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The role of executive functions and ICTs in anxiety management of children with learning disabilities

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Abstract. Anxiety is a particular form of emotional distress which is frequently experienced by students with LD. Research has indicated that high levels of anxiety have negative effects on performance on cognitive and academic tasks. Also, findings suggest that children with LD present cognitive and neuropsychological deficits. The mindfulness function of MMA proved to be helpful in promoting calmness, tolerance and acceptance of distress, as well as self-understanding in youth. Youth with learning disabilities (LDs) have information processing challenges that place them at increased risk for emotion dysregulation and often rely on coping strategies that emphasize avoidance of challenging emotions, experiences or tasks. We highlight that cognitive interference may help in reducing the quality or efficiency of test-anxious students' with LD performance during exams.
Keywords: executive functions, LD, anxiety management, test anxiety, cognitive behavioral therapy, mindfulness practices, martial arts

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Contextualization and analysis

The executive functions' (EFs) include planning, cognitive flexibility, inhibition, attention control, verbal and visuo-spatial working memory (Wafa, Ghobashy, & Hamza, 2020). According to the World Health Organization, stress is the "health epidemic" of our century. In the last years, mindfulness is one of the most popular topics in psychology, psychiatry, medicine and neuroscience (Matko & Sedlmeier, 2019). Mindfulness practices constitute key factor in personal and professional development. In many schools of general and special education, mindfulness-based programs are valuable tools for bodily, cognitive, emotional and social improvement (Drigas, Karyotaki, 2018 Karyotaki, Drigas 2016). In the current study, we describe the metacognitive mechanisms of mindfulness, taking into account the relevant physical, emotional and mental operations. Particularly, we analyze the immediate role of executive functions in stress management of learning-disabled children.

Executive functions in students with LD

Youth with learning disabilities (LDs) have information processing challenges that place them at increased risk for emotion dysregulation (Milligan, Badali, & Spiroiu, 2013). Scientific evidence indicate that both academic and social difficulties presented by students with LD and ADHD arise from the deficiencies in self-regulation processes (Harris, Reid, & Graham, 2004). Also, students with LD/EBD are at especially high risk for internalizing disorders (Fristad et al., 1992).

Anxiety in children with LD disrupts attentional focus and consumes space in working memory, resulting in inefficient information processing (Eysenck, Derakshan, Santos, & Calvo, 2007). Furthermore, recent evidence suggesting that worry restricts working memory capacity supports the plausibility of worry as a causal agent in reducing test performance (Hayes, Hirsch, & Mathews, 2008).

Students with anxiety problems tend to show lower levels of academic achievement, self-efficacy, and self-concept. Problem based learning is a teaching method proven to increase students' levels

of positive metacognition (Zelazo & Lyons, 2012). In fact, students with learning disabilities reported relying on cognitive avoidance as a coping strategy more heavily than did non-learning-disabled students when coping with an academic stress event, and reported that they mobilized fewer peers for social support when dealing with an academic stressor or with an interpersonal problem. Adolescents and adults usually rely on avoidance strategies, such as cognitive avoidance, when they cannot deal with their stress (Geisthardt & Munsch, 1996).

Treatments of test anxiety in children with LD

Test anxiety constitutes an unpleasant experience of worry and frustration for students with learning disabilities. It is a fact that adolescents with learning disabilities experience higher levels of trait anxiety and have a higher prevalence of somatic complaints, as well as reduced self-esteem. (Sridevi, Sriveni, & Rangaswamy, 2015).

More specifically, eleven students completed a 8-week long treatment, which consisted of progressive muscle relaxation, guided imagery, self-instruction training, as well as training in study and test-taking skills. Results showed that a cognitive-behavioral intervention using relaxation training, guided imagery, self-instructional training, and study skills training reduced test anxiety effectively (Wachelka & Katz, 1999).

Integra mindfulness martial arts (MMA) was developed to address and help participants cope with these challenges and increase self-awareness**.** The mindfulness function of MMA promoted calmness, tolerance and acceptance of distress, as well as self-understanding in youth (Milligan, Badali, & Spiroiu, 2013).

Research has demonstrated significant and meaningful improvements following SRSD in students' development of planning and revising strategies, including brainstorming, self-monitoring, reading for information and semantic webbing, generating and organizing content, advanced planning and dictation, revising with peers, and revising for both substance and mechanics (Harris, Reid, & Graham, 2004).

After examining the emotional well-being of adolescents with learning disabilities in the areas of self-concept, attribution, anxiety, depression, and suicide, it was concluded that there is significant evidence of a neuropsychological interrelationship between emotional maladjustment and LD (Huntington & Bender, 1993).

For example, high levels of anxiety during reading interferes with the phonological loop, causing the need for articulatory rehearsal, which taxes working memory capacity (Eysenck, Derakshan, Santos, & Calvo, 2007). Similarly, the negative association between trait anxiety and math achievement has been found to be mediated by verbal working memory (Nelson & Harwood, 2011).

In addition, emotional and cognitive factors were examined in 18 children with mathematical learning disabilities (MLD), compared with 18 normally achieving children. While the children with MLD showed higher levels of anxiety in mathematics, their anxiety levels in other school subjects were similar to those of normal achievers. In addition, the results showed that children with MLD had higher levels of anxiety, exclusively related to mathematics learning and mathematics assessment. (Passolunghi, 2011; Pappas & all 2019, 2016; Drigas, Kostas 2014).

A sample of 774 elementary and secondary school students—195 students with LD and 579 students without LD—completed the Test Anxiety Inventory for Children and Adolescents (TAICA). LD students presented higher Cognitive Obstruction/Inattention scores suggesting a positive relationship between cognitive interference and test anxiety among students (Whitaker, Lowe, & Lee, 2007).

Another study investigated the relationship between negative affect, worry, working memory, and academic performance using self-report questionnaires, school administered academic test data, and a battery of computerized working memory tasks in typically developing children (12 to 13 years-old). Higher levels of anxiety and depression were associated with lower academic performance (Owens, Stevenson, Hadwin, & Norgate, 2012).

Both anxiety and depression are associated with increased worry about exams that interferes with complex working memory, leading to lowered test performance. The results are consistent with previous research that has found a negative relationship between elevated negative affect in young people and academic performance (Keogh, Bond, & Flaxman, 2006).

Another study compared 191 college students with learning disabilities (LD) and 190 students without LD in four main areas: academic difficulties, learning strategies, functioning during examinations, and students' perception of factors that help or impede their academic success. Students with LD used unusual strategies and preferred additional oral explanations or visual explanations, whereas nondisabled students preferred more written examples. These differences indicated that students without LD used more written techniques than did students with LD. During examinations, the students with LD experienced stress, were nervous, and felt more frustrated, helpless, or uncertain during exams than students without LD.

In a study that examined the subtypes of reading disabilities in Hong-Kong, 60% of the Chinese children with dyslexia were classified as belonging to a surface subtype, but no children were classified as belonging to the phonological subtype usually found in alphabetical languages. The Chinese children with surface dyslexia were found to have greater difficulties in phonological working memory and learning new exceptional words than

younger typically-achieving readers (Büttner & Hasselhorn, 2011). Also, positive affect may even influence cognitive organization such that cognitive material may be more integrated and related than might occur without the influence of positive affect (Yasutake & Bryan, 1995).

Discussion

We assume that appropriate learning strategies and skills can help LD students to better deal with academic tasks and enable them to reduce stress or to benefit from social support. Researchers are encouraged to further investigate the learning strategies used by students with LD, to examine various teaching methods and specific conditions in order to help these students (Heiman & Precel, 2003). E-learning Applications, AI applications and games also play an important role (Drigas et al. 2004, 2017; Vrettaros et al. 2008; Papanastasiou et al. 2017)

Latest trend in anxiety management for LD children is the usage of Clinical Hypnosis and Neuro Language Programming in cooperation with Virtual Reality (Drigas et al. 2021, 2022). In addition, the metacognition, the mindfulness, the metacognitive strategies and the consciousness development are powerful tools for stress management for all children and especially for LD children (Drigas & Karyotaki, 2014, 2018; Drigas & Mitsea, 2020, 2021). More specifically, the Emotional training and development with the usage of ICT help anxiety for students with LD (Drigas & Papoutsi, 2016, 2018; Drigas & Chaidi, 2020; Drigas et al. 2004, 2018, 2021)

Also, the mobile applications are very attractive to be used as a training tool within all levels of education for anxiety management (Drigas, Kokkalia, 2014, 2016; Drigas & Angelidakis 2017; Karabatzaki, et al., 2018; Stathopoulou et al. 2019, Kokkalia, et al. 2017). Artificial intelligence, Robotics and STEM can be used for anxiety management and other interventions (Drigas, Rodi-Ioannidou, 2011, 2013; Drigas, Kefalis, 2019; Drigas et al. 2017, 2019). ICTs in accordance with music have remarkable results in anxiety management (Drigas, Theodorou, 2017).

Consequently, it is important to help students with learning disabilities understand that actively dealing with school related problems is a more productive long-term strategy than denial (Geisthardt & Munsch, 1996).

The most advanced strategies are metacognition, mindfulness and meditation (Drigas et al. 2017, 2019; Pappas et al. 2018; Tourimpampa et al. 2018; Angelopoulou et al. 2021). Chronic stress presents a growing pervasive burden in health care, but mobile applications have the potential to deliver stress management strategies. (Drigas et al. 2020, 2019; Papoutsi et al. 2021; Politi et al. 2020; Gkeka et al. 2020).

Concluding, we should underline the role of all forms of ICTs, like web and mobile applications, AI & STEM tools, serious games, e-learning and tele-education services, etc. in anxiety support and management. (Drigas et al. 2013, 2017, 2017; Papoutsi et al. 2016; Kamakari et al. 2012; Chaidi et al. 2020)

Conclusion

Different kinds of intervention programs for school children are presented. A great number of studies show that mindfulness practices enhance learning disabled children's mental, emotional and social development (Drigas & Mitsea, 2020). Based on the above research:

1. Learning disabled children with comorbid diagnoses present cognitive and neuropsychological deficits (Hall, Halperin, Schwartz, & Newcorn, 1997).
2. Students with LD prefer cognitive avoidance as a coping strategy more heavily than their non-learning-disabled peers when coping with academic stress. (Geisthardt & Munsch, 1996).
3. Significant improvements have been noticed in LD students by implementing SRSD approach (Harris, Reid, & Graham, 2004).
4. Cognitive behavioral therapy combined with MMA (mixed martial arts) training is an effective intervention to manage high levels of anxiety by promoting calmness, tolerance and acceptance of distress, as well as self-understanding in children population (Haydicky et al., 2012; Milligan, Badali, & Spiroiu, 2013).
5. A cognitive-behavioral intervention using relaxation training, guided imagery, self-instructional training, and study skills training reduces levels of test anxiety (Wachelka & Katz, 1999).
6. Especially, a cognitive-behavioral intervention using relaxation training, guided imagery, self-instructional training, and study skills training reduces test anxiety levels (Wachelka & Katz, 1999).

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