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Measuring Computational Thinking in Primary Education: A Comparison of BCTt and Bebras Challenge

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Abstract

The assessment of Computational Thinking in primary education requires reliable instruments, yet variations in test formats can significantly impact student performance through cognitive load. Therefore, this correlational study investigates the concurrent validity between the paper-based Beginners Computational Thinking Test (BCTt) and the online Bebras Challenge among 4th and 5th-grade Czech pupils (N=90). It explores the previously demonstrated ceiling effect in the BCTt and the phenomenon of task impurity at a micro-level. Quantitative data from both platforms were analyzed using Spearman's rank correlation coefficient at macro level (overall score) and selected isolated tasks were compared to matching contextual Bebras challenges. At the macro-level, a moderate, statistically significant correlation was found in the 4th grade ($r_s = 0.44$, $p < 0.01$), which notably weakened in the 5th grade ($r_s = 0.37$, $p < 0.05$). The data confirmed a strong ceiling effect in the 5th grade for the BCTt ($M = 22.98/25$, $SD = 1.77$), reducing its diagnostic sensitivity. Furthermore, micro-level analysis highlighted a significant discrepancy in success rates: while pupils easily solved isolated algorithmic concepts in the BCTt, their performance dropped sharply on matching Bebras challenges across both cohorts, indicating the impact of extraneous cognitive load. The findings empirically support the presence of task impurity driven by extraneous cognitive load. While the BCTt effectively measures foundational algorithmic logic, it hits a developmental ceiling for older primary pupils. Conversely, the Bebras Challenge's complex narratives demand high cognitive resilience, testing broader reading literacy and working memory capacity rather than isolated computational thinking skills.

Keywords: Algorithmization; Assessment; Educational Measurement; Pupils; Working Memory