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Effects of Technology-Enhanced Mathematics Learning: A Raw IPD Multilevel Meta-Analysis of Single-Case Experiments

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Oral presentation

Effects of Technology-Enhanced Mathematics Learning: A Raw IPD Multilevel Meta-Analysis of Single-Case Experiments

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Abstract

Although single-case experiments (SCEs) are increasingly used in many domains, they are often excluded from meta-analyses, which means that a wealth of information is not utilized. The main purpose of this study was therefore to meta-analyze raw individual participant data (IPD) of SCEs about the effects of technology-enhanced mathematics learning (TEML). A four-level hierarchical meta-analysis was performed, with measurement occasions nested within time series, which are nested within participants, which in turn are nested within studies. The analysis included 166 studies (143 journal articles, 21 theses, 1 book chapter, and 1 conference paper), containing 15,246 measurement occasions, 899 time series, and 587 participants (63% male). In addition to estimating the overall effect, we studied the moderating effects of publication year, author country, document type, age, gender, grade, SCE type, digital tools (tools for outsourcing mathematics, dynamic mathematical tools, data analysis software, program and language tools, extended reality, mathematics content learning platform and artificial intelligence tools), mathematics standards (numbers and operations, algebra, geometry, measurement, and statistics and probability), and disabilities (EBD, IDD, OHI, SLD, and brain injury). The results revealed not only a significant positive immediate effect of TEML but also a significant interaction effect between time and intervention, indicating that after the intervention started, the positive effect increased over time. During the presentation, the moderator effects at both study and participant levels will also be discussed. The meta-analysis of SCEs offers granular and robust effects of TEML at the individual level, accommodating the hierarchal structure of raw IPD. The purpose of the presentation is also to emphasize the value of (the meta-analysis of) SCEs, and more generally to promote methodological diversity and innovation.

Keywords: Single-case experiments, technology-enhanced learning, mathematics, raw IPD, multilevel meta-analysis.

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