THE EFFECTS OF CUT-OUT INCLINED DESKS ON HANDWRITING PERFORMANCE IN CHILDREN WITH CEREBRAL PALSY

Originally appraised by Jenna Cunningham & Rebecca Stanke (OT Students, 2017) (BEAR Appraisal as part of SEIPI)

Reviewed by Jennifer Law and Ivonne Montgomery (OTs, 2018) (Traffic Light Appraisal)

Sunny Hill Health Centre for Children

STEP 1: CLINICAL QUESTION (PICO)

- **P** – Children with Cerebral Palsy
- **I** – Cut-out/inclined desk
- **C** – Standard school desk
- **O** – Handwriting performance

STEP 2: SEARCHING FOR EVIDENCE

Search Sources

- TRIP database
- CINAHL
- MEDLINE (PubMed)
- Rehabilitation Reference Centre
- ERIC
- Google Scholar

Search Terms

- Cerebral palsy, desk, children, handwriting

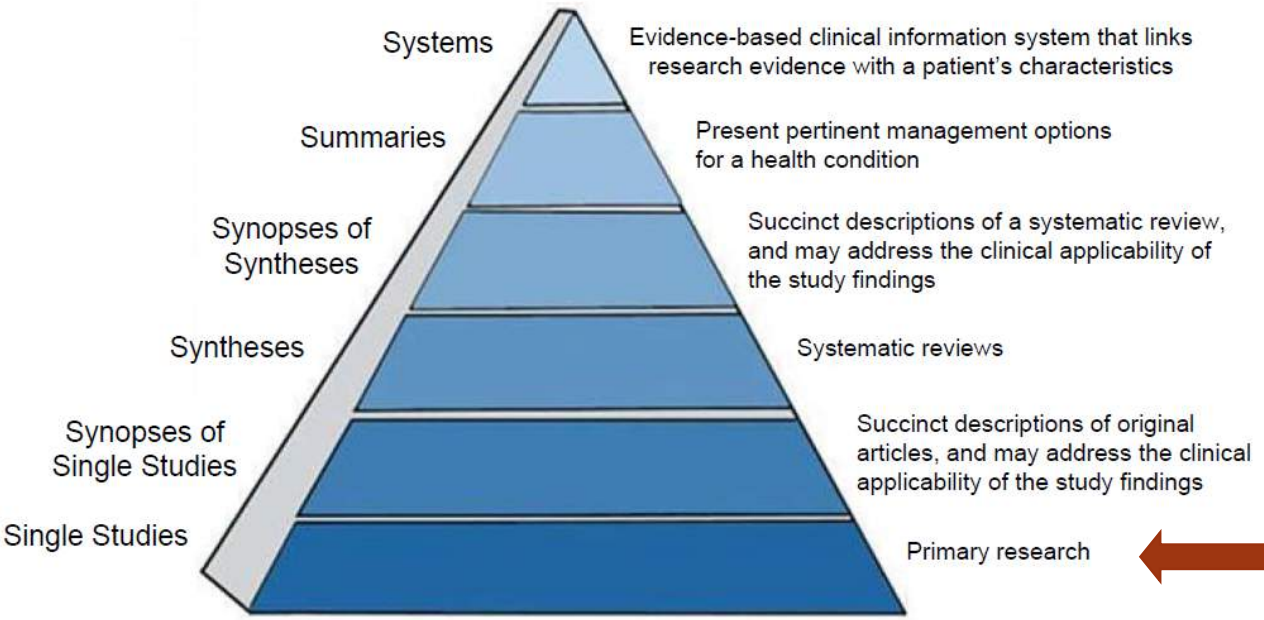
BEST EVIDENCE IDENTIFIED

- Shen, I. H., Kang, S. M., & Wu, C. Y. (2003). **Comparing the effect of different design of desks with regard to motor accuracy in writing performance of students with cerebral palsy**. Applied ergonomics, 34(2), 141-147.
- Kavak, S.T., & Bumin, G. (2009). **The effects of pencil grip posture and different desk designs on handwriting performance in children with hemiplegic cerebral palsy.** Journal de pediatria, 85(4), 346-352.
- Ryan, S. E., Rigby, P. J., & Campbell, K. A. (2010). **Randomised controlled trial comparing two school furniture configurations in the printing performance of young children with cerebral palsy.** Australian occupational therapy journal, 57(4), 239-245.

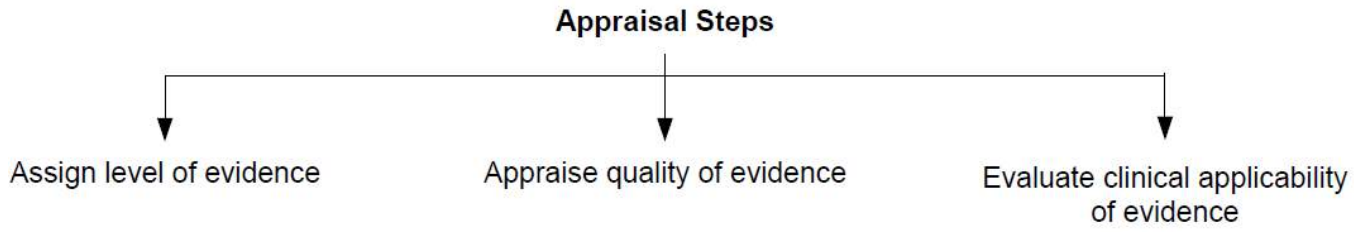
STATE OF THE EVIDENCE TRAFFIC LIGHT

STEP 3 : APPRAISING THE EVIDENCE

Determine where your best evidence fits on the 6s Hierarchy of Pre-Appraised Evidence[1]



Reference: DiCenso, A., Bayley, L., & Haynes, R. B. (2009). Accessing pre appraised evidence: Fine-tuning the 5s model into a 6s model. *ACP Journal Club*, *151*(3), JC3-2-JC3-3.



3.1 ASSIGN LEVEL OF EVIDENCE

AACPDM Level of Evidence Scales[1]

Table 1a: Levels of Evidence for Group Designs

Level	Intervention (Group) Studies
I	Systematic review of randomized controlled trials (RCTs) Large RCT (with narrow confidence intervals) (n>100)
II	Smaller RCTs (with wider confidence intervals) (n<100) Systematic reviews of cohort studies "Outcomes research" (very large ecologic studies)
III	Cohort studies (must have concurrent control group) Systematic reviews of case control studies
IV	Case series Cohort study without concurrent control group (e.g. with historical control group) Case-control study
V	Expert opinion Case study or report Bench research Expert opinion based on theory or physiologic research Common sense/anecdotes

Table 1b: Levels of Evidence for Single Subject Designs

Level	Single Subject Design Studies
I	Randomized controlled N-of-1 (RCT), alternating treatment design (ATD), and concurrent or non-concurrent multiple baseline design (MBDs); generalizability if the ATD is replicated across three or more subjects and the MBD consists of a minimum of three subjects, behaviors, or settings. These designs can provide causal inferences.
II	Non-randomized, controlled, concurrent MBD; generalizability if design consists of a minimum of three subjects, behaviors, or settings. Limited causal inferences.
III	Non-randomized, non-concurrent, controlled MBD; generalizability if design consists of a minimum of three subjects, behaviors or settings. Limited causal inferences.
IV	Non-randomized, controlled SSRDs with at least three phases (ABA, ABAB, BAB, etc.); generalizability if replicated across three or more different subjects. Only hints at causal inferences.
V	Non-randomized controlled AB SSRD; generalizability if replicated across three or more different subjects. Suggests causal inferences allowing for testing of ideas.

APPRAISAL SUMMARY

- The following 3 articles were chosen as they were readily found during our search as the highest level of current evidence available
- One additional article was located that was not included in SEIPI BEAR (Ryan et al., 2010)
- No synthesized review articles were found.
- All three articles had samples that are relevant to our population/context/setting with intervention(s) that is/are clinically relevant, feasible and applicable.

3.2 APPRAISE QUALITY OF EVIDENCE

Citations	Group Design	Level of Evidence Rating (AACPDM)	Quality of Evidence Rating	Traffic Light Code & State of the Evidence Classification
Shen, I. H., Kang, S. M., & Wu, C.Y. (2003)	Group	II	Moderate 4/7	 **Proven Effective**
Kavak, S.T., & Bumin, G. (2009)	Group	III	Moderate 4/7	**Insufficient Evidence**  Group design Level III-V evidence of any quality, regardless of outcome
Ryan, S. E., Rigby, P. J., & Campbell, K. A. (2010)	Group	III	Moderate 4/7	

SHEN, I.H., KANG, S.M. & WU, C.Y. (2003)

Purposes

- To examine the effect of ergonomic desk design for improving motor accuracy in writing performance in students with CP
- To provide information regarding the effect of work surface design (regular vs. cut-out) and desk angle design (horizontal vs 20 degrees inclination) on motor accuracy

POPULATION

- 32 students with CP: 21 male and 11 female
- Ages 5-20 years Mean age 15.2 years
- Dx: 9 with mild-moderate spastic diplegia

  23 with mild-moderate athetoid quadriplegia
- Students recruited from clinics and school with mental disabilities in Taiwan
- Students had oral speech capability and could follow instructions

INTERVENTION

INTERVENTION

Workstation 1
Regular surface, 20 degree incline

Workstation 2
Regular surface, horizontal

Workstation 3
Cutout, 20 degrees incline

Workstation 4

Cutout, horizontal

INTERVENTION

- 2 independent variables

  -work surfaces (regular and cut-out work surface)

  -desk top angles (horizontal and incline at 20 degrees)

  The desk and chair with adjustable footrests, hip strap and footrests were adjusted to support the subjects individually

- Each subject was tested on all 4 desks. The order of desks was randomized.

MEASUREMENT

- Test Used:

-MAC, a subtest of both Southern California Sensory Integration Test and Sensory Integration and Praxis Tests (SIPT)

-The MAC test uses a tracing task to measure eye-hand control, motor planning and motor accuracy. These performance components have been identified to be associated with handwriting by a # of studies

-Requires the subject to visually guide the hand to trace a pre-printed 15" solid black line. Scores take into account speed and accuracy

-2 raters scored test separately

APPRAISAL

- Strengths of study

- Excellent inter-rater reliability of MAC (based on 2 raters' accuracy scores=0.99)

- Inclusion and exclusion criteria of the study population well described

- Intervention was well described

- Order of presentation of 4 work stations was randomized

APPRAISAL

- Weaknesses of the study:
- Use of MAC was used to test motor accuracy and speed. MAC has not been normed on low incidence population such as children with CP
- The validity and reliability of 'translation' to Mandarin has not been validated, peer reviewed or published

KEY POINTS

- Subjects demonstrate significantly higher accuracy scores and adjusted (both accuracy and speed) scores while using a cut-out desk compared to a regular desk
- No significant difference in MAC accuracy and speed scores between desk with 20 degrees inclination vs horizontal desk . However, an inclined desk may be better for vision and less neck flexion
- For the students who have athetoid CP, the adjusted scores were significantly higher when using the cut-out vs regular desk
- Use of cut-out desk resulted in higher MAC scores; therefore, possibly better writing performance

KEY POINTS

- Cut-out work surface appears to provide better trunk posture and stabilization for arms and forearms improving motor accuracy
- Cut out work surface is recommended to provide more upper limb support in writing activities for students with CP
- Cut out work surface led to significantly better tracing performance than a regular work surface. Effect appeared to be more beneficial for students with athetoid quadriplegia than those with spastic diplegia
- No difference in writing performance between horizontal or incline work surface

RYAN, S. E., RIGBY, P. J., & CAMPBELL, K. A. (2010).

POPULATION

- Gross Motor Function Classification System (GMFCS) Level I or Level II cerebral palsy
- Ages 6 - 8 years, 11 months
- Were reported by their parents to be able to print the alphabet
- MACS Level I (n = 14) and Level II (n = 16)
- Dx: diplegia (n = 14), hemiplegia (n = 12), triplegia (n = 2) and unclassified (n = 2)

INTERVENTION

OPTIMAL DESK CONFIGURATION:

SUBOPTIMAL DESK CONFIGURATION:

- No image provided for suboptimal
- Described as having the height and depth exceed the popliteal height and popliteal- to-buttock length of a 50th percentile 8-year old by 9.4 and 5.3 cm, respectively (ie oversized)
- The desk height was individually adjusted to be 5.1–7.6 cm higher than the seated elbow height of the participant to provide comparable working heights for the two desk interventions.

INTERVENTION

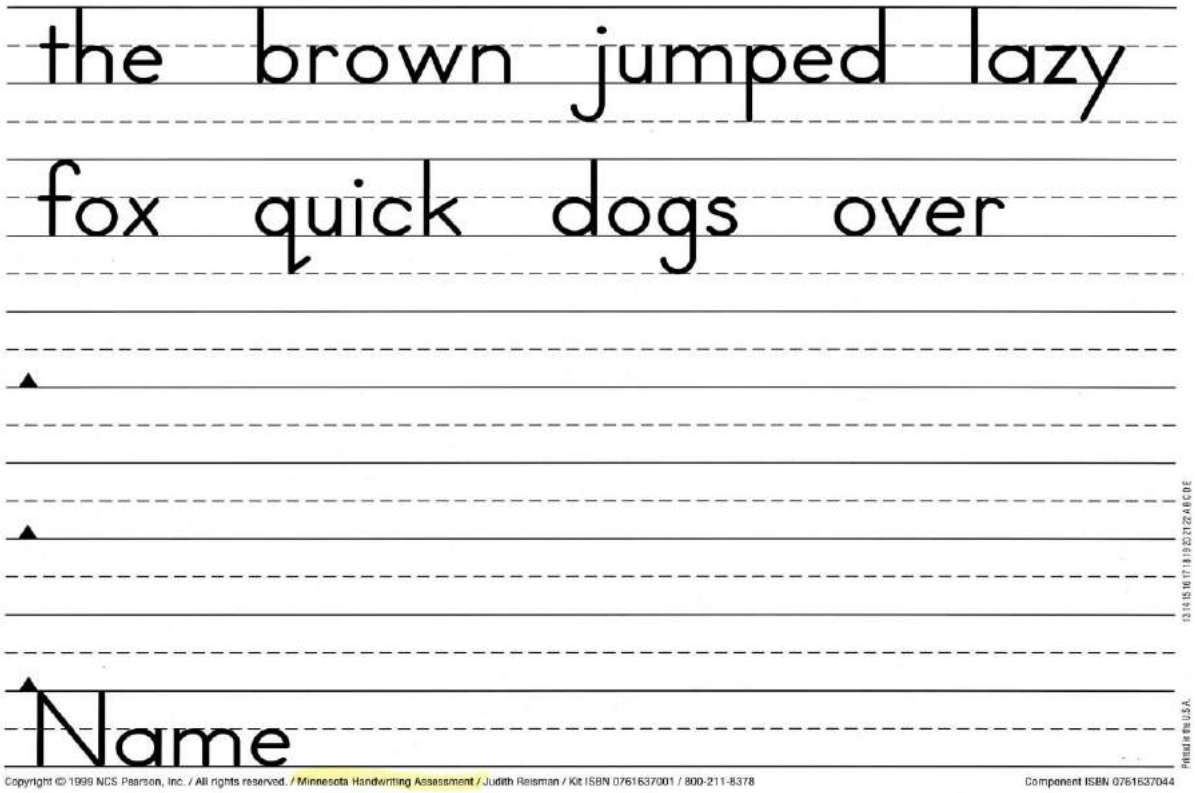
- Randomised the presentation order of the seating configurations to the children in three blocks of 10 sessions

However

- Minimal time to adjust to the seating was provided
- During the experiment, and students were not cued to reposition themselves if they were not optimally positioned in the intervention equipment nor to maintain a suboptimal position in the other condition, i.e. may have moved forward to ensure feet touching the ground

MEASUREMENT

- Assessor was blinded.
- MHA used however it has not been normed on low incidence populations, such as children with CP.



APPRAISAL

- Moderately conducted study (4/7)
- No significant difference in legibility score mean values between the interventions was detected and the effect size was small.
- Compared with standard school furniture, the use of specialty school furniture did not lead to immediate gains in printing legibility and other printing performance areas for children with cerebral palsy.

KEY POINTS

- However, it may be that with the optimization of desk height for all participants, children repositioned themselves, to achieve adequate foot support, and therefore configuration was no longer as suboptimal as described
- Therefore, the difference between the two conditions may not have been as vast as purported, leading to the insignificant results
- Bottom line: Further study of the influence of functional abilities, other contextual factors and the longer-term use of school furniture on handwriting performance is recommended

KAVAK & BUMIN, 2009

POPULATION

- 8-12 years olds
- 26 right handed children with left side hemiplegic cerebral palsy and 32 right handed TD children
- MACS classification system – either Level I, II or III

INTERVENTION


1

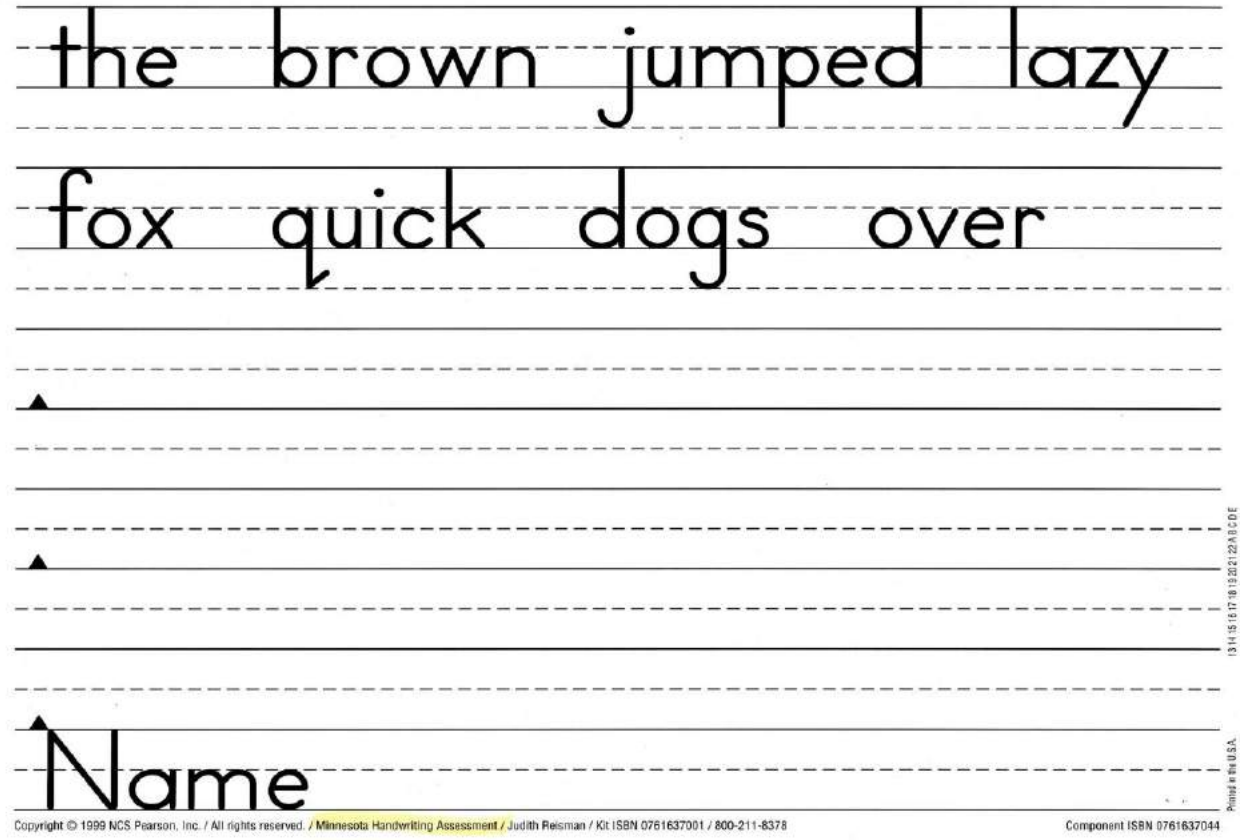

2


3


4

MEASUREMENT

- MHA has not been normed on low incidence populations, such as children with CP
- The validity/reliability of this translation to the Turkish language has not been peer reviewed/published.



APPRAISAL

- Moderately well conducted study (4/7)
- The test order (of the 4 desks) was randomized
- However did not account for/describe other variables such as seated chair positioning (pelvic and foot stability)

KEY POINTS

- At baseline, children w/ CP had lower scores in all handwriting parameters
- When the effects of different desk types on handwriting parameters were compared, it was noted that children with CP demonstrated better performance at desk 3 (cut-out; level surface) in rate and spacing parameters of handwriting ($p < 0.001$, $p < 0.05$).

KEY POINTS

- TD children demonstrated better performance at desk 2 (inclined) only in the rate parameter of handwriting ($p < 0.001$)

KEY POINTS

When median scores of handwriting parameters were used, the children with CP had better scores at:

- desk 3 (cut-out; level surface) in legibility, form, alignment and spacing parameters
- desk 4 (cut-out and incline) in rate and size parameters

KEY POINTS

- Cut-out desks provide more upper extremity support for children with hemiplegic CP ➡ better handwriting performance on rate and spacing parameters than when using a regular desk configuration
- Use of an incline was also found to be helpful (better rate and size) as it may lead to better visual motor organization
- Use of cut-out desks should be tried for children with motor impairments such as CP if they are displaying handwriting challenges (speed and/or quality) with outcomes measured over time

KEY POINTS

- Clinicians should consider also measuring fatigue and posture as additional beneficial constructs to track and measure over time (with possibly resultant better attention and learning)
- The ergonomics of the cut-out desk with incline/slant appear to be the important for postural support for upper extremity use.
- Use of a slant board can be tried as a more usable alternative to an inclined desk.
- Long term results need to be better evaluated

BOTTOM LINE

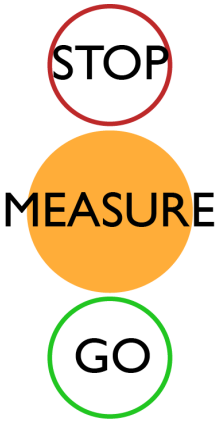
CLINICAL IMPRESSIONS AND RECOMMENDATION FOR PRACTICE:

- Important to note that the SHEN article assessed motor accuracy
- Kavak and Rigby assessed handwriting with conflicting results
- Therefore, overall, in terms of handwriting (which is the most meaningful construct for school-aged children) the study findings would be a "yellow" – need to measure and monitor desk prescription (both use of a cut-out and/or inclined surface)

CLINICAL IMPRESSIONS AND RECOMMENDATION FOR PRACTICE:

Will be added to Traffic Lighting Database:

http://10.2.50.68/fmi/iwp/res/iwp_home.html



RECOMMENDATIONS FOR PRACTICE:

- Ergonomic factors (such as desk configuration and slant) have traditionally been considered and should continue to be considered when supporting handwriting skills in students with motor challenges

Image by CAP Furniture via https://capfurniture.com.au/product/650-650-cutout-table/

Image by School Outfitters via https://www.schooloutfitters.com/catalog/product_info/pfam_id/PFAM7252/products_id/PRO18342

RECOMMENDATIONS FOR PRACTICE:

Supportive Seating:

- Ensure the child is well supported in chair/wheelchair with desk/tray
- Feet resting flat on footplates/floor
- Ensure good desk height
- Trial use of a cut out desk and/or incline
- Measure and monitor

KNOWLEDGE PRODUCT - HANDOUT

SEATING & POSITIONING

CUT- OUT INCLINED DESKS

Did you know?

Some moderate quality evidence supports the use of cut-outs desks with inclined surfaces to improve fine motor skills and classroom performance in children with motor impairments, such as cerebral palsy. However, some of the research is conflicting; therefore, the following recommendations should be evaluated when applied with a child to determine their effectiveness for that individual child.

What is a cut-out desk with inclined surface and where should it be used?

A cut-out desk with an inclined surface is an ergonomic, sloped work surface with a semi-circular cut-out around the trunk. This design can be useful for children with motor impairments. The cut-out surface provides added support and stability to the trunk and forearms to enhance fine motor skills, such as pencil motor accuracy, and writing. Cut-out desks, with or without inclined surfaces, are often used in the classroom, along with supportive classroom seating.

Image credit: CAP Furniture

Image credit: School Outfitters

Developed 2017 by Rebecca Stanke and Jenna Cunningham, Occupational Therapy Students
Revised 2018 by Ivonne Montgomery & Jennifer Law, Occupational Therapists,
Bobby Hill Health Centre for Children

To be added to the CDR

What are the best suggestions for classroom seating?

The following suggestions to help improve fine motor skills for school-aged children with motor impairments are based on clinical expertise as well as on primary research articles about studies involving children with cerebral palsy.

Desk or Table:

- Ensure good desk height (approximately 1 – 2 inches above bent height depending on the child's height)
- Try out and compare the use of a cut-out and/or inclined desk surface
- Alternately trial use of a cut-out desk combined with a slant board
- Encourage the child to sit upright and positioned close to desk surface ("tummy touches table")
- Measure outcomes (e.g. posture, stability, writing legibility) and monitor over time to determine effectiveness

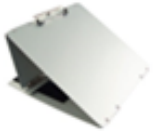


Image credit: School Specialty
https://tinyurl.com/yxldxxz2l

Seating:

- Ensure the child is well supported in chair/wheelchair
  - Feet should rest flat on floor or footrest(s) (knees typically bent at 90 degrees)
  - Ensure good seat depth with back well supported

Where can I find a cut-out desk?

- Ability Healthcare (ergobasicdesign.com) – custom sizing available
- Priority Posture Systems Ltd. (priorityposture.ca) – custom sizing available
- Motion Specialties (motionspecialties.com)
- Performance Health (performancehealth.ca/)
- School Specialty (schoolspecialty.ca)
- Rifton (rifton.com)

Prices vary depending on size, features and provider.

Where can I find a slant board?

- School Specialty (schoolspecialty.ca)
- Therapy Shoppe (therapyshoppe.com)
- Toys Tools and Treasures (toystoolsandtreasures.com)
- Tools for Kids (toolsforkids.ca)

Prices for slant boards vary depending on size, features and provider. Some are fixed and some fold flat for easier storage.

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REFERENCES:

- Shen, I. H., Kang, S. M., & Wu, C. Y. (2003). Comparing the effect of different design of desks with regard to motor accuracy in writing performance of students with cerebral palsy. Applied ergonomics, 34(2), 141-147.
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