

Associations Between Exposures and Education Outcomes

The forest plot displays the results of 100 studies across three outcome categories: Learning, Literacy, and Numeracy. Each study is represented by a point estimate (diamond) and a 95% confidence interval (horizontal error bar). The x-axis represents the effect size, ranging from -0.30 to 0.30. The y-axis lists the specific interventions. A vertical line at 0.00 indicates no effect. Individual study estimates are color-coded by outcome category.

Outcome	Specific Outcome	Exposure	Age Group	Population	Study Design	Lead Author, Date	r with 95% CI	I ²	K	N	Indiv. Data	Eggers	Excess Signif.
Learning	General	Screen-based intervention: With digital characters	Children	General	Experimental	Schroeder, 2013	0.28 [0.18, 0.37]	0%	5	348	✓	✗	✓
	General	Video games: Educational (with competition)	Children	General	Experimental	Chen, 2020	0.32 [0.10, 0.10]	8	724	✗	—	—	—
	General	Video games: Educational (with competition)	Adolescents	General	Experimental	Chen, 2020	0.21 [0.11, 0.11]	8	740	✗	—	—	—
	General	Video games: Educational (with instructional support)	Adolescents	General	Experimental	Wouters, 2013	0.07 [-0.07, 0.20]	60%	13	471	✓	✓	✓
	General	Video games: Virtual reality (Educational)	Mixed	General	Experimental	Merchant, 2014	0.25 [0.12, 0.12]	90%	13	3,081	✗	—	—
	Literacy and numeracy	Screen-based intervention: Sesame Street	Children	General	Mixed or unspecified	Mares, 2013	0.14 [0.08, 0.08]	15	7,604	✗	—	—	—
	Physical and social environment	Screen-based intervention: Sesame Street	Children	General	Mixed or unspecified	Mares, 2013	0.17 [0.09, 0.09]	13	7,797	✗	—	—	—
	Programming skills	Screen-based intervention: Education (programming)	Children	General	Experimental	Scherer, 2020	0.43 [0.21, 0.65]	86%	6	317	✓	✗	✓
	Programming skills	Screen-based intervention: Education (programming)	Adolescents	General	Experimental	Scherer, 2020	0.32 [0.12, 0.52]	88%	4	767	✓	✗	✓
	School attendance problems	Internet use: Cyberbullying victimization	Adolescents	General	Cross-sectional only	Gardella, 2017	0.20 [0.18, 0.21]	0%	9	25,242	✓	✗	✓
	Second language	Screen use: General (mobile phone for language learning)	Children	General	Experimental	Cho, 2018	0.26 [0.13, 0.38]	80%	7	1,192	✓	✗	✓
	Second language	Screen use: General (mobile phone for language learning)	Adolescents	General	Experimental	Cho, 2018	0.20 [-0.13, 0.53]	84%	3	201	✓	✗	✓
	Second language vocabulary	Screen-based intervention: English as foreign language	Children	General	Experimental	Hao, 2021	0.22 [-0.36, 0.79]	94%	3	147	✓	✗	✓
	Second language vocabulary	Screen-based intervention: English as foreign language	Adolescents	General	Experimental	Hao, 2021	0.42 [0.25, 0.60]	90%	12	569	✓	✗	✓
	Behavior	Video games: Educational (with competition)	Children	General	Mixed or unspecified	Arztmann, 2022	0.43 [0.28, 0.57]	70%	5	439	✓	✗	✓
	Computational thinking	Computer use: Programming exercises	Children	General	Experimental	Li, 2022	0.19 [0.02, 0.36]	78%	4	682	✓	✗	✓
	Computational thinking	Computer use: Programming exercises	Adolescents	General	Experimental	Li, 2022	0.33 [0.21, 0.45]	54%	8	493	✓	✗	✓
	Educational achievement problems	Internet use: Cyberbullying victimization	Adolescents	General	Cross-sectional only	Gardella, 2017	0.15 [0.13, 0.17]	0%	7	7,768	✓	✗	✓
	General	Screen use: General (in schools)	Children	General	Experimental	Chauhan, 2017	0.26 [0.23, 0.23]	86%	122	32,096	✗	—	—
	General	Screen use: General (mobile phone)	Mixed	General	Mixed or unspecified	Kates, 2018	-0.15 [-0.24, -0.05]	100%	8	179,186	✓	✗	✓
General	Screen use: Video (vs face-to-face)	Young children	General	Experimental	Strouse, 2021	-0.26 [-0.32, -0.21]	76%	122	3,436	✓	✗	✓	
General	Screen use: Virtual reality simulations (Educational)	Mixed	General	Experimental	Merchant, 2014	0.20 [0.09, 0.09]	86%	29	2,553	✗	—	—	
General	Screen use: Virtual reality worlds (Educational)	Mixed	General	Experimental	Merchant, 2014	0.18 [0.14, 0.14]	78%	25	2,798	✗	—	—	
General	Screen-based intervention: Sesame Street	Children	General	Mixed or unspecified	Mares, 2013	0.14 [0.10, 0.10]	—	24	10,596	✗	—	—	
General	Screen-based intervention: Augmented reality (in schools)	Children	General	Experimental	Garzón, 2019	0.33 [0.29, 0.29]	94%	19	1,207	✗	—	—	
General	Screen-based intervention: Augmented reality (in schools)	Adolescents	General	Experimental	Garzón, 2019	0.27 [0.22, 0.22]	96%	12	1,053	✗	—	—	
General	Screen-based intervention: Education (via computer)	Children	General	Mixed or unspecified	Liao, 2008	0.22 [0.15, 0.28]	—	48	5,121	✗	—	—	
General	Screen-based intervention: Education (via touch screen)	Children	Autism	Experimental	Aspiranti, 2020	0.35 [NA, NA]	—	3	33	✗	—	—	
Literacy	Decoding	e-Books: General	Children	General	Mixed or unspecified	Zucker, 2009	0.01 [-0.17, 0.20]	0%	2	109	✓	✗	✓
	General	Screen-based intervention: Literacy	Mixed	Poor readers	Experimental	McArthur, 2018	0.16 [-0.01, 0.33]	54%	6	294	✓	✗	✓
	General	Screen-based intervention: Education (general)	Mixed	General	Cross-sectional only	Madigan, 2020	0.14 [-0.04, 0.31]	90%	7	1,228	✓	✗	✓
	General	Screen-based intervention: Education (general)	Mixed	General	Longitudinal only	Madigan, 2020	0.10 [0.00, 0.00]	—	6	727	✗	—	—
	General	Screen-based intervention: Literacy videos	Children	General	Mixed or unspecified	Hurwitz, 2018	0.10 [0.07, 0.07]	0%	45	24,624	✗	—	—
	General	TV programs and movies: Coviewing	Mixed	General	Observational - mixed	Madigan, 2020	0.11 [0.01, 0.01]	—	9	3,376	✗	—	—
	General	TV programs and movies: General	Mixed	General	Cross-sectional only	Adelantado-Renau, 2019	-0.09 [-0.18, 0.00]	96%	8	16,761	✓	✗	✓
	General	TV programs and movies: General	Mixed	General	Observational - mixed	Madigan, 2020	-0.15 [-0.21, -0.21]	—	26	12,337	✗	—	—
	General	TV programs and movies: General (in background)	Mixed	General	Observational - mixed	Madigan, 2020	-0.19 [-0.31, -0.06]	70%	5	2,792	✓	✗	✓
	Listening comprehension	Screen-based intervention: Literacy (Abracadabra; in schools)	Children	General	Experimental	Abrami, 2020	0.11 [-0.01, 0.23]	92%	8	3,715	✓	✗	✓
	Phonics	Screen-based intervention: Literacy (phonics; via computer)	Mixed	Poor readers	Experimental	McArthur, 2012	0.08 [-0.11, 0.27]	14%	4	124	✓	✗	✓
	Phonemic awareness	Screen-based intervention: Literacy (Abracadabra; in schools)	Children	General	Experimental	Abrami, 2020	0.16 [0.11, 0.22]	68%	10	5,124	✓	✗	✓
	Pronunciation	Screen-based intervention: Pronunciation	Mixed	General	Experimental	Hassan-Saleh, 2019	0.22 [NA, NA]	82%	6	302	✗	—	—
	Reading	Screen-based intervention: Reading (in schools)	Mixed	General	Experimental	Cheung, 2012	0.08 [0.06, 0.06]	78%	84	60,553	✗	—	—
	Reading comprehension	Screen-based intervention: Literacy (Abracadabra; in schools)	Children	General	Experimental	Abrami, 2020	0.10 [0.03, 0.17]	82%	9	5,773	✓	✗	✓
Reading comprehension	e-Books: General	Children	General	Mixed or unspecified	Zucker, 2009	0.23 [0.10, 0.35]	44%	7	401	✓	✗	✓	
Reading fluency	Screen-based intervention: Literacy	Children	General	Mixed or unspecified	Blok, 2002	0.13 [0.07, 0.19]	58%	50	3,083	✓	✗	✓	
Reading fluency	Screen-based intervention: Literacy (Abracadabra; in schools)	Children	General	Experimental	Abrami, 2020	0.06 [-0.06, 0.17]	74%	5	1,745	✓	✗	✓	
Reading performance	Screen use: Reading (vs paper)	Mixed	General	Experimental	Clinton, 2019	-0.11 [-0.26, 0.03]	76%	9	760	✓	✗	✓	
Vocabulary knowledge	Screen-based intervention: Literacy (Abracadabra; in schools)	Children	General	Experimental	Abrami, 2020	0.04 [-0.07, 0.15]	94%	8	5,181	✓	✗	✓	
Vocabulary learning	e-Books: General	Young children	General	Experimental	Furenas, 2021	0.14 [0.07, 0.20]	0%	18	871	✓	✓	✓	
Writing	Screen-based intervention: Writing feedback	Children	General	Experimental	Graham, 2015	0.19 [0.08, 0.08]	0%	4	463	✗	—	—	
Numeracy	General	Screen-based intervention: Mathematics	Children	Dyscalculia	Experimental	Kucukalkan, 2019	0.29 [0.24, 0.24]	86%	31	2,290	✗	—	—
	General	Screen-based intervention: Cognitive training	Mixed	General	Experimental	Oldrati, 2020	0.15 [0.02, 0.29]	70%	11	693	✓	✓	✓
	General	Screen-based intervention: Dynamic geometry software	Mixed	General	Experimental	Chan, 2014	0.43 [0.29, 0.57]	92%	9	1,174	✓	✗	✓
	General	Screen-based intervention: Mathematics (in schools)	Mixed	General	Experimental	Cheung, 2013	0.07 [0.05, 0.09]	82%	73	56,891	✓	✗	✓
	General	Screen-based intervention: Mathematics (via computer in classrooms)	Children	Math difficulties	Experimental	Kroesbergen, 2003	0.28 [0.13, 0.43]	74%	11	848	✓	✓	✓
	General	TV programs and movies: General	Mixed	General	Cross-sectional only	Adelantado-Renau, 2019	-0.12 [-0.18, -0.07]	78%	7	14,115	✓	✗	✓
	Mathematics	Screen-based intervention: Mathematics	Children	Math difficulties	Experimental	Benavides-Varela, 2020	0.26 [0.10, 0.41]	84%	13	982	✓	✓	✓
Science	General	Screen-based intervention: Science (in schools)	Children	General	Mixed or unspecified	Slavin, 2014	0.21 [0.15, 0.26]	—	6	2,384	✗	—	—

Note:
Indiv. Data: Individual study data available for reanalysis.
Egger's: $P > 0.05$ for Egger's test of asymmetry, or too few studies to analyse ($K < 10$)
Excess Signif.: $P > 0.05$ for test for excess significance.