A What Works Clearinghouse Rapid Evidence Review of Distance Learning Programs

Sahni, S. D., Polanin, J. R., Zhang, Q., Michaelson, L. E., Caverly, S., Polese, M. L., & Yang, J

January 2021
(Revised February 2021[1])

Due to the COVID-19 global pandemic, educators and school administrators need to understand the available distance learning models and programs that may assist students who attend school from a remote location. To meet this need, this rapid evidence review sought to identify and report on what works in distance learning educational programming. After an extensive search and screening process, the What Works Clearinghouse (WWC) reviewed 36 studies spanning kindergarten through postsecondary education. Fifteen studies met the WWC Group Design Standards; of those, three met the Every Student Succeeds Act Tier 1 requirements. An analysis of where research has been conducted revealed that several distance learning programs for K–8 students Met WWC Group Design Standards, but only one study of a distance learning program for high school students Met WWC Group Design Standards. In addition, a meta-analysis of studies with similar design characteristics (nine in total) found that, on average, students in the distance learning programs improved in the English language arts outcome domain but not in the mathematics domain. Although the results are promising, continued research using rigorous, randomized designs should be a priority.

TECHNICAL APPENDIX

This appendix includes detailed information about the data used for this report, as well as the methods used to complete the analyses.

Search

The WWC used two main search functions to facilitate the rapid evidence review process. The first was a broad call to education researchers, practitioners, program developers, and other stakeholders to submit studies that evaluated distance learning programs.[2] The second was a traditional online database search of the Education Resources Information Center (ERIC) using the following descriptors: distance education, online courses, electronic learning, virtual classrooms, online instruction, control group, comparison group, treatment group, or

---

[1] This is a revised version of the original report released in January 2021. For the Math Snacks program, the effect size, statistical significance, and Every Student Succeeds Act Tier rating has been revised. For the Education Program for Gifted Youth, the WWC rating was revised, and as a result, one additional effect size was added. The changes to these two programs resulted in small changes to the meta-analytic findings and moderator results. Additionally, the following program profiles have been modified to reflect small inconsistencies: Intelligent Tutoring for the Structure Strategy, MindPlay Virtual Reading Coach, and Reading Plus. The evidence gap map titles were updated to include the number of findings, rather than studies, presented in the maps. Finally, small copyedits and grammatical revisions were made throughout. None of the revisions resulted in substantive changes to the conclusions.

[2] National Center for Education Evaluation and Regional Assistance. (2020, March 26). *Seeking your help in learning more about what works in distance education: A rapid evidence synthesis* [Web log post]. https://ies.ed.gov/blogs/ncee/post/seeking-your-help-in-learning-more-about-what-works-in-distance-education-a-rapid-evidence-synthesis

experimental. Duplicate citations resulting from the two search processes were removed. As a result, 932 citations were located. The full list of citations is available on the Studies of Distance Learning webpage.

Inclusion and exclusion criteria used at the abstract and full-text screening stages

The study used the Review of Individual Studies Protocol, version 4.0 (RISP v4.0) to guide eligibility decisions regarding the sample, location, outcome measure, and outcome domain. To facilitate the rapid evidence review process and because the goal of this effort was to provide practitioners with the most rigorous evidence on effective programs as quickly as possible, several additional criteria were specified at the outset of the systematic review process. The WWC applied these criteria when screening the full-text PDF of each study (the screening process is described below) and retained randomized controlled trials (RCTs) of fully remote programs with at least one positive and statistically significant finding for full review. At the time the project was conceived, schools across the country had closed their doors completely, and no in-person learning opportunities were being offered.

Online intervention type. To be eligible, a study must have evaluated educational programming that was fully online or could be offered completely at a distance. Hybrid and blended distance learning programs that combined in-person instruction with online instruction were excluded.[3]

Study design. The study must have used an RCT design.

Significant finding. Upon initial full-text screening, the study must have shown at least one statistically significant finding in an outcome domain included in the RISP v4.0.[4]

Date of publication. The study must have been published during or after 2010.
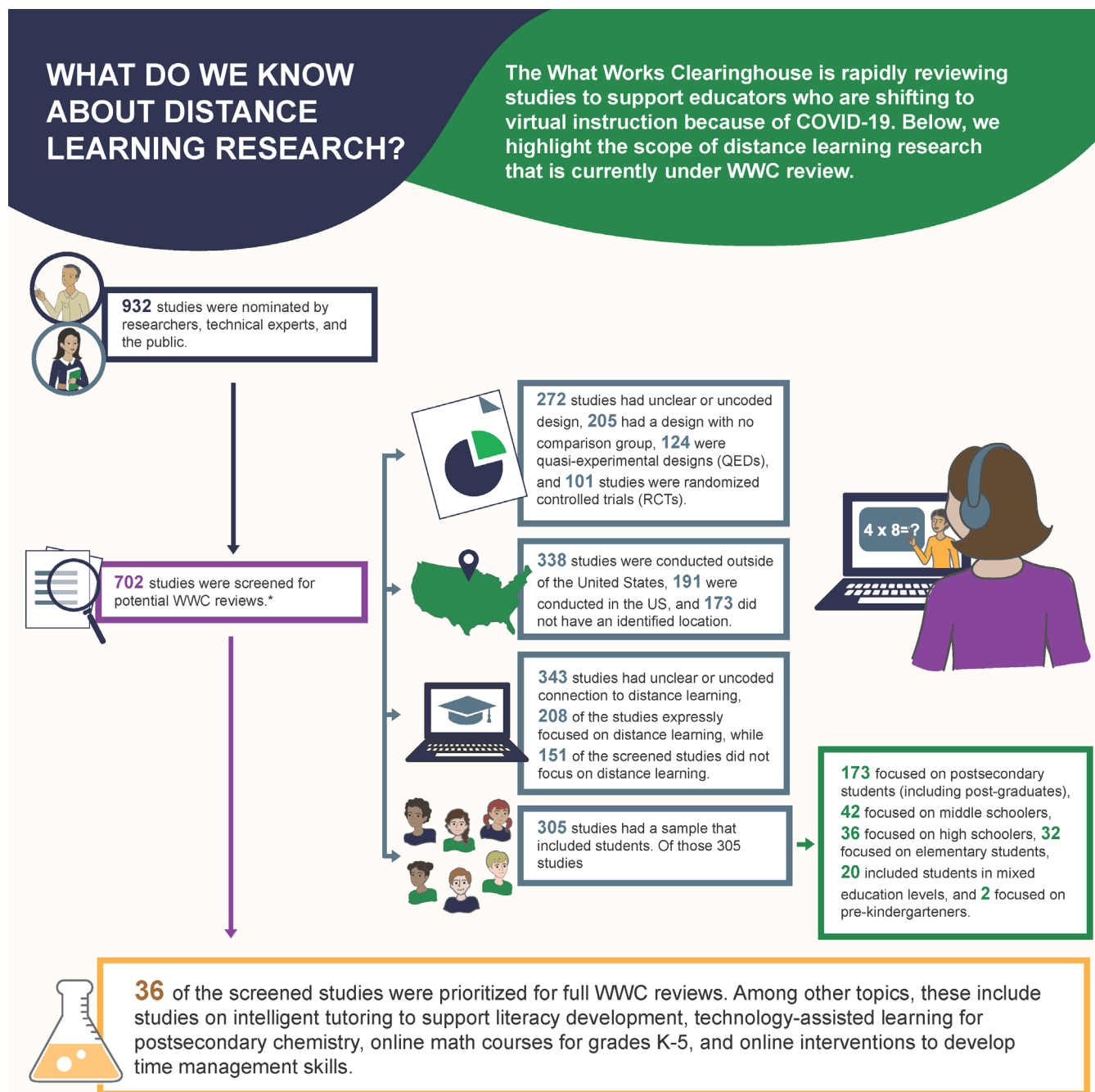
Study screening

The WWC conducted three rounds of eligibility screening to reduce the search results to the eligible and included studies. The first round consisted of screening the citation abstracts for the following criteria: a sample of students in grades K–16, a location in the United States, publication in 2010 or after, a measure of a student outcome, and availability in the ERIC database. Of the 932 citations found in the initial search, 266 were retained for the full-text screening. For full-text screening, the WWC sought studies of a distance learning intervention that had at least one statistically significant finding in addition to meeting the abstract screening criteria used in the previous round. After this screening round, 35 citations were identified for a full review. WWC contractors could not identify full text for one of the citations and substituted two recently released publications from the same study team for the citation, resulting in 36 citations for inclusion in the review. During the review process, the WWC determined that there were two instances of multiple publications describing the same study; in these instances, citations were combined for a single review. Two additional publications described multiple treatment conditions, so separate reviews were conducted for each treatment–comparison contrast within those publications. This process resulted in a total of 36 studies eligible for WWC review. The full list of citations and final WWC dispositions is provided in table A–3. Five of the studies had been previously reviewed by the WWC. As a result, the WWC reviewed 31 additional studies for this review, though 12 were determined to be ineligible. More information on the search and screen process, as well as the number of studies screened out due to various criteria, is provided in figure A–1.

---

[3] After eligible studies received a full review and the WWC coded the distance learning program components for each study, it was determined that several of the programs included in this review did include in-person instruction in addition to remote instruction. The delivery method for these programs was therefore coded as hybrid rather than fully remote.

[4] After WWC reviews were completed, it was determined that some studies did not have at least one finding that met the WWC Design Standards.

Figure A–1. Search and screen process

WHAT DO WE KNOW ABOUT DISTANCE LEARNING RESEARCH?

The What Works Clearinghouse is rapidly reviewing studies to support educators who are shifting to virtual instruction because of COVID-19. Below, we highlight the scope of distance learning research that is currently under WWC review.

932 studies were nominated by researchers, technical experts, and the public.

702 studies were screened for potential WWC reviews.*

272 studies had unclear or uncoded design, **205** had a design with no comparison group, **124** were quasi-experimental designs (QEDs), and **101** studies were randomized controlled trials (RCTs).

338 studies were conducted outside of the United States, **191** were conducted in the US, and **173** did not have an identified location.

4 x 8=?

343 studies had unclear or uncoded connection to distance learning, **208** of the studies expressly focused on distance learning, while **151** of the screened studies did not focus on distance learning.

305 studies had a sample that included students. Of those 305 studies

173 focused on postsecondary students (including post-graduates), **42** focused on middle schoolers, **36** focused on high schoolers, **32** focused on elementary students, **20** included students in mixed education levels, and **2** focused on pre-kindergarteners.

36 of the screened studies were prioritized for full WWC reviews. Among other topics, these include studies on intelligent tutoring to support literacy development, technology-assisted learning for postsecondary chemistry, online math courses for grades K-5, and online interventions to develop time management skills.

*The studies that were not screened are studies that aren't listed in ERIC.

Data extraction

The WWC conducted reviews of the 24 eligible studies. Five of the 24 had been previously reviewed, so 19 additional reviews were conducted. Fifteen studies *Met WWC Group Design Standards* version 2.1 or later (table A–1). When information required for the study review was not provided in the publicly available documents, the WWC sent an author query. In addition to data extracted from studies for official WWC reviews, the project team extracted a set of each program's components. Each component, a description of how it was operationalized, and levels for each component are shown in table A–2. The program components were extracted from the studies after they had undergone official WWC review. Two independent, WWC-certified reviewers extracted each piece of information. The reviewers discussed and resolved discrepancies, and any remaining discrepancies were resolved by a third WWC-certified reviewer. The WWC did not send author queries for missing program component information.

Table A–1. Additional characteristics of studies that Met WWC Group Design standards

Characteristics	Number of studies	Percentage of total
Education level		
K–8	11	73%
High school	1	7%
Postsecondary	3	20%
Intervention cost		
Free	4	27%
Some cost	8	53%
No cost information	3	20%
Outcome domain[a]		
English language arts	8	50%
Mathematics	4	25%
General achievement	3	19%
Progress in school	1	6%
Comparison condition		
Business as usual	9	60%
Alternative intervention	6	40%

a. One study reported measures in two outcome domains, so the number of studies listed in the outcome domain category totals 16.

Table A–2. Distance learning program components

Program characteristic	Levels	Definition
Duration (weeks)	#	Average number of weeks students engaged with the program.
Dosage (hours per week)	#	Average number of hours students engaged with the program per week.
Program type	• Full curriculum • Supplemental program	Full curricula cover an entire course or a semester's worth of content. Supplemental programs are used in conjunction with a full curriculum.
Content coverage	• Broad • Narrow	Programming with narrow content coverage is limited to a few substantive topics or focuses on a specific skill or strategy. Programming with broad content coverage includes a range of topics or skills. These could include an entire subject, such as mathematics or science, for an entire academic year or programs that cover multiple subjects. Programs that cover content or target outcomes in multiple WWC outcome domains are considered broad.

Program characteristic	Levels	Definition
Teacher–student interaction	• Teacher-led synchronous • Teacher-led asynchronous • No teacher-directed instruction	Programs with teacher-led synchronous instruction include an educator who is physically distanced from students but is engaging in real-time, live instruction. Teacher-led asynchronous instruction may occur via recorded interactions or through an interactive program that does not require the instructor and students to be engaged at the same time. Other programs may be fully automated and follow a preprogrammed set of activities or modules and do not require interaction from any live instructor.
Delivery method[5]	• Fully online • Blended/hybrid	Fully online programs are entirely computer based. Students using computer-based programs inside a school are considered fully online. Blended or hybrid programs combine in-person learning activities with computer-based programming.
Personalization or differentiation	• Adaptive • Nonadaptive	Adaptive programs are personalized and specific to the performance of the participant. Adaptive programming can be fully automated by a program or implemented by a teacher.
Gamification	• Gamified • Not gamified	Gamified programs are interactive and adaptive and include goals. They often include a story arc.
Level of cost	• Free • Some cost • No cost information	Coders consulted the source publication and WWC intervention reports and conducted Internet searches for the distance learning programs to determine associated costs. When cost information could be obtained, studies were categorized as either free (no cost entirely) or having "some" associated costs. When the study or associated publications did not publish any cost details, the studies were labelled as "no cost information."

Studies reviewed by the WWC

The WWC reviewed a total of 36 studies. After screening using the RISP v4.0, 12 studies were deemed ineligible for review. After a full review, nine studies received a rating of *Does Not Meet WWC Group Design Standards*. The "Description" column in table A–3 provides the rationale the WWC used to determine each study's eligibility or disposition. The column also describes the design of studies that *Met WWC Group Design Standards With or Without Reservations*. To review more information about the studies listed below, please consult the WWC's Review of Individual Studies database.[6]

Table A–3. Studies recommended for WWC review

Study citation	WWC disposition	Description
Baker, R., Evans, B., Li, Q., & Cung, B. (2019). Does inducing students to schedule lecture watching in online classes improve their academic performance? An experimental analysis of a time management intervention. *Research in Higher Education*, *60*(4), 521–552. https://eric.ed.gov/?id=EJ1216401; https://ies.ed.gov/ncee/wwc/Study/89702	Meets WWC Standards Without Reservations	RCT with low attrition
Bernacki, M. L., Vosicka, L. K, & Utz, J. C. (2020). Can a brief, digital skill training intervention help undergraduates "learn to learn" and improve their STEM achievement? *Journal of Educational Psychology, 112*(4), 765–781.[7] https://eric.ed.gov/?id=EJ1249831; https://ies.ed.gov/ncee/wwc/Study/89701	Does Not Meet WWC Standards	Equivalence of clusters in the analytic intervention and comparison groups is necessary, but the requirement was not satisfied.

[5] Screening criteria prioritized programs that were fully online or could be implemented completely at a distance. However, during program coding, some programs were determined to include in-person activities that were central to the distance learning program. Those programs were coded as blended or hybrid models.

[6] The WWC's Reviews of Individual Studies database can be found here: https://ies.ed.gov/ncee/wwc/Reviewedstudies.

[7] These two citations were substituted for an American Educational Research Association (AERA) online paper for which the WWC contractors could not retrieve the full text. The original citation is as follows: Bernacki, M. L., Vosicka, L., & Utz, J. (2017). *Web-delivered training to improve learning and achievement for underrepresented and first-generation STEM learners*. AERA Online Paper Repository.

Study citation	WWC disposition	Description
Bernacki, M. L., Vosicka, L., Utz, J. C., & Warren, C. B. (2020). Effects of digital learning skill training on the academic performance of undergraduates in science and mathematics. *Journal of Educational Psychology.*[7] https://ies.ed.gov/ncee/wwc/Study/89699	Does Not Meet WWC Standards	RCT with high attrition; analytic intervention and comparison groups do not satisfy the baseline equivalence requirement
Bruchok, C., Mar, C., & Craig, S. D. (2017). Is free recall active: The testing effect through the ICAP lens. *Journal of Interactive Learning Research*, *28*(2), 127–148. https://eric.ed.gov/?id=EJ1136375	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Chen, C. C., Huang, C., Gribbins, M., & Swan, K. (2018). Gamify online courses with tools built into your learning management system (LMS) to enhance self-determined and active learning. *Online Learning*, *22*(3), 41–54. https://eric.ed.gov/?id=EJ1191480	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Chingos, M. M., Griffiths, R. J., & Mulhern, C. (2017). Can low-cost online summer math programs improve student preparation for college-level math? Evidence from randomized experiments at three universities. *Journal of Research on Educational Effectiveness*, *10*(4), 794–816. https://eric.ed.gov/?id=EJ1159782	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
DeBoer, J., Haney, C., Atiq, S. Z., Smith, C., & Cox, D. (2019). Hands-on engagement online: Using a randomized control trial to estimate the impact of an at-home lab kit on student attitudes and achievement in a MOOC. *European Journal of Engineering Education*, *44*(1–2), 234–252. https://eric.ed.gov/?id=EJ1203328	Ineligible for review	Does not occur within a geographic area specified by the review protocol
Dennis, A. R., Abaci, S., Morrone, A. S., Plaskoff, J., & McNamara, K. O. (2016). Effects of e-textbook instructor annotations on learner performance. *Journal of Computing in Higher Education*, *28*(2), 221–235. https://eric.ed.gov/?id=EJ1106615	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Heppen, J. B., Walters, K., Clements, M., Faria, A. M., Tobey, C., Sorensen, N., & Culp, K. (2011). *Access to algebra I: The effects of online mathematics for grade 8 students* [NCEE 2012-4021]. National Center for Education Evaluation and Regional Assistance. https://eric.ed.gov/?id=ED527394; https://ies.ed.gov/ncee/wwc/Study/70514	Meets WWC Standards Without Reservations	RCT with low attrition
Huang, X., & Mayer, R. E. (2019). Adding self-efficacy features to an online statistics lesson. *Journal of Educational Computing Research*, *57*(4), 1003–1037. https://eric.ed.gov/?id=EJ1217663	Ineligible for review	Does not occur within a geographic area specified by the review protocol
Kennedy, M. J., Deshler, D. D., & Lloyd, J. W. (2015). Effects of multimedia vocabulary instruction on adolescents with learning disabilities. *Journal of Learning Disabilities*, *48*(1), 22–38. https://eric.ed.gov/?id=EJ1047703; https://ies.ed.gov/ncee/wwc/Study/89733	Meets WWC Standards Without Reservations	RCT with low attrition
Kim, H., Ke, F., & Paek, I. (2017). Game-based learning in an OpenSim-supported virtual environment on perceived motivational quality of learning. *Technology, Pedagogy and Education*, *26*(5), 617–631. https://eric.ed.gov/?id=EJ1158816	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Kim, Y. (2013). Digital peers to help children's text comprehension and perceptions. *Journal of Educational Technology & Society*, *16*(4), 59–70. https://eric.ed.gov/?id=EJ1013602; https://ies.ed.gov/ncee/wwc/Study/89743	Does Not Meet WWC Standards	Does not establish the reliability of the eligible outcomes
Kloos, H., Sliemers, S., Cartwright, M. D., Mano, Q., & Stage, S. (2019). MindPlay Virtual Reading Coach: Does it affect reading fluency in elementary school? *Frontiers in Education*, *4*(67). https://eric.ed.gov/?id=ED596283; https://ies.ed.gov/ncee/wwc/Study/89593	Meets WWC Standards With Reservations	Cluster RCT with high individual-level nonresponse but provides evidence of effects on individuals by satisfying baseline equivalence

Study citation	WWC disposition	Description
Lou, A. J., & Jaeggi, S. M. (2020). Reducing the prior-knowledge achievement gap by using technology-assisted guided learning in an undergraduate chemistry course. *Journal of Research in Science Teaching*, *57*(3), 368–392. https://eric.ed.gov/?id=EJ1242801	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Lynch, K., & Kim, J. S. (2017). Effects of a summer mathematics intervention for low-income children: A randomized experiment. *Educational Evaluation and Policy Analysis*, *39*(1), 31–53.[8] https://eric.ed.gov/?id=EJ1129002; https://ies.ed.gov/ncee/wwc/Study/89763	Does Not Meet WWC Standards	RCT with high attrition; analytic intervention and comparison groups do not satisfy baseline equivalence
MacKenzie, L. M. (2019). Improving learning outcomes: Unlimited vs. limited attempts and time for supplemental interactive online learning activities. *Journal of Curriculum and Teaching*, *8*(4), 36–45. https://eric.ed.gov/?id=EJ1237507	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
McGuire, P., Tu, S., Logue, M. E., Mason, C. A., & Ostrow, K. (2017). Counterintuitive effects of online feedback in middle school math: Results from a randomized controlled trial in ASSISTments. *Educational Media International*, *54*(3), 231–244.[9] https://eric.ed.gov/?id=EJ1159690; https://ies.ed.gov/ncee/wwc/Study/89697	Does Not Meet WWC Standards	RCT with high attrition; analytic intervention and comparison groups do not satisfy the baseline equivalence
Meyer, B. J., Wijekumar, K. K., & Lin, Y. C. (2011). Individualizing a web-based structure strategy intervention for fifth graders' comprehension of nonfiction. *Journal of Educational Psychology*, *103*(1), 140–168. https://eric.ed.gov/?id=EJ914858; https://ies.ed.gov/ncee/wwc/Study/86233	Meets WWC Standards Without Reservations	RCT with low attrition
Meyer, B. J., Wijekumar, K., Middlemiss, W., Higley, K., Lei, P. W., Meier, C., & Spielvogel, J. (2010). Web-based tutoring of the structure strategy with or without elaborated feedback or choice for fifth-and seventh-grade readers. *Reading Research Quarterly*, *45*(1), 62–92. https://eric.ed.gov/?id=EJ871741; https://ies.ed.gov/ncee/wwc/Study/89695	Meets WWC Standards Without Reservations	RCT with low attrition
Moradi, M., Liu, L., Luchies, C., Patterson, M. M., & Darban, B. (2018). Enhancing teaching-learning effectiveness by creating online interactive instructional modules for fundamental concepts of physics and mathematics. *Education Sciences*, *8*(3), 109. https://eric.ed.gov/?id=EJ1200769	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Nye, B. D., Pavlik, P. I., Windsor, A., Olney, A. M., Hajeer, M., & Hu, X. (2018). SKOPE-IT (Shareable Knowledge Objects as Portable Intelligent Tutors): Overlaying natural language tutoring on an adaptive learning system for mathematics. *International Journal of STEM Education*, *5*, 12. https://eric.ed.gov/?id=EJ1181934	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol
Perry, S. M. (2014). A delayed treatment control group design study of an after-school online tutoring program in reading. In F. J. Garcia-Peñalvo & A. M. Seoane Pardo (Eds.), *Online tutor 2.0: Methodologies and case studies for successful learning* (pp. 264–279). IGI Global. https://eric.ed.gov/?id=ED600863; https://ies.ed.gov/ncee/wwc/Study/82209	Meets WWC Standards Without Reservations	RCT with low attrition
Roschelle, J., Feng, M., Murphy, R. F., & Mason, C. A. (2016). Online mathematics homework increases student achievement. *AERA Open*, *2*(4), 1–12. https://eric.ed.gov/?id=EJ1194398; https://ies.ed.gov/ncee/wwc/Study/86375	Meets WWC Standards Without Reservations	RCT with low attrition

[8] This study included multiple treatment conditions. Separate WWC reviews were conducted for each treatment and comparison contrast, resulting in two reviews. This citation is treated as two studies in the evidence gap map.

[9] This study included multiple treatment conditions. Separate WWC reviews were conducted for each treatment and comparison contrast, resulting in two reviews. This citation is treated as two studies in the evidence gap map.

Study citation	WWC disposition	Description
Selhorst, A. L., Bao, M., Williams, L., & Klein, E. (2017). The effect of online discussion board frequency on student performance in adult learners. *Online Journal of Distance Learning Administration*, *20*(4). https://eric.ed.gov/?id=EJ1165472; https://ies.ed.gov/ncee/wwc/Study/89660	Meets WWC Standards Without Reservations	RCT with low cluster-level attrition and individual-level nonresponse
Spichtig, A. N., Gehsmann, K. M., Pascoe, J. P., & Ferrara, J. D. (2019). The impact of adaptive, web-based, scaffolded silent reading instruction on the reading achievement of students in grades 4 and 5. *The Elementary School Journal*, *119*(3), 443–467. https://eric.ed.gov/?id=EJ1208260; https://ies.ed.gov/ncee/wwc/Study/89730	Meets WWC Standards With Reservations	Compromised RCT
Stanley, D., & Zhang, Y. (2018). Student-produced videos can enhance engagement and learning in the online environment. *Online Learning*, *22*(2), 5–26. https://eric.ed.gov/?id=EJ1181370; https://ies.ed.gov/ncee/wwc/Study/89592	Meets WWC Standards Without Reservations	RCT with low attrition
Suppes, P., Holland, P. W., Hu, Y., & Vu, M. T. (2013). Effectiveness of an individualized computer-driven online math K–5 course in eight California Title I elementary schools. *Educational Assessment*, *18*(3), 162–181. https://eric.ed.gov/?id=EJ1023953; https://ies.ed.gov/ncee/wwc/Study/89696	Meets WWC Standards Without Reservations	RCT with low attrition
Terrazas-Arellanes, F. E., Gallard M., A. J., Strycker, L. A., & Walden, E. D. (2018). Impact of interactive online units on learning science among students with learning disabilities and English learners. *International Journal of Science Education*, *40*(5), 498–518.[10] https://eric.ed.gov/?id=EJ1173826; https://ies.ed.gov/ncee/wwc/Study/89720	Does Not Meet WWC Standards	Includes only outcomes for which the measures were collected differently for subjects in the intervention and comparison groups
Terrazas-Arellanes, F., Strycker, L., Walden, E., & Gallard, A. (2017). Teaching with technology: Applications of collaborative online learning units to improve 21st century skills for all. *Journal of Computers in Mathematics and Science Teaching*, *36*(4), 375–386.[10] https://eric.ed.gov/?id=EJ1164500; https://ies.ed.gov/ncee/wwc/Study/89720	Does Not Meet WWC Standards	Includes only outcomes for which the measures were collected differently for subjects in the intervention and comparison groups
Vreeburg Izzo, M., Yurick, A., Nagaraja, H. N., & Novak, J. A. (2010). Effects of a 21st-century curriculum on students' information technology and transition skills. *Career Development for Exceptional Individuals*, *33*(2), 95–105. https://eric.ed.gov/?id=EJ889963; https://ies.ed.gov/ncee/wwc/Study/89721	Does Not Meet WWC Standards	Equivalence of the clusters in the analytic intervention and comparison groups was not satisfied
Wiburg, K., Chamberlin, B., Valdez, A., Trujillo, K., & Stanford, T. (2016). Impact of Math Snacks games on students' conceptual understanding. *Journal of Computers in Mathematics and Science Teaching*, *35*(2), 173–193. https://eric.ed.gov/?id=EJ1095367; https://ies.ed.gov/ncee/wwc/Study/89722	Meets WWC Standards Without Reservations	RCT with low cluster-level attrition and individual-level nonresponse
Wijekumar, K. K., Meyer, B. J., & Lei, P. (2012). Large-scale randomized controlled trial with 4th graders using intelligent tutoring of the structure strategy to improve nonfiction reading comprehension. *Educational Technology Research and Development*, *60*(6), 987–1013.[11] https://eric.ed.gov/?id=EJ986753; https://ies.ed.gov/ncee/wwc/study/77453	Meets WWC Standards Without Reservations	RCT with low cluster-level attrition and individual-level nonresponse

---

[10] The WWC determined that Terrazas-Arellanes et al. (2017) and Terrazas-Arellanes et al. (2018) described the same study. These two publications were therefore included in a single review and are counted as a single study in the evidence gap map.

[11] The WWC determined that Wijekumar et al. (2012) and Wijekumar et al. (2014) described the same study. These two publications were therefore included in a single review and are counted as a single study in the descriptive characteristics, evidence gap map, and meta-analysis.

Study citation	WWC disposition	Description
Wijekumar, K. K., Meyer, B. J., & Lei, P. (2017). Web-based text structure strategy instruction improves seventh graders' content area reading comprehension. *Journal of Educational Psychology*, *109*(6), 741-760. https://eric.ed.gov/?id=EJ1149967; https://ies.ed.gov/ncee/wwc/Study/86126	Meets WWC Standards With Reservations	Compromised RCT
Wijekumar, K., Meyer, B. J., Lei, P. W., Lin, Y. C., Johnson, L. A., Spielvogel, J. A., Shurmatz, K. M., Ray, M., & Cook, M. (2014). Multisite randomized controlled trial examining intelligent tutoring of structure strategy for fifth-grade readers. *Journal of Research on Educational Effectiveness*, *7*(4), 331–357.[12] https://eric.ed.gov/?id=EJ1041354; https://ies.ed.gov/ncee/wwc/Study/86255	Meets WWC Standards Without Reservations	RCT with low cluster-level attrition and individual-level nonresponse
Zeglen, E., & Rosendale, J. (2018). Increasing online information retention: Analyzing the effects of visual hints and feedback in educational games. *Journal of Open, Flexible, and Distance Learning*, *22*(1), 22–33. https://eric.ed.gov/?id=EJ1189435	Ineligible for review	Does not address at least one outcome in a domain specified by the review protocol

Assigning Every Student Succeeds Act (ESSA) tier tags

The ESSA tier tags listed within each program profile follow guidance and requirements outlined within several WWC resources and on the WWC's Reviews of Individual Studies webpage. The ESSA criteria state that a study or study finding may receive one of four evidence ratings: "strong" (Tier 1), "moderate" (Tier 2), "promising" (Tier 3), or "demonstrates a rationale" (Tier 4). Currently, the WWC provides study ratings for Tiers 1 and 2.

The criteria for ESSA Tier 1 evidence rating include the following: A study must (a) *Meet WWC Group Design Standards Without Reservations* (version 2.1 or later), (b) have at least one statistically significant positive finding, (c) have at least 350 students, and (d) have at least two educational sites. The tier rating can be assigned based on a single study finding or on a combination of findings within a study or across studies of the same intervention. For example, if one study shows a statistically significant positive finding with less than 350 students but another study evaluates more than 350 students at multiple schools and also has a statistically significant positive finding, then all of the program's findings will receive a Tier 1 rating. Tier 1 ratings are indicated in this report if any finding in a WWC-reviewed study of the target intervention has received a Tier 1 rating.

Profiles of distance learning programs that Met WWC Group Design Standards

Below we provide profiles of the nine studies that *Met WWC Group Design Standards with or Without Reservations* but did not meet ESSA Tier 1 rating requirements. The profiles include a brief program description, program components, program cost, duration, and relevant information for any positive, statistically significant findings, including the WWC's improvement index. Please consult the WWC's Reviews of Individual Studies database for full study review details.

---

[12] The WWC determined that Wijekumar et al. (2012) and Wijekumar et al. (2014) described the same study. These two publications were therefore included in a single review and are counted as a single study in the descriptive characteristics, evidence gap map, and meta-analysis.

CONTENT ACQUISITION PODCASTS

PROGRAM DESCRIPTION

Content Acquisition Podcasts (CAPs) facilitate vocabulary instruction for high school students. CAPs were created by the study authors using Microsoft PowerPoint and contained narrated audio recordings. Students independently accessed CAPs from their school's intranet and were randomly assigned to a condition. CAPs viewed by students in both groups provided a rationale for learning the given vocabulary term, direct instruction of word meanings, examples of synonyms, guided practice, and word consciousness instruction. CAPs provided to students in the intervention condition included keyword mnemonic strategies and images of keywords interacting with the vocabulary term and were designed using Mayer's instructional design principles. Students in the control group watched CAPs that did not have these features.

PROGRAM FEATURES

PROGRAM TYPE	DELIVERY METHOD
Supplemental	*Fully online*

TEACHER-STUDENT INTERACTION	COST
Automated/Not teacher directed	*No information provided*

- *Content Coverage:* Narrow
- *Participant Grade Level:* Grades 9–12
- *Gamification:* No
- *Adaptive:* No

Duration: Students viewed 10 CAPs over three days.

FINDINGS | *This study Meets WWC Group Design Standards Without Reservations and has at least one statistically significant positive finding.*

Outcome measure	Comparison	Sample	Significant?	Improvement index
Comprehension	Enhanced CAPs versus basic CAPs	141 students	Yes	41 (-50 to +50)

CITATION

Kennedy, M. J., Deshler, D. D., & Lloyd, J. W. (2015). Effects of multimedia vocabulary instruction on adolescents with learning disabilities. *Journal of Learning Disabilities, 48*(1), 22–38. https://eric.ed.gov/?id=EJ1047703

THE EDUCATION PROGRAM FOR GIFTED YOUTH

PROGRAM DESCRIPTION

The Education Program for Gifted Youth (EPGY) is a technology-driven, computer-managed individualization of the standard mathematics curriculum for grades K–5 in California. For this study, the EPGY curriculum was revised for nongifted students at eight Title I elementary schools. Students in the experimental group used the program in a computer lab under the supervision of a classroom teacher and an EPGY school site instructor. Students in the control group remained in the classroom during this time under the supervision of a classroom teacher and received supplementary worksheets from either the adopted textbook or the Renaissance Learning Accelerated Math product.

PROGRAM FEATURES

PROGRAM TYPE	DELIVERY METHOD
Supplemental	*Fully online*

TEACHER-STUDENT INTERACTION	COST
Teacher-led asynchronous	*No information provided*

- *Content Coverage:* Broad
- *Participant Grade Level:* Grades 1–5
- *Gamification:* No
- *Adaptive:* No

Duration: Students used the program for 20 minutes a day, every day, throughout the academic year.

FINDINGS | *This study Meets WWC Group Design Standards Without Reservations and has no statistically significant positive findings.*

Suppes, P., Holland, P. W., Hu, Y., & Vu, M. T. (2013). Effectiveness of an individualized computer-driven online math K–5 course in eight California Title I elementary schools. *Educational Assessment, 18*(3), 162–181. https://eric.ed.gov/?id=EJ1023953

EDUCATE ONLINE

PROGRAM DESCRIPTION

Educate Online is a system that facilitates one-on-one remote tutoring for middle school students performing below grade level in reading. The program connects certified teachers with students in real time using computers or Voice Over Internet Protocol technology to engage in personalized tutoring after the school day. Tutors begin instructional sessions by choosing and loading appropriate skill–level lessons, depending on the individual student's personal learning plan and baseline performance on the California Achievement Test.

PROGRAM FEATURES

PROGRAM TYPE

Supplemental

DELIVERY METHOD

Fully online

TEACHER-STUDENT INTERACTION

Teacher-led synchronous

COST

Some cost

- **Content Coverage:** Broad
- **Participant Grade Level:** Grades 6–8
- **Gamification:** No
- **Adaptive:** Yes

Duration: Students used the program for one semester.

FINDINGS | *This study Meets WWC Standards Without Reservations and has at least one statistically significant positive finding.*

Outcome measure	Comparison	Sample	Significant?	Improvement index
Reading comprehension	Educate Online versus business as usual	274 students	Yes	17 (-50 to +50)

CITATION

Perry, S. M. (2014). A delayed treatment control group design study of an after-school online tutoring program in reading. In F. J. Garcia-Peñalvo & A. M. Seoane Pardo (Eds.), *Online tutor 2.0: Methodologies and case studies for successful learning* (pp. 264–279). IGI Global. https://eric.ed.gov/?id=ED600863

MATH SNACKS

PROGRAM DESCRIPTION

The Math Snacks program is available online and comprises six animations and five games. Supporting materials include instructional materials, teacher and learner guides, how-to videos, and comic book transcripts. The students in this study played four of the five games: Monster School Bus, Gate, Ratio Rumble, and Game Over Gopher. The games covered instruction on ratios, the coordinate plane, number systems, fractions, and decimals. In addition to using the four games, teachers engaged with students in guided discussions and led students in additional inquiry-based activities related to gameplay.

PROGRAM FEATURES

PROGRAM TYPE

Supplemental

DELIVERY METHOD

Hybrid

TEACHER-STUDENT INTERACTION

Teacher-led synchronous

COST

Free

- **Content Coverage:** Broad
- **Participant Grade Level:** Grade 5
- **Gamification:** Yes
- **Adaptive:** No

Duration: Students received Math Snacks for a total of six to eight hours of classroom instruction during the five weeks of intervention.

FINDINGS | *This study Meets WWC Group Design Standards Without Reservations and has no statistically significant positive findings.*

Wiburg, K., Chamberlin, B., Valdez, A., Trujillo, K., & Stanford, T. (2016). Impact of Math Snacks games on students' conceptual understanding. *Journal of Computers in Mathematics and Science Teaching*, *35*(2), 173–193. https://eric.ed.gov/?id=EJ1095367

MINDPLAY VIRTUAL READING COACH

PROGRAM DESCRIPTION

MindPlay Virtual Reading Coach is an educational software program aimed at improving the reading fluency of elementary students. Lessons are delivered by an online reading coach, followed by practice and immediate feedback. The program adapts to the individual needs of the students and covers phonological awareness, phonics, vocabulary, grammar, silent reading fluency, and reading comprehension. Students move through the lessons based on their individual progress.

- **Content Coverage:** Broad
- **Participant Grade Level:** Grades 2 and 4
- **Gamification:** No
- **Adaptive:** Yes

PROGRAM FEATURES

PROGRAM TYPE

Supplemental

DELIVERY METHOD

Fully online

TEACHER-STUDENT INTERACTION

Automated/Not teacher directed

COST

Some cost

Duration: Students worked 30 minutes per day for nine weeks. Students had access to the program for the entire year.

FINDINGS | *This study Meets WWC Group Design Standards With Reservations and has no statistically significant positive findings.*

Kloos, H., Sliemers, S., Cartwright, M. D., Mano, Q., & Stage, S. (2019). MindPlay Virtual Reading Coach: Does it affect reading fluency in elementary school? *Frontiers in Education, 4*(67). https://eric.ed.gov/?id=ED596283

ONLINE DISCUSSION BOARDS

PROGRAM DESCRIPTION

This study examined the effect of reducing required weekly discussion board entries from two to one. Intervention and comparison courses required students to participate in an online open forum in which they posted thoughts and questions and responded to their classmates' posts. The course included weekly readings, assignments, and quizzes. Intervention course sections were supplemented to ensure an equal number of points and requirements by adding more required readings, increasing the length and rigor of remaining discussions, and increasing the assessment points for the final discussion.

- **Content Coverage:** Broad
- **Participant Grade Level:** Postsecondary
- **Gamification:** No
- **Adaptive:** No

PROGRAM FEATURES

PROGRAM TYPE

Supplemental

DELIVERY METHOD

Fully online

TEACHER-STUDENT INTERACTION

Automated/Not teacher directed

COST

Free

Duration: The courses were five weeks long, and the weekly requirement was reduced for the entire course.

FINDINGS | *This study Meets WWC Group Design Standards Without Reservations and has no statistically significant positive findings.*

Selhorst, A. L., Bao, M., Williams, L., & Klein, E. (2017). The effect of online discussion board frequency on student performance in adult learners. *Online Journal of Distance Learning Administration, 20*(4). https://eric.ed.gov/?id=EJ1165472

READING PLUS PROGRAM

PROGRAM DESCRIPTION

Students in in the intervention group used the adaptive, web-based, scaffolded silent reading component of the Reading Plus program. In the silent reading component, students chose from a selection of informational and literary texts that was presented to them page by page, with programmed pauses for various scaffolds. Scaffolds include reading in a guided window format, a static display, or both. Students engaged with the intervention on their own, either in a classroom using tablets or laptops or in a computer lab. The WWC intervention report on Reading Plus can be retrieved from https://ies.ed.gov/ncee/wwc/EvidenceSnapshot/419.

PROGRAM FEATURES

PROGRAM TYPE

Supplemental

DELIVERY METHOD

Fully online

TEACHER-STUDENT INTERACTION

Teacher-led synchronous

COST

Some cost

- **Content Coverage:** Broad
- **Participant Grade Level:** Grades 4–5
- **Gamification:** No
- **Adaptive:** Yes

Duration: Students used the program at least four times a week during a 25-minute literacy block throughout the academic year.

FINDINGS | *This study Meets WWC Group Design Standards With Reservations and has no statistically significant positive findings.*

Spichtig, A. N., Gehsmann, K. M., Pascoe, J. P., & Ferrara, J. D. (2019). The impact of adaptive, web-based, scaffolded silent reading instruction on the reading achievement of students in grades 4 and 5. *The Elementary School Journal, 119*(3), 443–467. https://eric.ed.gov/?id=EJ1208260

SCHEDULING VIDEO LECTURES

PROGRAM DESCRIPTION

The goal of the intervention was to improve students' time management by having students schedule the day and time they watched video lectures. In the first two weeks of the course, students in the intervention group received an email from the instructor with a link to an online scheduling survey asking them to schedule the day and time they would watch each of the video lectures for that week. Students in the comparison condition were not asked to schedule their video lectures and were able to watch the lectures at their leisure.

PROGRAM FEATURES

PROGRAM TYPE

Full curriculum

DELIVERY METHOD

Fully online

TEACHER-STUDENT INTERACTION

Automated/Not teacher directed

COST

Free

- **Content Coverage:** Broad
- **Participant Grade Level:** Postsecondary
- **Gamification:** No
- **Adaptive:** No

Duration: Students scheduled their video lectures for two of the course's five weeks.

FINDINGS | *This study Meets WWC Group Design Standards Without Reservations and has no statistically significant positive findings.*

Baker, R., Evans, B., Li, Q., & Cung, B. (2019). Does inducing students to schedule lecture watching in online classes improve their academic performance? An experimental analysis of a time management intervention. *Research in Higher Education, 60*(4), 521–552. https://eric.ed.gov/?id=EJ1216401

STUDENT-GENERATED VIDEOS

PROGRAM DESCRIPTION

Participants in the intervention section developed student-generated video projects showcasing the steps to solve a multiple-choice question on an exam. Students chose from a bank of existing questions or had the instructor select a question for them. Students were given directions explaining how to make the video and what type of medium they could use (a narrated PowerPoint slideshow, a YouTube video, and other options), as well as an example video. Each student produced a narrated video and posted it in a discussion forum in the relevant module. Other students viewed the videos and provided ratings and comments.

PROGRAM FEATURES

PROGRAM TYPE	DELIVERY METHOD
Supplemental	*Fully online*

TEACHER-STUDENT INTERACTION	COST
Teacher-led asynchronous	*No information provided*

- *Content Coverage:* Broad
- *Participant Grade Level:* Postsecondary

- *Gamification:* No
- *Adaptive:* No

Duration: The course was a full semester. At least one student posted a video each week.

FINDINGS | *This study Meets WWC Group Design Standards Without Reservations and has no statistically significant positive findings.*

Stanley, D., & Zhang, Y. (2018). Student-produced videos can enhance engagement and learning in the online environment. *Online Learning, 22*(2), 5–26. https://eric.ed.gov/?id=EJ1181370

Evidence gap map

Evidence gap maps are "thematic collections of evidence structured around a framework which schematically represents the types of interventions and outcomes of relevance to a particular sector" (Snilstveit, Vojtkova, Bhavsar, Stevenson, & Gaarder, 2016, p. 120). They are used to document and illustrate both where research has been conducted and where research has *not* been conducted.

The process of determining how best to visually represent the dimensions and evidence markers requires decisions on several issues. Primarily, the WWC asked what framework helps to inform education stakeholders, particularly education researchers and education practitioners or administrators, about what evidence exists. The WWC wanted to represent three primary elements: intervention characteristics as described by the program components, the outcome domain, and the grade level of the sample. Given the importance of the intervention and outcome domain dimensions, the WWC determined it was important to represent them both along the axes. The decisions followed evidence gap map best practices (Snilstveit et al., 2016).

For the evidence markers (that is, the representation of the studies within the cells), one important element to represent was the sample grade level (K–8, high school, or postsecondary). A decision was made to indicate the grade level by the shape and color of the marker. In addition, representing the summary findings by citing the average effect size was decided against because of the small number of findings per cell. Instead, the number of findings from studies that *Met WWC Group Design Standards* and the total number of eligible studies were indicated by the numerals within the cells with lighter shading and bolded outlines.

Several caveats should be mentioned regarding these decisions. First, although the initial screen was for studies of fully online programs, during the program component coding some of the programs were found to have an in-person component and so delivery method was coded as hybrid. As a result, the WWC decided it best not to include this dimension on the gap map because the numbers do not accurately represent the wider literature. Second, although cost was a dimension that the WWC attempted to extract, a majority of eligible studies did not report exact cost data. Thus, the WWC determined it best not to include this dimension on the gap map as well. Third, the WWC sought to inform multiple audiences—education researchers as well as education administrators. The WWC determined it important to represent the most trustworthy evidence in one map for education

administrators; this information is represented in figure 4. It was also important to represent all eligible research in one map; therefore, this information is presented in figure 3.

Meta-analysis

The WWC conducted a meta-analysis of the studies that *Met WWC Group Design Standards With or Without Reservations*. To capture the effectiveness of distance learning interventions compared with curricula that students received in traditional school settings, the meta-analysis only included studies with business-as-usual comparison conditions. Students in the business-as-usual condition carried on with the regular school curricula and did not receive the distance learning programs. Studies that contrasted two distance learning programs in the treatment and comparison conditions were excluded from the analysis. In addition, if a study included multiple effect sizes within an outcome domain, the effect sizes were aggregated to the study level's outcome domain, which resulted in one unique effect size per study. A study that measured end-of-grade mathematics test scores and a standardized mathematics achievement test, for example, would have been aggregated to one effect size within the mathematics outcome domain. A study that measured both English language arts (ELA) and mathematics standardized achievement, however, would continue to have two effect sizes included in the analysis but represented in two outcome domains. Finally, only non-subgroup, aggregate samples at the first wave of data collection were included in the analysis. The aggregated effect sizes' variances were estimated using the formulas outlined in the *WWC Procedures Handbook*, version 4.1 (WWC, 2020b).

The meta-analysis was conducted using a fixed-effects model, consistent with the method of effect size synthesis outlined in the *WWC Procedures Handbook,* version 4.1 (WWC, 2020b). The aggregated study-level effect sizes and the associated variances were calculated via the WWC-recommended fixed effects, meta-analytic average method. The average effect size was translated to the WWC's improvement index, also described in the *WWC Procedures Handbook,* version 4.1 (2020b).

In addition to the overall average effect size, the WWC attempted to conduct moderator analyses. The moderator variables were planned *a priori* and therefore constituted confirmatory moderator analyses. As is recommended, the WWC conducted a fixed effects test of homogeneity using the *Q*-between test (Pigott & Polanin, 2020). Although the results indicated that the effect sizes were homogeneous, the tests were conducted given the importance of the moderator analyses. A fixed effects, analysis of variance (ANOVA)–like moderator model was used; given that multiple tests were conducted, the alpha level was reduced to .01 to decrease the likelihood of type I error. The full moderator analysis results are given in tables A–4 and A–5. All meta-analyses were carried out using the *metafor* Package in *R* (Viechtbauer, 2010).

The results of the moderator analyses, from both the ELA and mathematics outcome domains, did not yield any statistically significant findings. The determination of statistical significance can be found in the "Q-value (*p*-value)" column, and the number of degrees of freedom for each moderator test is the number of levels minus one. For example, the "Interaction" moderator analysis of the ELA outcome domain, listed in table A–4, has two levels: programs that used "Teacher-led synchronous" interactions and programs that were not teacher directed ("Not teacher directed"). The moderator analysis tested for differences between the two levels. The "Teacher-led synchronous" level had two studies, totaling 700 students; the average effect size was 0.16. The "Not teacher directed" level had three studies, totaling 6,153 students; the average effect size was 0.24. The moderator test asks whether the difference between those two average effect sizes is statistically significant at the .01 alpha level. The results of the moderator analysis indicated that the differences were not statistically significant (*p* = .10). The remaining moderator analyses can be interpreted in the same manner.

Table A–4. Findings of the moderator analysis of distance learning programs' effects on ELA outcomes from five studies that Met WWC Group Design Standards

Moderator (level)	Q-value (p-value)	Average effect size (standard error)	Number of studies	Number of students
Interaction	6.19 (.10)			
Teacher-led synchronous		0.16 (0.07)	2	700
Not teacher directed		0.24 (0.05)	3	6,153
Content coverage	6.64 (.08)			
Narrow		0.24 (0.05)	2	5,933
Broad		0.17 (0.07)	3	920

Note: The Q-value is the test statistic for a Q-between ANOVA-like hypothesis test; the degrees of freedom are the number of levels minus one. Given the use of multiple hypothesis tests, the alpha level was *a priori* set to .01.

Table A–5. Findings of the moderator analysis of distance learning programs' effects on mathematics outcomes from four studies that Met WWC Group Design Standards

Moderator (level)	Q-value (p-value)	Average effect size (standard error)	Number of studies	Number of students
Interaction	1.39 (.50)			
Teacher-led synchronous		0.19 (0.11)	2	3,469
Teacher-led asynchronous		-0.01(0.12)	2	1,924
Personalization	2.56 (.28)			
Adaptive		0.17 (0.13)	1	2,728
Nonadaptive		0.01 (0.05)	3	2,665
Gamification	3.20 (.20)			
Gamified		0.27 (0.24)	1	741
Not gamified		0.02 (0.05)	3	4,652
Program type	3.33 (.19)			
Full curriculum		0.27 (0.26)	1	440
Supplemental program		0.02 (0.05)	3	4,953

Note: The Q-value is the test statistic for a Q-between ANOVA-like hypothesis test; the degrees of freedom are the number of levels minus one. Given the use of multiple hypothesis tests, the alpha level was *a priori* set to .01.