.67$, $p = .72$, $\eta^2 = .00$ |
| never | 81.4% | 82.9% | 82.9% | |
| sometimes | 7.1% | 5.7% | 7.1% | |
| moderately often | 7.1% | 7.1% | 5.7% | |
| often | 4.3% | 4.3% | 4.3% | |
| **Large display** | 2.16 ± 1.19 (2.0)[a] | 2.16 ± 1.19 (2.0)[a] | 2.09 ± 1.16 (2.0)[a] | $\chi^2_2 = 2.92$, $p = .23$, $\eta^2 = .01$ |
| never | 44.3% | 44.3% | 45.7% | |
| sometimes | 14.3% | 14.3% | 17.1% | |
| moderately often | 22.9% | 22.9% | 20.0% | |
| often | 18.6% | 18.6% | 17.1% | |
| **Projector** | 1.67 ± 0.79 (1.0)[a] | 1.66 ± 0.80 (1.0)[a] | 1.66 ± 0.81 (1.0)[a] | $\chi^2_2 = 2.33$, $p = .31$, $\eta^2 = .01$ |
| never | 51.4% | 52.9% | 52.9% | |
| sometimes | 31.4% | 30.0% | 31.4% | |
| moderately often | 15.7% | 15.7% | 12.9% | |
| often | 1.4% | 1.4% | 12.9% | |
| **Document camera** | 1.94 ± 1.03 (2.0)[a] | 1.90 ± 1.01 (2.0)[a] | 1.87 ± 0.95 (2.0)[a] | $\chi^2_2 = 0.67$, $p = .72$, $\eta^2 = .00$ |
| never | 47.1% | 48.6% | 47.1% | |
| sometimes | 20.0% | 20.0% | 22.9% | |
| moderately often | 24.3% | 24.3% | 25.7% | |
| often | 8.6% | 7.1% | 4.3% | |
| **Laptop computer** | 2.40 ± 1.18 (2.0)[a] | 2.39 ± 1.20 (2.0)[a] | 2.40 ± 1.18 (2.0)[a] | $\chi^2_2 = 0.67$, $p = .72$, $\eta^2 = .00$ |
| never | 32.9% | 34.3% | 32.9% | |
| sometimes | 18.6% | 17.1% | 18.6% | |
| moderately often | 24.3% | 24.3% | 24.3% | |
| often | 24.3% | 24.3% | 24.3% | |
| **Tablet computer** | 1.73 ± 0.99 (1.0)[a] | 1.70 ± 0.95 (1.0)[a] | 1.69 ± 0.96 (1.0)[a] | $\chi^2_2 = 0.75$, $p = .69$, $\eta^2 = .00$ |
| never | 57.1% | 57.1% | 58.6% | |
| sometimes | 21.4% | 22.9% | 21.4% | |
| moderately often | 12.9% | 12.9% | 12.9% | |
| often | 8.6% | 7.1% | 7.1% | |
| **Digital camera** | 2.40 ± 1.12 (2.5)[a] | 2.40 ± 1.11 (2.0)[a] | 2.39 ± 1.12 (2.0)[a] | $\chi^2_2 = 0.50$, $p = .78$, $\eta^2 = .00$ |
| never | 30.0% | 28.6% | 30.0% | |
| sometimes | 20.0% | 22.9% | 21.4% | |
| moderately often | 30.0% | 28.6% | 28.6% | |
| often | 20.0% | 20.0% | 20.0% | |
| **Voice recorder** | 1.17 ± 0.54 (1.0)[a] | 1.17 ± 0.54 (1.0)[a] | 1.19 ± 0.60 (1.0)[a] | $\chi^2_2 = 2.00$, $p = .37$, $\eta^2 = .01$ |
| never | 88.6% | 88.6% | 88.6% | |
| sometimes | 7.1% | 7.1% | 7.1% | |
| moderately often | 2.9% | 2.9% | 1.4% | |
| often | 1.4% | 1.4% | 2.9% | |
| **Reading pen** | 1.01 ± 0.12 (1.0)[a] | 1.01 ± 0.12 (1.0)[a] | 1.01 ± 0.12 (1.0)[a] | $\chi^2_2 = 0.00$, $p = 1.00$, $\eta^2 = .00$ |
| never | 98.6% | 98.6% | 98.6% | |
| sometimes | 1.4% | 1.4% | 1.4% | |
| moderately often | 0.0% | 0.0% | 0.0% | |
| often | 0.0% | 0.0% | 0.0% | |
| **Noise-canceling headphones** | 1.01 ± 0.12 (1.0)[a] | 1.01 ± 0.12 (1.0)[a] | 1.01 ± 0.12 (1.0)[a] | $\chi^2_2 = 0.00$, $p = 1.00$, $\eta^2 = .00$ |
| never | 98.6% | 98.6% | 98.6% | |
| sometimes | 1.4% | 1.4% | 1.4% | |
| moderately often | 0.0% | 0.0% | 0.0% | |
| often | 0.0% | 0.0% | 0.0% | |

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

[a] Mean ± Standard deviation (median): 1, never; 2, sometimes; 3, moderately often; 4, often.

[b] Holm–Bonferroni post hoc tests were applied in cases of significant differences in the Friedman test ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$).

**Table 4** ICT device use by class type

| $n$ = 18 | RC | RR | CS | Statistics[b] |
|---|---|---|---|---|
| **Electronic blackboard** | 1.44 ± 1.04 (1.0)[a] | 1.17 ± 0.51 (1.0)[a] | 1.39 ± 0.92 (1.0)[a] | $\chi^2_2 = 5.60$, $p = .06$, $\eta^2 = .10$ |
| never | 83.3% | 88.9% | 83.3% | |
| sometimes | 0.0% | 5.6% | 0.0% | |
| moderately often | 5.6% | 5.6% | 11.1% | |
| often | 11.1% | 0.0% | 5.6% | |
| **Large display** | 2.50 ± 1.34 (3.0)[a] | 1.22 ± 0.73 (1.0)[a] | 2.39 ± 1.29 (2.5)[a] | $\chi^2_2 = 15.79$, $p = .00$, $\eta^2 = .29$ |
| never | 38.9% | 88.9% | 38.9% | Post hoc test: |
| sometimes | 5.6% | 5.6% | 11.1% | RC > RR$^{**}$ |
| moderately often | 22.2% | 0.0% | 22.2% | RR < CS$^{*}$ |
| often | 33.3% | 5.6% | 27.8% | |
| **Projector** | 2.00 ± 1.08 (2.0)[a] | 1.17 ± 0.38 (1.0)[a] | 1.61 ± 1.04 (1.0)[a] | $\chi^2_2 = 12.25$, $p = .00$, $\eta^2 = .23$ |
| never | 44.4% | 83.3% | 66.7% | Post hoc test: |
| sometimes | 22.2% | 16.7% | 16.7% | all ns |
| moderately often | 22.2% | 0.0% | 5.6% | |
| often | 11.1% | 0.0% | 11.1% | |
| **Document camera** | 2.44 ± 1.15 (3.0)[a] | 1.17 ± 0.51 (1.0)[a] | 1.56 ± 0.78 (1.0)[a] | $\chi^2_2 = 17.23$, $p = .00$, $\eta^2 = .32$ |
| never | 33.3% | 88.9% | 61.1% | Post hoc test: |
| sometimes | 5.6% | 5.6% | 22.2% | RC > RR$^{**}$ |
| moderately often | 44.4% | 5.6% | 16.7% | |
| often | 16.7% | 0.0% | 0.0% | |
| **Laptop computer** | 2.94 ± 1.16 (3.0)[a] | 2.33 ± 1.37 (2.0)[a] | 2.67 ± 1.24 (3.0)[a] | $\chi^2_2 = 6.47$, $p = .04$, $\eta^2 = .12$ |
| never | 22.2% | 44.4% | 27.8% | Post hoc test: |
| sometimes | 0.0% | 11.1% | 11.1% | all ns |
| moderately often | 38.9% | 11.1% | 27.8% | |
| often | 38.9% | 33.3% | 33.3% | |
| **Tablet computer** | 1.61 ± 1.09 (1.0)[a] | 1.78 ± 1.26 (1.0)[a] | 2.00 ± 1.28 (1.0)[a] | $\chi^2_2 = 3.71$, $p = .16$, $\eta^2 = .07$ |
| never | 72.2% | 66.7% | 55.6% | |
| sometimes | 5.6% | 11.1% | 11.1% | |
| moderately often | 11.1% | 0.0% | 11.1% | |
| often | 11.1% | 22.2% | 22.2% | |
| **Digital camera** | 3.17 ± 0.99 (3.0)[a] | 2.22 ± 1.31 (2.0)[a] | 3.06 ± 0.94 (3.0)[a] | $\chi^2_2 = 7.26$, $p = .03$, $\eta^2 = .13$ |
| never | 11.1% | 44.4% | 5.6% | Post hoc test: |
| sometimes | 5.6% | 16.7% | 22.2% | all ns |
| moderately often | 38.9% | 11.1% | 33.3% | |
| often | 44.4% | 27.8% | 38.9% | |
| **Voice recorder** | 1.17 ± 0.38 (1.0)[a] | 1.94 ± 1.30 (1.0)[a] | 1.11 ± 0.32 (1.0)[a] | $\chi^2_2 = 8.96$, $p = .01$, $\eta^2 = .17$ |
| never | 83.3% | 61.1% | 22.2% | Post hoc test: |
| sometimes | 16.7% | 5.6% | 22.2% | all ns |
| moderately often | 0.0% | 11.1% | 0.0% | |
| often | 0.0% | 22.2% | 0.0% | |
| **Reading pen** | 1.00 ± 0.00 (1.0)[a] | 1.00 ± 0.00 (1.0)[a] | 1.00 ± 0.00 (1.0)[a] | $\chi^2_2 = 0.00$, $p = 1.00$, $\eta^2 = .00$ |
| never | 100.0% | 100.0% | 100.0% | |
| sometimes | 0.0% | 0.0% | 0.0% | |
| moderately often | 0.0% | 0.0% | 0.0% | |
| often | 0.0% | 0.0% | 0.0% | |
| **Noise-canceling headphones** | 1.00 ± 0.00 (1.0)[a] | 1.11 ± 0.47 (1.0)[a] | 1.00 ± 0.00 (1.0)[a] | $\chi^2_2 = 2.00$, $p = .37$, $\eta^2 = .03$ |
| never | 100.0% | 94.4% | 100.0% | |
| sometimes | 0.0% | 0.0% | 0.0% | |
| moderately often | 0.0% | 5.6% | 0.0% | |
| often | 0.0% | 0.0% | 0.0% | |

RC, regular classes; RR, resource rooms; CS, classes for special needs education.

[a] Mean ± Standard deviation (median): 1, never; 2, sometimes; 3, moderately often; 4, often.

[b] Holm–Bonferroni post hoc tests were applied in cases of significant differences in the Friedman test ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$).

expected to be fruitful for quality education for students with developmental disabilities.

A review of the results reveals that the ICT devices which were included in the survey, despite differences among the devices, were available to some extent. However, the ICT devices seem not to be fully used for elementary school students with developmental disabilities, which is inferred from the mean score for the use of ICT devices: it is 2.5 points or less for all devices except for laptop computers and digital cameras in regular classes and classes for special education. Especially, ICT devices for individual use such as tablet computers should be used more for students with developmental disabilities, which might entail a shift in the way students learn (Montrieux et al., 2015). Aside from versatile devices including tablet computers, devices that target the personal needs of developmental disabilities are also expected to be useful, such as reading pens and noise-canceling headphones, which were revealed by this survey to be rarely available.

This study provided data about the use and availability of ICT devices for students with developmental disabilities in elementary schools in Japan, indicating a need for more effective use of ICT devices. However, this study has several limitations. Since the survey of this study was administered before the GIGA school initiative, the situation of use and availability of ICT devices for students with developmental disabilities may have changed by now. Also, the findings of this study were based on self-report data from teachers and the small sample size and response rate, which might have led to bias in the estimation of use and availability of the ICT devices. Although some caution is required in interpreting the results, this study offers indications of paths to enhancement of educational practices with ICT for students with developmental disabilities and avenues for future investigation in this field.

## References


Abdallah, E. E. & Fayyoumi, E. (2016). Assistive technology for deaf people based on android platform. *Procedia Computer Science, 94*, 295–301.

Berry, K. J., Johnston, J. E., & Mielke Jr., P. W. (2007). An alternative measure of effect size for Cochran's Q test for related proportions. *Perceptual and Motor Skills, 104*, 1236–1242.

Corkett, J. K. & Benevides, T. (2016). iPad versus handwriting: Pilot study exploring the writing abilities of students with learning disabilities. *Journal of International Special Needs Education, 19*(1), 15–24.

DuPaul, G. J. & Eckert, T. L. (1998). Academic interventions for students with attention-deficit/hyperactivity disorder: A review of the literature. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 14*(1), 59–82.

Higgins, E. L. & Raskind, M. H. (2004). The compensatory effectiveness of the Quicktionary Reading Pen II on the reading comprehension of students with learning disabilities. *Journal of Special Education Technology, 20*(1), 31–40.

Ikuta, N., Iwanaga, R., Tokunaga, A., Nakane, H., Tanaka, K., & Tanaka, G. (2016). Effectiveness of earmuffs and noise-cancelling headphones for coping with hyper-reactivity to auditory stimuli in children with Autism Spectrum Disorder: A preliminary study. *Hong Kong Journal of Occupational Therapy, 28*, 24–32.

Kaur, D., Koval, A., & Chaney, H. (2017). Potential of using iPad as a supplement to teach math to students with learning disabilities. *International Journal of Research in Education and Science, 3*(1), 114–121.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., D'Amico, F., Buonocunto, F., Lanzilotti, C., Alberti, G., & Navarro, J. (2020). Mainstream technology to support basic communication and leisure in people with neurological disorders, motor impairment and lack of speech. *Brain Injury, 34*(7), 921–927.

Leas, D., Persoon, E., Soiffer, N., & Zacherle, M. (2008). Daisy 3: A standard for accessible multimedia books. *IEEE MultiMedia, 15*(4), 28–37.

Lewandowski, L., Wood, W., & Miller, L. A. (2016). Technological applications for individuals with learning disabilities and ADHD. In J. K. Luiselli, & A. J. Fischer (Eds.), *Computer-assisted and web-based innovations in psychology, special education, and health* (pp. 61–93). London, UK: Academic Press.

Ministry of Education Culture Sports Science and Technology. (2012). Tsujo no gakkyu ni zaiseki

suru hattatsu shogai no kanosei no aru tokubetsu na kyoikuteki shien wo hitsuyo to suru jido seito ni kansuru chosa kekka ni tsuite. Retrieved January 13, 2022 from https://www.mext.go.jp/a_menu/shotou/tokubetu/material/__icsFiles/afieldfile/2012/12/10/1328729_01.pdf (in Japanese)

Ministry of Education Culture Sports Science and Technology. (2014). Hattatsu shogai no aru kodomotachi no tame no ICT katsuyo handobukku. Retrieved January 13, 2022 from https://www.mext.go.jp/a_menu/shotou/zyouhou/detail/1408030.htm (in Japanese)

Ministry of Education Culture Sports Science and Technology. (2017). Shogakko gakushu shido yoryo (Heisei 29 nen kokuji). Retrieved January 13, 2022 from https://www.mext.go.jp/content/1413522_001.pdf (in Japanese)

Ministry of Education Culture Sports Science and Technology. (2019). GIGA sukuru koso no jitsugen ni tsuite. Retrieved January 13, 2022 from https://www.mext.go.jp/a_menu/other/index_00001.htm (in Japanese)

Montrieux, H., Vanderlinde, R., Schellens, T., & De Marez, L. (2015). Teaching and learning with mobile technology: A qualitative explorative study about the introduction of tablet devices in secondary education. *PLoS One, 10*(12), e0144008.

National Institute of Special Education Needs. (2016). Senmon kenkyu A shogai no aru jido seito no tame no ICT katsuyo ni kansuru sogoteki na kenkyu: Gakushujo no shien kikito kyozai no katsuyo jirei no shushu to seiri Heisei 26 nendo – Heisei 27 nendo kenkyu chosa seika hokokusho. (in Japanese)

Ono, A. & Saito, F. (2017). A research about the use of ICT in Special Needs Education. *The Journal of Senri Kinran University, 14*, 31–36. (in Japanese)

Osada, Y. & Tsuzuki, S. (2015). An examination on content and style of teaching for the child with developmental disorders in special class. *Bulletin of Special Education and Welfare, 11*, 67–77. (in Japanese)

Shimizu, H. (2016). An introduction to the statistical free software HAD: Suggestions to improve teaching, learning and practice data analysis. *Journal of Media, Information and Communication, 1*, 59–73. (in Japanese)

Svensson, I., Nordström, T., Lindeblad, E., Gustafson, S., Björn, M., Sand, C., Almgren/Bäck, G., & Nilsson, S. (2021). Effects of assistive technology for students with reading and writing disabilities. *Disability and Rehabilitation: Assistive Technology, 16*(2), 196–208.

Szpiro, S. F. A., Hashash, S., Zhao, Y., & Azenkot, S. (2016). How people with low vision access computing devices: Understanding challenges and opportunities. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility* (pp. 171–180). ACM.

Verma, P., Singh, R., & Singh, A. K. (2012). A framework for the next generation screen readers for visually impaired. *International Journal of Computer Applications, 47*(10), 31–38.

World Health Organization. (2021). Disability and Health. Retrieved January 13, 2022 from https://www.who.int/news-room/fact-sheets/detail/disability-and-health