

Activities and approaches for promoting executive function in upper primary school



School resources

Executive function supports students to control their thoughts, feelings, and behaviours, so it is vital for the cognitive control students need for learning, as well as for social skills and emotional regulation. Students use executive function skills when they need to concentrate, plan, coordinate, make choices, solve problems or achieve tasks and goals¹. Specifically executive function skills comprise:

- **attention and inhibition:** the ability to focus and concentrate, to ignore distractions, and to control impulses and instead choose appropriate behaviours²
- **working memory:** the ability to hold several pieces of information in mind at the same time, in order to think about them, reason and make decisions³
- **cognitive flexibility:** the ability to think flexibly, to switch gear and adapt to changing circumstances or demands when necessary, and to apply different rules in different settings^{4 5}.

These skills are crucial to most learning activities in school, enabling students to prioritise and sequence different behaviours to attain a goal. Executive function enables students to inhibit dominant or familiar behavioural responses (so that, for example, they raise their hand to speak rather than blurt out an answer), remember and keep in mind information relevant to the attainment of a task (such as a list of information for solving a maths problem), avoid distractions (listening to the teacher rather than looking out of the window), switch between tasks (such as scanning a text for information and then recording it)⁶, and to keep track of what they are doing as they are working. Executive function is also needed for the ability to wait for a turn, cooperate well with others, and deal with difficult emotions such as anxiety, frustration, or anger without hitting out⁷.

Executive function skills are essential for learning to read and perform basic mathematics. For example, when reading, children use selective attention to focus on the meaning of the text, and inhibition to suppress the influence of interfering information, such as the alternative meanings a particular word may have in other contexts. They use working memory to remember previously read text and to anticipate upcoming text. Finally, cognitive flexibility enables children to make the mental shifts required when they encounter different word tenses or shift between known and unknown words⁸.

Research has found executive function skills to be more predictive of academic achievement than IQ⁹, and to be related to higher achievement in areas such as reading, maths and spelling^{10 11 12}. Similarly, difficulties in executive function are found to be predictive of learning difficulties¹³. One study shows that children with high levels of executive function make faster progress and can catch up with peers even if they are initially behind¹⁴, and other research suggests that higher levels of executive function protect students from the risk of academic failure associated with a poorer socioeconomic context¹⁵.

However, it is important to note that, while executive function is correlated with higher achievement, there is no research that demonstrates a causal relation. Other characteristics of students, such as high socioeconomic status or high levels of parental education, while linked to higher executive function skill, could be the reason for higher achievement¹⁶.

How to support the development of executive function skills

Executive function skills depend on the maturation of particular brain regions but also on stimulation received from the child's social interactions at home and at school¹⁷. Research shows that it is possible to improve executive function skills through practice and training, although it is not clear from the research that this improvement translates to an improvement in academic and social skills¹⁸. It is likely, however, that students with strong executive function skills will be able to make better decisions more often, and to function effectively in a range of situations, with positive consequences for learning and wellbeing throughout life¹⁹.

Using games to promote executive function

Games that offer students options and enable them to plan strategies support the development of attention, working memory and cognitive flexibility²⁰. These kinds of games offer opportunities to practise holding complicated rules in mind, planning moves in advance (sometimes over many turns), and then adjusting these depending on the imagined or actual moves of opponents.

- Many card games involve **planning and strategy**, such as *Hearts*, *Spades*, and *Bridge*.
- Other card games challenge students' attention skills and quick decision-making by requiring **careful monitoring and fast responses**. *Spit* is a good example here.
- **Matching games** such as *Rummy* in which students have to match by either suit or number challenge students' cognitive flexibility. More complicated sets of options are involved in games like *Poker* or *Mahjong*.
- There are many **strategy games** available, from traditional favourites such as chess or *Go!*, to a wide range of more modern strategy games, such as *Forbidden Island*. Another possibility is fantasy role play games such as *Minecraft* or *Dungeons and Dragons*, which require children to hold complex information and rules about characters, places, and materials in mind as they develop strategies for pursuing self-set goals.
- **Video games**, carefully selected, offer many opportunities for students to practise monitoring of the (game) environment, responding flexibly and at speed, and inhibiting inappropriate actions.

Using physical activity and sports to build executive function

Physical activities, games and sports encourage children to pay careful attention, monitor their own actions, and plan flexible responses dependent on the varied state of play. They offer lots of potential for practising executive function skills.

- **Organised sports** challenge students to remember complex rules and strategies and hold these in mind as they monitor their own and others' actions, and quickly decide on and execute responses to the ongoing play, which requires cognitive flexibility. Research shows that high levels of physical activity, particularly sports such as soccer or netball, which require enhanced coordination, improve all components of executive function²¹.
- **Skipping rope games** are highly challenging, and require focused practice, attention control and working memory to remember the words of the skipping chant while also doing the correct actions.
- **Physical group games** in which students must constantly monitor the environment and respond with appropriate actions at speed require selective attention, monitoring and inhibition. Examples here include *Tunnel Tag* (sometimes known as *Stuck in the Mud*), in which tagged players stand still with legs wide, waiting for other players to 'free' them by crawling through their legs. This game requires that students inhibit movement when tagged and monitor each other's movements in order to free other players.

Using music to support executive function

Learning to play musical instruments, and participating in music classes or community events, also supports the development of selective attention and monitoring.

- **Following rhythmic patterns**, through clapping or drumming, and particularly improvising, challenges students' attention, inhibition, working memory, and cognitive flexibility.
- **Singing in parts and rounds** requires coordination of working memory, selective attention and monitoring.
- **Dancing** exercises students' executive function skills as they must hold the choreography in mind at the same time as coordinating their movements with the music. This challenges students' working memory, attention and self-monitoring.
- **Learning to play an instrument** requires focused attention on the physical skill required, as well as the development of working memory needed to hold the music in mind. The high levels of physical co-ordination required to play an instrument have been found to support higher levels of executive function.

Using puzzles and problem-solving to develop executive function

Finally, any kind of puzzle is helpful for executive function development as puzzles require students to hold and manipulate information in their working memory.

- **Crossword puzzles** require students to manipulate letters and words and so provide exercises in working memory and cognitive flexibility. Sudoku puzzles provide the same challenges with numbers and equations.
- **Spatial puzzles** like a *Rubik's Cube* also challenge students' cognitive flexibility.
- It is also possible to draw on **computer game puzzles** and training programmes such as [Luminosity](#) to give students opportunities to practise and develop their attention and working memory²².

Endnotes

- 1 Jacob, R., & Parkinson, J. (2015). The potential for school-based interventions that target executive function to improve academic achievement: A review. *Review of Educational Research*, 85 (4), 512-552
- 2 Left Brain Buddha
- 3 Left Brain Buddha
- 4 Centre on the Developing Child at Harvard University (2014). Enhancing and Practicing Executive Function Skills with Children from Infancy to Adolescence. www.developingchild.harvard.edu.
- 5 Left Brain Buddha
- 6 Jacob & Parkinson (2015)
- 7 ENGAGE. (2020). Whānau book.
- 8 Daucourt, M. C., Schatschneider, C., Connor, C. M., Al Otaiba, S., & Hart, S. A. (2018). Inhibition, updating working memory, and shifting predict reading disability symptoms in a hybrid model: Project KIDS. *Frontiers in Psychology*, 9 (238). <https://doi.org/10.3389/fpsyg.2018.00238> [open access]

- 9 Kassai, R., Futo, J., Demetrovics, Z., & Takacs, Z. K. (2019). A meta-analysis of the experimental evidence on the near- and far-transfer effects among children's executive function skills. *Psychological Bulletin*, 145 (2), 165-188. <http://dx.doi.org/10.1037/bul0000180>
- 10 Huizinga, M., Baeyens, D., & Burack, J. A. (2018). Editorial: Executive function and education. *Frontiers in Psychology*, 9 (1357). <https://doi.org/10.3389/fpsyg.2018.01357> [open access]
- 11 Ribner, A. D., Willoughby, M. T., Blair, C. B. & the Family Life Project Key Investigators. (2017). Executive function buffers the association between early math and later academic skills. *Frontiers in Psychology*, 8 (869). <https://doi.org/10.3389/fpsyg.2017.00869>
- 12 Jacob & Parkinson (2015).
- 13 Daucault, et al. (2018)
- 14 Ribner, et al. (2017)
- 15 Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). Executive function: Implications for education. National Center for Education Research. <https://ies.ed.gov/ncer/pubs/20172000/pdf/20172000.pdf>
- 16 Jacob & Parkinson (2015)
- 17 Huizinga et al. (2018)
- 18 Kassai et al. (2019)
- 19 ENGAGE (2020).
- 20 Centre on the Developing Child at Harvard University (2014).
- 21 Centre on the Developing Child at Harvard University (2014).
- 22 All activities taken from ENGAGE (2020) School cards and the Centre on the Developing Child at Harvard University (2014).

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