ABSTRACT

Reading and arithmetic skills are considered as the foundation skills necessary for educational and vocational success. Research has outlined the important role of specific cognitive functions for efficient reading, comprehension of text and arithmetic processes. Learning difficulties have been shown to have a tremendous impact on later life, both in academics and social relationships. It therefore becomes imperative that we identify, as early as possible, children ‘at risk’ for learning difficulties and attempt to assess the relevant cognitive skills and plan and execute intervention programs to improve the efficacy of these cognitive skills. This present study has attempted to do this, keeping the Right to Intervention (RTI) model as the rationale and has focussed on designing an assessment tool along with a remediation program based on the cognitive viewpoint.

The two objectives of this research were: development of a screening measure for identification of children with reading and arithmetic difficulties and development of a computer based cognitive intervention program for improving reading and arithmetic skills. The research was conducted in two stages. Stage one involved the compiling of the screening measure which consisted of three domains: cognitive abilities, reading comprehension and arithmetic ability. The assessment measure was administered on 1091, third, fourth and fifth grade children from English medium schools in South Bangalore, following the ICSE syllabus. The data obtained was subjected to item analyses and the final screening tool - Arithmetic and Reading Test (ART) - was developed, which comprised of tests for reading comprehension, arithmetic ability and cognitive functions, i.e., attention and concentration, visual perception, visuo-spatial ability, processing and working memory. Psychometric properties were established and the ART was found to be reliable and valid. Test-retest reliability of the ART was 0.76. The tests in the ART were found to be internally consistent. Concurrent validity of the reading and arithmetic measure of ART was found to be 0.43 and 0.36 with performance in school examinations, i.e., marks in English and Mathematics respectively. Thus the reading and arithmetic measures developed for the purpose of this research are good indicators of reading and arithmetic abilities as indicated through school achievement.
The ART was administered to 338 children in their fourth and fifth grades, in English medium schools following ICSE syllabus, in order to identify children with reading and arithmetic difficulties and to explore the relationships between reading, arithmetic and cognitive skills. It was found that there were significant relationships between the reading comprehension and arithmetic ability components of the ART and all the five cognitive skills. This thus highlighted that the five cognitive skills chosen for this research underlie reading and arithmetic processes. The Draw-a-man test of Intelligence had been administered along with the ART in order to screen out children with below average intelligence. Following this, children meeting the criteria for reading and arithmetic difficulties based on the reading comprehension and number calculations measures were included for the Stage 2 of the study. These were categorized in two groups- Intervention group which consisted of 24 children and control group which consisted of 38 children. The intervention group were administered a computerized cognitive remediation program named ALADIN (Ace Language and Develop Interest in Numbers). This program comprised of activities to improve attention and concentration, visual perception, visuo-spatial ability, processing and working memory.

The ALADIN program was conducted for 15 sessions, over a period of two months with the help of laptops. Outcome measures were the scores on the ART and school marks in English and Mathematics. These measures were considered both before and after the conduct of the remediation program. Statistical analysis was conducted on the data using the Pearson’s correlation method, Independent and Paired t tests and effect sizes were computed. Results indicated that the reading difficulties group which underwent the intervention improved significantly in their reading comprehension, attention and concentration, visual perception and working memory in comparison to the control group. The arithmetic difficulties intervention group performed better than the control group in their arithmetic ability and attention and concentration. Overall the ALADIN program had a positive effect in enhancing the working memory apart from the other cognitive skills. Results also indicated significant transfer effects as improvement was seen in reading and arithmetic skills, which were not targeted in the training program. This study thus provides evidence for the benefits of computer based cognitive training towards improvement of learning outcomes. Thus both ART and ALADIN can be used by teachers and
educators in classroom settings for quick and easy identification of children with difficulties and providing them with remediation. This research lends support to the neuroplasticity theory and has practical implications for the field of Educational Neuroscience.