Working Memory Training and Math Achievement
Evidence From a Large-Scale Intervention in a Real Learning Environment

David Munez, Kiat Hui Khng, Kerry Lee, Rebecca Bull, Fiona Cheam and Ridzuan Abd Rahim

KEY IMPLICATIONS

• Numeracy training programmes may be particularly effective at improving the math skills of children in the Learning Support for Mathematics (LSM) programme.
• Focusing on early learners’ acquisition and development of early numeracy skills to reduce the LSM intake.
• Real-life implementations of working memory (WM) training studies are complex, as training protocols do not fit the context of the real-world.

BACKGROUND

Each year, approximately 5% to 6% of children entering Primary 1 enroll in LSM. Children are enrolled when they perform poorly in a readiness test designed to evaluate fundamental skills in numeracy and basic arithmetic. A common cognitive aspect in these children is that they present very limited WM capacity, as well as poor early numeracy skills. The study is based on findings that show that: first, children with poorer WM or updating capacity also have poorer performances in Math (Lee, Ng, & Ng, 2009; Lee & Peh, 2008); second, such WM capacity can potentially be improved – i.e., near-transfer effects (Ang, Lee, Cheam, Poon, & Koh, 2015); and third, that improvements in WM capacity may be linked to improvements in math performance – i.e., far-transfer effects. Nonetheless, it is unknown whether these empirical findings also emerge when WM training protocols are implemented in real learning environments. Our study is the first large-scale study that has particularly aimed at adapting and testing an auto-administered training programme to support teaching efforts.

FOCUS OF STUDY

Although LSM already provides additional educational support to children during their early years of formal schooling, a sizable proportion of children require even more support to perform at a level that is within range of their normally achieving peers. Thus, in this intervention study, we designed and implemented four different training protocols to investigate how to effectively support these students. The protocols included three experimental conditions (WM training, numeric working memory training, and numeracy training), and an active control group. We looked at whether the training protocols affected children’s growth rate in a variety of academic and cognitive aspects.

KEY FINDINGS

We found that WM training did not translate into sustainable working memory gains. Children assigned to the numeric WM and numeracy
training conditions experienced steeper growth in their number line estimation skills. Furthermore, children in the numeracy training also showed higher growth rates in their math addition skills.

SIGNIFICANCE OF FINDINGS

Our study reveals that real-life implementations of WM training protocols are complex. Findings highlight the role that early numeracy skills have in the curriculum and goals of early learners. Providing early childhood educators with adequate numeracy resources and theoretical rationale of their effectiveness may be a key aspect to fostering the quality of early childhood education and reduce the LSM intake.

Additionally, given that LSM students show poor WM capacity, our findings suggest alternative teaching methods that take into account the limited cognitive resources of these children. For instance, providing short instructions (one idea at a time), and visual resources that offload such limitations of the working memory capacity (e.g., visuals for development of fact fluency, structure of numbers).

PARTICIPANTS

This study involved 427 Primary 1 children from 63 schools who were enrolled in the LSM programme.

RESEARCH DESIGN

The intervention was conceptualized as a tablet game. Four parallel versions of the game were developed according to the training conditions. The administration was fully computerized and automated. Four different data points spanning one year allowed charting the contribution to each training programme to children’s growth trajectories in a variety of aspects that included several early numeracy measures and math skills, as well as different WM measures.

REFERENCES


About the authors

David MUNEZ and Kiat Hui KHNG are with the National Institute of Education, Singapore.

Kerry LEE is with The Education University of Hong Kong, Hong Kong.

Rebecca BULL is with Macquarie University, Australia.

Fiona CHEAM and Ridzuan ABD RAHIM are with the Ministry of Education, Singapore.

Contact David Munez at david.munez@nie.edu.sg for more information about the project.

This brief was based on OER 30/15 KL: Working Memory and Numeracy Intervention for Children in the Learning Support Programme for Mathematics.

How to cite this publication


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