Narrative Synthesis

In addition to the meta-analysis comparing online learning conditions with face-to-face instruction, analysts reviewed and summarized experimental and quasi-experimental studies contrasting different versions of online learning. Some of these studies contrasted purely online learning conditions with classes that combined online and face-to-face interactions. Others explored online learning with and without elements such as video, online quizzes, assigned groups, or guidance for online activities. Five of these studies involved K–12 learners.

Key Findings

The main finding from the literature review was that

- few rigorous research studies of the effectiveness of online learning for K–12 students have been published. A systematic search of the research literature from 1994 through 2006 found no experimental or controlled quasi-experimental studies comparing the learning effects of online versus face-to-face instruction for K–12 students that provide sufficient data to compute an effect size. A subsequent search that expanded the time frame through July 2008 identified just five published studies meeting meta-analysis criteria.

The meta-analysis of 51 study effects, 44 of which were drawn from research with older learners, found that

- students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction. Learning outcomes for students who engaged in online learning exceeded those of students receiving face-to-face instruction, with an average effect size of +0.24 favoring online conditions. The mean difference between online and face-to-face conditions across the 51 contrasts is statistically significant at the p < .01 level. Interpretations of this result, however, should take into consideration the fact that online and face-to-face conditions generally differed on multiple dimensions, including the amount of time that learners spent on task. The advantages observed for online learning conditions therefore may be the product of aspects of those treatment conditions other than the instructional delivery medium per se.

2 The meta-analysis was run also with just the 44 studies with older learners. Results were very similar to those for the meta-analysis including all 51 contrasts. Variations in findings when K-12 studies are removed are described in footnotes.

3 The + sign indicates that the outcome for the treatment condition was larger than that for the control condition. A – sign before an effect estimate would indicate that students in the control condition had stronger outcomes than those in the treatment condition. Cohen (1992) suggests that effect sizes of .20 can be considered “small,” those of approximately .50 “medium,” and those of .80 or greater “large.”

4 The p-value represents the likelihood that an effect of this size or larger will be found by chance if the two populations under comparison do not differ. A p-value of less than .05 indicates that there is less than 1 chance in 20 that a difference of the observed size would be found for samples drawn from populations that do not differ.
• Instruction combining online and face-to-face elements had a larger advantage relative to purely face-to-face instruction than did purely online instruction. The mean effect size in studies comparing blended with face-to-face instruction was +0.35, \( p < .001 \). This effect size is larger than that for studies comparing purely online and purely face-to-face conditions, which had an average effect size of +0.14, \( p < .05 \). An important issue to keep in mind in reviewing these findings is that many studies did not attempt to equate (a) all the curriculum materials, (b) aspects of pedagogy and (c) learning time in the treatment and control conditions. Indeed, some authors asserted that it would be impossible to have done so. Hence, the observed advantage for online learning in general, and blended learning conditions in particular, is not necessarily rooted in the media used per se and may reflect differences in content, pedagogy and learning time.

• Studies in which learners in the online condition spent more time on task than students in the face-to-face condition found a greater benefit for online learning.\(^5\) The mean effect size for studies with more time spent by online learners was +0.46 compared with +0.19 for studies in which the learners in the face-to-face condition spent as much time or more on task (\( Q = 3.88, p < .05 \)).\(^6\)

• Most of the variations in the way in which different studies implemented online learning did not affect student learning outcomes significantly. Analysts examined 13 online learning practices as potential sources of variation in the effectiveness of online learning compared with face-to-face instruction. Of those variables, (a) the use of a blended rather than a purely online approach and (b) the expansion of time on task for online learners were the only statistically significant influences on effectiveness. The other 11 online learning practice variables that were analyzed did not affect student learning significantly. However, the relatively small number of studies contrasting learning outcomes for online and face-to-face instruction that included information about any specific aspect of implementation impeded efforts to identify online instructional practices that affect learning outcomes.

• The effectiveness of online learning approaches appears quite broad across different content and learner types. Online learning appeared to be an effective option for both undergraduates (mean effect of +0.35, \( p < .001 \)) and for graduate students and professionals (+0.17, \( p < .05 \)) in a wide range of academic and professional studies. Though positive, the mean effect size is not significant for the seven contrasts involving K–12 students, but the number of K–12 studies is too small to warrant much confidence in the mean effect estimate for this learner group. Three of the K–12 studies had significant effects favoring a blended learning condition, one had a significant negative effect favoring face-to-face instruction, and three contrasts did not attain statistical significance. The test for learner type as a moderator variable was nonsignificant. No

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\(^{5}\) This contrast falls just short of statistical significance (\( p < .06 \)) when the five K-12 contrasts are removed from the analysis.

\(^{6}\) The \( Q_{\text{between}} \) statistic tests whether the variances for the two sets of effect sizes under comparison are statistically different.
significant differences in effectiveness were found that related to the subject of instruction.

- **Effect sizes were larger for studies in which the online and face-to-face conditions varied in terms of curriculum materials and aspects of instructional approach in addition to the medium of instruction.** Analysts examined the characteristics of the studies in the meta-analysis to ascertain whether features of the studies’ methodologies could account for obtained effects. Six methodological variables were tested as potential moderators: (a) sample size, (b) type of knowledge tested, (c) strength of study design, (d) unit of assignment to condition, (e) instructor equivalence across conditions, and (f) equivalence of curriculum and instructional approach across conditions. Only equivalence of curriculum and instruction emerged as a significant moderator variable ($Q = 5.40$, $p < .05$). Studies in which analysts judged the curriculum and instruction to be identical or almost identical in online and face-to-face conditions had smaller effects than those studies where the two conditions varied in terms of multiple aspects of instruction (+0.20 compared with +0.42, respectively). Instruction could differ in terms of the way activities were organized (for example as group work in one condition and independent work in another) or in the inclusion of instructional resources (such as a simulation or instructor lectures) in one condition but not the other.

The narrative review of experimental and quasi-experimental studies contrasting different online learning practices found that the majority of available studies suggest the following:

- **Blended and purely online learning conditions implemented within a single study generally result in similar student learning outcomes.** When a study contrasts blended and purely online conditions, student learning is usually comparable across the two conditions.

- **Elements such as video or online quizzes do not appear to influence the amount that students learn in online classes.** The research does not support the use of some frequently recommended online learning practices. Inclusion of more media in an online application does not appear to enhance learning. The practice of providing online quizzes does not seem to be more effective than other tactics such as assigning homework.

- **Online learning can be enhanced by giving learners control of their interactions with media and prompting learner reflection.** Studies indicate that manipulations that trigger learner activity or learner reflection and self-monitoring of understanding are effective when students pursue online learning as individuals.

- **Providing guidance for learning for groups of students appears less successful than does using such mechanisms with individual learners.** When groups of students are learning together online, support mechanisms such as guiding questions generally influence the way students interact, but not the amount they learn.

**Conclusions**
In recent experimental and quasi-experimental studies contrasting blends of online and face-to-face instruction with conventional face-to-face classes, blended instruction has been more effective, providing a rationale for the effort required to design and implement blended approaches. Even when used by itself, online learning appears to offer a modest advantage over conventional classroom instruction.

However, several caveats are in order: Despite what appears to be strong support for online learning applications, the studies in this meta-analysis do not demonstrate that online learning is superior as a medium. In many of the studies showing an advantage for online learning, the online and classroom conditions differed in terms of time spent, curriculum and pedagogy. It was the combination of elements in the treatment conditions (which was likely to have included additional learning time and materials as well as additional opportunities for collaboration) that produced the observed learning advantages. At the same time, one should note that online learning is much more conducive to the expansion of learning time than is face-to-face instruction.

In addition, although the types of research designs used by the studies in the meta-analysis were strong (i.e., experimental or controlled quasi-experimental), many of the studies suffered from weaknesses such as small sample sizes; failure to report retention rates for students in the conditions being contrasted; and, in many cases, potential bias stemming from the authors’ dual roles as experimenters and instructors.

Finally, the great majority of estimated effect sizes in the meta-analysis are for undergraduate and older students, not elementary or secondary learners. Although this meta-analysis did not find a significant effect by learner type, when learners’ age groups are considered separately, the mean effect size is significantly positive for undergraduate and other older learners but not for K–12 students.

Another consideration is that various online learning implementation practices may have differing effectiveness for K–12 learners than they do for older students. It is certainly possible that younger students could benefit more from a different degree of teacher or computer-based guidance than would college students and older learners. Without new random assignment or controlled quasi-experimental studies of the effects of online learning options for K–12 students, policy-makers will lack scientific evidence of the effectiveness of these emerging alternatives to face-to-face instruction.