DiToM
Diagnostic Tool in Mathematics

Teacher's Manual for the Functional Diversity Adaptation of DiToM Diagnostic Tests

Diversity categories covered:

Visual Impairments –Developmental Language Disorder (DLD) – Learning Difficulties – Attention Deficit Hyperactivity Disorder (ADHD) – Autism – Significant Cognitive Disabilities (SCD) – Physical and Motor Disabilities – Hearing Impairments (DHH)

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1 Overview

This manual serves as a guide for teachers in administering and interpreting the DiToM screening test items. It provides brief and practical modifications that help ensure the original test meets the needs of students with ADHD, Autism, DLD, Learning Difficulties, SCD, Physical Disabilities and Visual Impairments. The goal is to enable accessible and equitable mathematical assessment for students aged 0–8.

2 Accessibility Features and Accommodations

This manual proposes accessibility features and accommodations that may be required during assessment.

Features such as answer masking, color contrast (background/font), and low- or medium-tech assistive technology can be used for any student who needs them. These needs should be identified in advance through the Personal Needs Profile (PNP).

3 Visual impairments

Converting a written test into formats such as large print, Braille, or audio does not automatically guarantee accessibility. It is essential to select formats based on each student's individual profile. For example:

- A young child who is blind may not yet know contracted Braille and therefore requires uncontracted Braille.
- A student with low vision who is experienced with large print but unfamiliar with audio formats may struggle if the test is only provided in audio.

For computer-based tests:

- Students should be familiar with the software used.
- If the application is not self-voicing, it must be compatible with the student's screen reader.

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- Students with low vision may need adjustable contrast and font sizes.
- Assistive technology (Figures 1–4) may be necessary.

Figure 1

Figure 2

Figure 3

Figure 4

Large Print

14" × 18" paper

To achieve optimal enlargement (150% / 18-point font), print large-print materials on 14" × 18" paper. Disable print scaling or “fit to page.”

11" × 17" paper

Large-print tests may also be printed on 11" × 17" paper at <150% enlargement. In this case, scaling or “fit to page” must be enabled.

Tactile Graphics:

Tactile graphics use raised surfaces that enable blind students to perceive information haptically (Červenka, 2013). They support interpretation of maps, graphs, diagrams, and other non-textual content. A person with a visual impairment can feel these raised lines and surfaces to obtain the same information that sighted individuals receive visually.

In this approach, only one image was represented using tactile graphics; all others were presented in the same way as for students without visual impairment. Therefore, if a student

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who is blind or has a visual impairment requires tactile graphics for completing the practice tests, ideas and instructions for creating tactile graphics can be found in the resources attached:

Tactile Graphics Project – "Let's Do It" Guide
https://sites.google.com/view/tactile-graphics/lets-do-it#h.888a5ryxcg84

Perkins School for the Blind – Teaching Tactile Graphics
https://www.perkins.org/resource/teaching-tactile-graphics/

Equal Entry – Creating Tactile Graphics
https://equalentry.com/create-tactile-graphics/

PRCVI – Tactile Graphics Guidelines
https://www.prcvi.org/media/1125/guidelines-and-standards-for-tactile-graphics.pdf

American Printing House – Tactile Graphics Manual
https://sites.aph.org/files/manuals/7-08851-00.pdf

Braille Authority of North America – Tactile Graphics Standards
https://www.brailleauthority.org/guidelines-and-standards-tactile-graphics

4 SCD, AUTISM, LEARNING DIFFICULTIES, DLD, ADHD

Communication challenges can create barriers to learning. Mathematics achievement is closely related to cognitive areas such as working memory, processing speed, visual-spatial reasoning, phonological processing, and symbolic understanding. Learning difficulties such as dyslexia, dysgraphia, and dysorthographia significantly influence mathematical performance (Alloway, 2006; Kolkman, 2013).

Understanding students' communication functions enables teachers to use appropriate language and to support meaningful communication, especially for students who rely on Augmentative and Alternative Communication (AAC).

Students with neurodevelopmental disorders often experience:

- Attention and processing difficulties

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- Sensory sensitivities
- Executive functioning challenges
- Increased anxiety during timed tasks

The following strategies can support these learners:

Supportive Communication Strategies

- Provide simple clarification for students with ADHD, Autism, or SCD.
- Repeat key information and allow processing time.
- Ask for clarification with prompts such as “What?” or “Which one?”
- Rephrase instructions.
- Use descriptive language (e.g., “small brown teddy bear”).
- Give phonological cues (e.g., “It starts with P”).
- Model language by pairing spoken instructions with AAC symbols.

Provide a Structured and Predictable Format

- Keep layout consistent and predictable.
- Use clear sectioning and spacing.
- Avoid unnecessary visual clutter or decorative elements.
- Present steps clearly with wide spacing for students with dyslexia.

Use Clear and Simple Language

- Use direct, simple instructions.
- Avoid multi-step commands in a single sentence.
- Pictograms may support comprehension, especially for autistic students.

Example – Simplifying a task:

Original:
Find the sum of the two largest numbers in the set {3, 7, 2, 9, 5}.

Accessible version:

1. Circle the two biggest numbers.
2. Add them together.

Provide Multiple Ways to Process Information

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- Use visual supports such as number lines or diagrams.
- Break down multi-step tasks.
- Use concrete examples or real-life contexts.

Extra Time Accommodations

In some countries, for these categories of educational needs, students are given additional time to minimize time pressure and anxiety. It would be good if this possibility was utilized in any country that provides it. International testing standards commonly provided:

- +25% time: reduces mild/moderate time pressure
- +50% time: appropriate for slow processing, anxiety, ADHD, dyslexia
- +100% time: for students who freeze or need prolonged regulation breaks

Chunked timing (e.g., 3 × 20 minutes instead of 60 minutes) can further reduce stress.

Working Memory and Focus Support

- Provide checklists for multi-step problems.
- Allow formula sheets.
- Permit highlighting to mark key information.

5 Physical and Motor Disabilities

5.1 Students with Complex Physical Needs and Limited Hand Use

Partner-Assisted Scanning (PAS)

PAS is recommended for students with severe motor impairments who cannot point or operate devices (Beukelman, 2020). A communication partner presents choices in a consistent order while the student indicates selection through:

- Eye movement
- Vocalization
- Body movement
- A single-switch device

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The partner must:

- Follow a predictable scanning pattern
- Provide sufficient wait time (3–30 seconds depending on the learner)
- Confirm the student's intended choice

Two common methods:

- One-step selection – student chooses directly.
- Two-step selection – student selects a group, then an item.

PAS is effective when high-tech AAC is unavailable or inappropriate.

5.2 Writing and drawing difficulties:

Some students experience challenges with writing, drawing, or counting due to difficulties in gripping pens or pencils, manipulating small objects, or controlling fine motor movements. These students often struggle with tasks that require precision and coordination. Fortunately, there are low-tech solutions that can support these students and make tasks easier, including:

Writing supports:

- Pencil grips
- Foam tubing
- Weighted pencils or pens
- HandiWriter
- Slant boards or angled writing surfaces
- Clipboards with non-slip bases

Drawing aids:

- Stencils and templates
- Shape guides
- Letter formation guides

Counting supports

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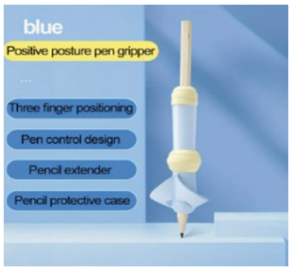
- Large tactile number lines
- Velcro-based numbers or shapes
- Abacuses with oversized beads
- Large or magnetic base-10 blocks
- Finger spacers or guiding strips

Bipgrip Pencil Grip



HandiWriter

Steady Write Writing Instrument

Figures 5 - 10

6 Hearing impairment - DEAF AND HARD OF HEARING (DHH)

Research shows that deaf and hard-of-hearing students are capable of developing mathematical reasoning similarly to hearing peers (Meadow, 1980). However, achievement gaps of around three years are common (Brun, 2018; Santos et al., 2022), mainly due to:

- Limited mathematical vocabulary
- Reduced incidental learning
- Communication modality differences

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- High linguistic demands in word problems

Given these challenges, research highlights the importance of instructional and environmental strategies that enhance accessibility and comprehension:

- Use multimodal visuals and multimedia to reduce visual fatigue.
- Allow sufficient viewing time for visual materials.
- Provide scaffolded or interpreted directions when literacy demands exceed language skills.
- Present concepts through multiple modes: manipulatives, gestures, pictures, verbal explanations, and symbolic notation.

Overall, the literature emphasizes that when instructional methods are intentionally designed to reduce linguistic barriers and increase multimodal access, students who are deaf or hard of hearing can engage successfully and meaningfully with mathematical content.

Assistive technology:

- Screen readers: NVDA, JAWS, VoiceOver (compatible with MathML)
- Braille displays: NVDA and JAWS can convert MathML to Nemeth Braille
- FM systems / sound-field systems
- Hearing loops

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