

Developmental Trends and Associations Between Executive Functions and Literacy in Taiwanese Grade 1–3 Typically Developing and Special Education Children.

Research Overview

This study examined the developmental trends and bidirectional relationships between executive functions (EF) and literacy skills (LIT) among Taiwanese Grade 1–3 typically developing children and children receiving special education services using a nationally representative longitudinal database. The findings reveal different developmental pathways of EF and early literacy between the two groups.

Purpose of Study

EF are closely associated with children's cognitive, academic, and adaptive development, while LIT are fundamental to lifelong learning and educational participation. Increasing research has examined the developmental relationships between EF and LIT, particularly among children receiving special education services. However, most previous studies have focused on specific disability categories, limiting understanding of broader developmental patterns across heterogeneous special education populations.

In Taiwan, nationally representative studies with both cross-sectional and longitudinal perspectives remain limited. From the perspective of educational equity and inclusion, understanding the interactions between EF and LIT across developmental stages is important for designing equitable educational supports and early interventions. Therefore, this study investigated the developmental trends and associations between EF and LIT among Taiwanese Grade 1–3 children (aged 7–9), comparing typically developing children and children receiving special education services using nationwide longitudinal data.

Research Methods

This study conducted a secondary analysis of the nationally representative Kids in Taiwan (KIT) database. Among 1,755 children who completed three waves of teacher questionnaires from Grade 1 to Grade 3, 51 children receiving special education

services were identified as the special education group (SEG). Based on gender, parental education level, teachers' teaching experience, and school region, 51 typically developing children were randomly matched as a comparison group (TDG).

EF, including working memory (WM) and inhibitory control (IC), and LIT were derived from the cognitive and language development sections of the KIT teacher questionnaire. Structural equation modeling was conducted using a Two-factor Latent Growth Model (LGM) and Autoregressive Cross-lagged Panel Models (AR-CLPM) to examine developmental trajectories and bidirectional relationships over time.

Results and Discussion

Results from the Two-factor LGM showed significant mean intercepts for EF and LIT in both the SEG ($z = 2.784, 2.756, p_s < .001$) and TDG ($z = 3.567, 3.452, p_s < .001$). Regarding developmental growth, the EF mean slope in the SEG was non-significant ($z = .083, p > .05$), whereas the LIT mean slope was significant ($z = .212, p < .01$). In contrast, the TDG showed significant growth in both EF and LIT ($z = .381, .449, p_s < .01$), indicating lower initial performance and slower developmental growth in the SEG.

Results from the AR-CLPM indicated significant synchronous correlations between EF and LIT across Grade 1 to Grade 3 in the SEG ($\beta = .666, .483, .626, p_s < .001$), while significant correlations in the TDG were found in Grade 1 and Grade 3 ($\beta = .697, p < .001; \beta = .285, p < .05$).

Longitudinally, the TDG demonstrated developmental pathways in which EF facilitated subsequent LIT development, with significant cross-lagged effects from Grade 1 EF to Grade 2 LIT and from Grade 2 EF to Grade 3 LIT ($\beta = .302, p < .05; \beta = .4, p < .01$). In contrast, the SEG showed an alternative pattern in which LIT more strongly predicted subsequent EF development, with significant effects from Grade 1 LIT to Grade 2 EF and from Grade 2 LIT to Grade 3 EF ($\beta = .357, \beta = .618, p_s < .01$). Cross-lagged effects from EF to later LIT in the SEG were non-significant.

Furthermore, synchronous correlations between WM and LIT were stronger than those between IC and LIT in both groups. In the SEG, WM and LIT showed significant high-to-moderate correlations across Grade 1 to Grade 3 ($\beta = .704, .597, .675, p_s < .001$), whereas IC showed consistently moderate correlations

($\beta=.437, .374, .434, p_s < .001$). Similarly, in the TDG, WM demonstrated significant high-to-moderate correlations with LIT in Grade 1 and Grade 3 ($\beta=.751, .427, p_s < .001$), while IC was significantly correlated with LIT only in Grade 1 ($\beta = .508, p < .001$). These findings highlight the critical role of WM in literacy acquisition during the early primary school years.

From the perspective of educational equity and inclusion, the findings suggest that children receiving special education services may rely more heavily on literacy learning experiences to support broader cognitive development. These findings underscore the importance of strengthening emergent literacy, early literacy intervention, and inclusive educational support systems during early childhood and primary education.

The findings imply the importance of the development of diversified and equitable intervention strategies that promote learning opportunities and developmental outcomes for children with diverse educational needs. This study contributes nationally representative longitudinal evidence to the literature on EF and LIT development and provides implications for sustainable and inclusive educational practices.

Keywords

Executive Functions; Literacy Development; Special Education; Educational Equity; Working Memory