**Paper Title** Online Development of Reading and Math Abilities: Interplay and Impact in Third and Fourth Grades (Poster 40)

**Author(s)** Renata Kiss, University of Szeged; Réka Ökördi, Eötvös Loránd University; Katalin Szili, Hungarian University of Agriculture and Life Sciences; Dora Mokri, University of Szeged; Gyongyver Molnar, University of Szeged

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# Online Development of Reading and Math Abilities: Interplay and Impact in 3rd and 4th Grades


## Abstract

The study highlights the importance of continuously monitoring and developing reading and mathematical abilities in 3rd and 4th-grade students. Research underscores the crucial objective of nurturing proficient skills in both domains while acknowledging varied conclusions regarding their interplay. Therefore, the study aims to examine the effectiveness of reading comprehension (RC) and mathematical development (M) programs, as well as assessing their combined application and exploring transfer effects in the entire sample and among disadvantaged students. Utilizing a quasi-experimental design with online assessments and adaptive interventions, the results reveal the positive impact of a year-long developmental program encompassing both RC and M. These findings offer valuable insights for shaping effective educational practices and promoting comprehensive academic growth, particularly among disadvantaged student populations.


## *1. Objectives or purposes*

Considering the complexities of the contemporary world and the findings from international assessments, it becomes evident that the ongoing monitoring and advancement of reading and mathematical proficiencies are imperative. While these two skills can be assessed and enhanced independently, a multitude of research studies underscore the efficacy of integrating their development and the potential transfer effects between these interconnected domains. (e.g. Hübner et al., 2022).

Therefore the study aims to:

1) examine the effectiveness of the reading comprehension improvement program (RC),
2) investigate the effectiveness of the mathematical development program (M),
3) assess the combined application of both development programs and explore the transfer effects between the two domains in case of the whole sample and in the case of disadvantaged students.

## *2. Theoretical framework*

The pursuit of cultivating proficient reading and mathematical abilities constitutes a pivotal goal within the domain of early years education. Scholars have diligently explored the intricate correlation between math and reading performance, and certain studies have illuminated a positive association between the two domains (Erbeli et al., 2021). Nevertheless, the dynamics of this interplay remain multifaceted, rendering the conclusions in research subject to diversity (Hübner et al., 2022). While some researchers posit a reciprocal relationship between reading and mathematics (e.g., Little et al., 2021), others assert that one skill, whether it pertains to reading or mathematics, exercises a more potent influence on the subsequent growth of the other skill (e.g., Duncan et al., 2007; Erbeli et al., 2021).

Delving into the potential transferability of interventions targeted at one skill to positively impact the other assumes paramount significance for educators. Even in scenarios where direct influence might not be evident, a thorough exploration of such cross-skill transfer can bestow

valuable insights upon teachers, enabling them to effectively support their students' developmental trajectories in the future (Kleemans et al., 2018).
Moreover, it is imperative to acknowledge the far-reaching implications of subpar academic performance, as it can perpetuate low economic status for individuals (Ritchie & Bates, 2013). Consequently, an urgent need arises to direct focused attention towards fostering both reading and mathematical abilities during the early years of schooling, especially among students grappling with academic challenges. Notably, burgeoning research underscores that advancements in reading proficiency among these children also positively contribute to heightened mathematical performance (Erbeli et al., 2021).
In essence, this nuanced interplay between reading and mathematics skills warrants continuous attention and investigation, as it harbors immense potential for shaping efficacious educational practices and nurturing comprehensive academic growth among students.

## *3. Methods*

The study involved third- and fourth-grade students from 14 schools and 35 classes (N=190). The average age of the students is 8.99 years (SD=.85). The number of the disadvantaged students is 69.
The study used quasi-experimental design, propensity score matching technique was used to arrange the students into learning pairs, create the intervention and the control goup. The online assessment tools included pre-, intermediate, and post-tests, with students in intervention group receiving RC and M interventions between the measurements points. The adaptive RC development program consisted of 18 sessions, allowing each student to follow their personalized learning path, starting from foundational tasks and progressing through word, text reading fluency, comprehension, and spelling exercises. Similarly, the adaptive M intervention program comprised 20 distinct sets of tasks focused on multiplication, division, and combined operations topics.

## *4. Data sources*

Data collection took place during the 2022-2023 academic year, where students completed a pretest in September-October, an intermediate test in December, and a posttest in May-June. The data collection occurred in the computer rooms of the schools, using PCs to administer the tasks. The tasks were supported with audio material, ensuring that reading difficulties did not influence the understanding of instructions. The online test was delivered using the eDia online assessment system.

## *5. Results and discussion*

Both the RC and M development programs proved to be reliable at all three measurement points (Cronbach's alpha =.76-.85). For both the RC and M development programs, there were no significant performance differences between the experimental and control groups on the pre- and intermediate tests. However, among the students who completed at least 70% of the year-long development program, they achieved significantly higher performance in both RC (t=3.50, p=.001) and M (t=3.31, p=.001) compared to their peers in the control group. As a result, a continuous, regular, differentiated, year-long developmental program covering both RC and M

areas leads to significant performance improvement. Considering these results, the investigation of the transfer effects between the two domains holds considerable significance.

ANOVA analysis was applied to compare the performance of students in the experimental and control groups in the two developed areas. Thus, four groups (RCexp, RCc, Mexp, Mc) were formed. Our results supported that there is a significant performance difference in favour of the RC development among students who participated in both reading and mathematical development programs during the post-test ($F=8.66$, $p=.00$). Therefore, the combined effect of the two programs positively influences reading outcomes. However, concerning mathematical development, this effect is not evident. The reading development does not significantly enhance mathematical performance, but the effect of mathematical development is observed in reading outcomes among students in the control group ($F=4.27$, $p=.006$).

In the case of disadvantaged students, both reading and mathematics performance in the post-test significantly differs between students who participated in both development programs ($F_{RC}=8.46$, $p=.00$; $F_{M}=3.27$, $p=.03$). Thus, in the case of the entire sample, the combined application of the two development programs leads to a significant improvement in reading outcomes, while for disadvantaged students, the combined application of the two programs results in significant performance growth in both reading and mathematics domains. Therefore, the transfer effect between the two domains is evident in the entire sample for reading and in disadvantaged students for both areas.

*6. Scientific or scholarly significance of the study or work*

The study emphasizes the importance of targeted, systematic development. The transfer effects of RC and M interventions proved to be significant, particularly for disadvantaged students. The uniqueness of our program stems from its alignment with the national curriculum and recommended text- and math books used in our country, making it suitable for both classroom and extracurricular activities. Moreover, its branching structure allows for adaptation to individual students' needs and abilities, providing helpful information, explanations, and highlights to guide them to the right solution. As a result, it supports differentiated learning approaches. Additionally, its user-friendly interface requires no specialist to implement development, ensuring ease of use for educators. Furthermore, the online nature of the program allows for flexibility in timing, as it can be initiated at any point during the school year and day.

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