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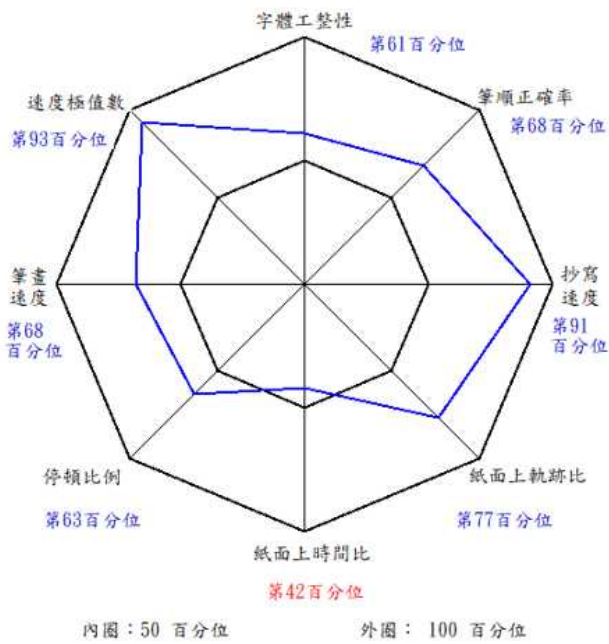
学童在学校中约有30%-60%的时间须从事精细动作的活动，其中又以写字等纸笔活动居多 (MCHALE & CERMAK, 1992)。若无法写字写得很顺畅,例如：经常写错字、写字速度慢经常无法准时完成作业或是写得非常潦草让老师无法分辨字体等情况，文献上常用“POOR HANDWRITERS”或“DYSGRAPHIA”来描述这些学童 (MARR, WINDSOR, & CERMAK, 2001)。根据调查，学龄儿童写字困难发生率大约 10% ~ 34% (RUBIN & HENDERSON,1982; SMITS-ENGELSMAN, NIEMEIJER,& VAN GALEN, 1997,2001)。其中写字困难在发展协调障碍儿童(DEVELOPMENTAL COORDINATION DISORDER, DCD)特别容易出现 [DSM-5,(APA) ,2013]。

写字问题也是学龄儿童最常转介职能治疗的因素之一(TSENG & CERMAK, 1993)。写字是属于职能中教育的一环，提升学龄儿童写字能力，须考虑学校情境与老师的要求，而任务导向训练能立即缓解在学校中所遇到的学习困难。因此，学龄儿童写字困难问题介入朝向由上到下的方法(TOP-DOWN APPROACH)与人-环境-职能模式(PEO MODEL)发展，此两大方向将会是未来趋势与创新(SCHNECK & O' BRIEN,2020)。

写字是一项高度协调性且自动化的动作技巧。要获得此技巧，牵涉动作控制与动作学习的历程。一个字是由许多小动作所组成，此一小动作称之为「笔画」(STROKE)。上肢的动作控制需要把每一笔画用正确的方向与正确的顺序放在正确的位置上。运动学（速度&位置）和动力学（力量）的回馈对动作控制来说相当重要。尤其是刚学一个新的生字或需要同时要求正确与可读性时，立即且有效的回馈是非常重要的。写字自动化是则是动作学习的过程，此过程需要大量具有有效回馈的练习模式，我们称之为治疗性练习(THERAPEUTIC PRACTICE)(ZWICKER & HARRIS, 2009)。当我们写字时，依赖这些回馈的程度降到最低，写字动作便已成为自动化(CHANG & YU, 2010)。

智能科技写字评估与训练系统(COMPUTERIZED HANDWRITING EVALUATION AND TRAINING SYSTEM)是一套由台湾义守大学感觉统合与动作控制研究室团队所研发的一套中文字的写字评估与训练系统，设备包括计算机、智能手写笔、智能数字写字板及评估与训练软件(FUNWRITE 1.0)。评估系统内容包括字体工整性、笔顺正确率、抄写速度、纸面与空中轨迹长度比、纸面与空中时间比、停顿比例、笔画速度与速度极值数(图一)。训练系统则包括笔顺练习、默写练习与生字练习三种模式。介入练习设计以动作控制与动作学习理论为基础，过程中给予运动学与动力学的立即回馈，回馈方式以视觉与听觉两种模式呈现，并可回放写字笔画过程让学童可以自我检视与反馈。另有金币奖赏制度提升学童练习写字动机。

智能科技写字评估与训练系统之具体介入成果已发表于国际期刊(CHANG & YU,2013, 2014)，于2018年获得科技部创新发明博览会创新技术奖、2019与2020年分别通过台湾(第I676919号)与美国(NO.US 10,685,222 B)发明专利，并于台湾推动临床应用(图二)，未来进一步规画朝向小区与学校推广。更多相关信息请参阅义守大学感觉统合与动作控制研究室网站。
[HTTPS://0FUNFUNCTION.WIXSITE.COM/FUNFUNCTION](https://0FUNFUNCTION.WIXSITE.COM/FUNFUNCTION)



圖一：寫字評估結果首頁以雷達圖呈現



圖二：電腦化寫字評估與訓練系統臨床運用

參考文獻

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.
- Chang, S. H., & Yu, N. Y. (2010). Characterization of motor control in handwriting difficulties in children with or without developmental coordination disorder. *Developmental Medicine and Child Neurology*, 52, 244–250. <https://doi.org/10.1111/j.1469-8749.2009.03478.x>
- Chang, S. H., & Yu, N. Y. (2013). Handwriting movement analyses comparing first and second graders with normal ordysgraphic characteristics. *Res Dev Disabil*. 2013; 34(9): 2433–41. Epub 2013/06/12. doi: 10.1016/j.ridd.2013.02.028. PubMed <https://doi.org/10.1016/j.ridd.2013.02.028> PMID: 23747934
- Chang, S. H. & Yu, N. Y. (2014). The effect of computer-assisted therapeutic practice for children with handwriting deficit: A comparison with the effect of the traditional sensorimotor approach. *Research in Developmental Disabilities*, 35 (7), 1648– 1657. <https://doi.org/10.1016/j.ridd.2014.03.024>.
- Marr, D., Windsor, M., & Cermak, S. (2001) Handwriting readiness: Locatives and visuomotor skills in the kindergarten year. *Early Childhood Research and Practice* 34(1): 1–28.
- McHale, K., & Cermak, S. A. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy*, 46, 898–903. <https://doi.org/10.5014/ajot.46.10.898>
- Rubin, N. , & Henderson, S. E. (1982). Two sides of the same coin: Variations in teaching methods and failure to learn to write. *Special Education: Forward Trends*, 9, 17–24.
- Schneck, C., & O'Brien, S. P. (2020). Assessment and treatment of educational performance. In O'Brien & Kuhnick (Eds.), *Case-Smith's Occupational therapy for children and adolescents* (8th ed., pp. 380–382). St. Louis: Elsevier
- Smits-Engelsman, B. C. M., & Van Galen, G. P. (1994). Dysgraphia in children: Lasting psychomotor deficiency or transient developmental delay? *Journal of Experimental Child Psychology*, 67, pp. 164-184
- Smits-Engelsman, B. C. M., Niemeijer, A. S. & Van Galen, G. P. (2001). Fine motor deficiencies in children diagnosed as DCD based on poor grapho-motor ability. *Hum Mov Sci*, 20, 161–82.
- Tseng, M. H., & Cermak, S. A. (1993). The influence of ergonomic factors and perceptual–motor abilities on handwriting performance. *American Journal of Occupational Therapy*, 47, 919–926. <https://doi.org/10.5014/ajot.47.10.919>
- Zwicker, J. G., & Harris, S. R. (2009). A reflection on motor learning theory in pediatric occupational therapy practice. *Can J Occup Ther*, 76, 29– 37.