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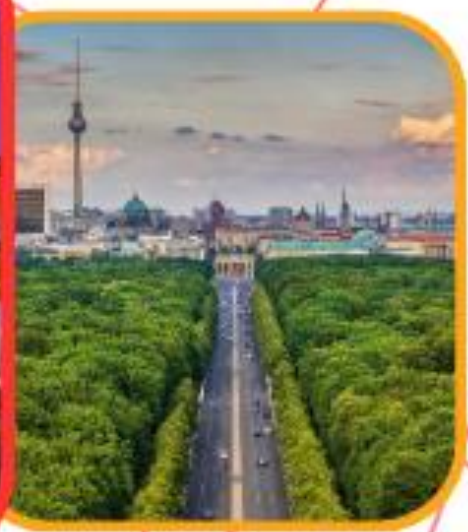

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Digital Reading vs. Print Reading: A Comparative Review of Comprehension and Attention

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Abstract. The rapid shift from print to screen-based reading has raised important questions about whether reading medium influences comprehension and attentional engagement. This review synthesizes evidence from two major meta-analyses and multiple experimental studies comparing digital and print reading across age groups and task conditions. Across studies, print reading tends to produce a small but reliable advantage in comprehension, especially for expository texts and when readers are under time pressure. Findings also suggest that screen reading can be associated with weaker task-adaptive attention (e.g., less reduction of mindwandering when demands increase) and, in some cases, reduced metacognitive efficiency. At the same time, medium effects are moderated by text genre, time constraints, and reader characteristics, indicating that "screen inferiority" is not universal. Educational implications include designing digital reading tasks that reduce scrolling burden, support deep processing, and scaffold attention regulation and calibration.

Keywords: digital reading, print reading, reading comprehension, attention, metacognition, time pressure, mode effect

Introduction. Digital devices have become the dominant platform for academic reading, assessment, and everyday information consumption. This transition is often treated as a neutral change in delivery format, but research increasingly indicates that medium can shape how readers allocate attention, navigate text, and construct meaning. Large-scale synthesis studies report a consistent—though generally small—advantage for print reading on comprehension outcomes, with the gap influenced by factors such as text type and task demands. For example, a meta-analysis covering studies from 2000–2017 found that paper-based reading yields better comprehension than digital reading (overall effect around a small negative Hedges' g for screens), with the difference amplified under time constraints and varying by text genre. At the same time, the "why" behind medium effects remains debated. Proposed explanations include differences in spatial navigation cues (e.g., locating information in a stable physical layout), scrolling-related cognitive costs, and differences in metacognitive regulation (readers may *feel* they understand screens better, yet perform worse on detailed comprehension). These issues matter for academic contexts because comprehension in education often depends on extracting key points, integrating details, and sustaining attention for long expository texts—not merely identifying a main idea.This article reviews eight peer-reviewed sources (two meta-analyses, two broad reviews/overviews, and four controlled empirical studies) to answer two guiding questions:How does

reading medium (screen vs. paper) affect comprehension outcomes?What role do attention and metacognitive factors play in any observed medium effects?

Method. This is a focused narrative review based on eight research articles previously identified on digital versus print reading. The set includes (a) two meta-analyses summarizing experimental evidence, (b) a major systematic review of print/digital comprehension research, and (c) controlled studies examining comprehension, attention (mindwandering), and metacognitive calibration under different conditions. Evidence was synthesized by grouping findings into (1) meta-analytic trends, (2) adult experimental results (comprehension and calibration), and (3) mode effects in school-aged readers and assessment contexts.

Findings. Across meta-analytic work, print generally shows an advantage for comprehension relative to screens. Delgado and colleagues' meta-analysis (2000–2017) reported a small overall effect favoring paper (Hedges' $g \approx -0.21$ for digital vs. paper), with moderators indicating the gap increases under time pressure and differs by genre (stronger for informational or mixed texts than for purely narrative texts). Clinton's systematic review and meta-analysis, which included randomized experiments comparing paper and screen reading, similarly found that reading from screens had a negative effect on reading performance ($g \approx -0.25$). Importantly, this effect appeared stronger for expository texts ($g \approx -0.32$) while narrative texts showed little difference (near zero). Clinton also found no reliable difference in reading time overall ($g \approx 0.08$), but reported better calibration (more accurate judgments of performance) when reading on paper ($g \approx 0.20$). Interpretation: The strongest and most stable conclusion across meta-analyses is not that screens "always" reduce comprehension, but that screens are more vulnerable to conditions that demand deep processing, especially expository reading and time-limited tasks. Controlled experiments with undergraduates offer finer-grained insight into *what type* of comprehension is affected. Singer and Alexander reported that students tended to prefer digital texts and predicted higher comprehension on screens, but performance did not consistently match these predictions. Specifically, there were no medium differences for identifying the main idea, yet print reading improved recall of key points and other relevant information (details linked to deep comprehension). This pattern aligns with the broader conclusion from Singer and Alexander's review in *Review of Educational Research*: medium effects are not uniform; they appear "under certain text or task conditions or for certain readers," suggesting that both task demands and reader strategies determine whether screens disadvantage comprehension. Interpretation: Digital reading may be "good enough" for gist-level understanding but can be weaker for detail integration and deeper recall—precisely the kinds of outcomes emphasized in academic study and high-stakes assessment. A key contribution of more recent research is direct measurement of attention during reading. Delgado and Salmerón examined how medium interacts with time pressure, measuring mindwandering ("task-unrelated thoughts") alongside comprehension. Under time

pressure, on-screen readers comprehended less than the other groups, and the attentional pattern suggested weaker task adaptation: print readers reduced mindwandering when pressured, while on-screen readers did not show the same attentional adjustment. Notably, when reading was self-paced (free time), mindwandering and comprehension were similar across media, implying that screen disadvantages may be most pronounced when tasks require rapid, efficient allocation of attention (e.g., exam-like settings, timed reading tests, or heavy course loads).Interpretation: Medium effects may partly reflect attention regulation rather than comprehension skill alone: screens can make it harder for readers to "tighten focus" when demands increase, which then harms comprehension under pressure. Metacognition—how accurately readers judge their own learning—matters because it influences study decisions (whether to reread, slow down, or change strategy). Clinton's meta-analysis found better calibration for paper compared to screens. Ackerman and Lauterman's experiments add nuance: under time pressure, test scores were lower on screens than on paper, but under free regulation (self-paced conditions) differences were not observed in the same way. The authors interpret this in terms of metacognitive regulation: screens can be associated with less effective allocation of time and strategy when readers must manage constraints. Interestingly, Delgado and Salmerón did *not* find differences in calibration in their specific design, even though comprehension diverged under time pressure.This suggests calibration effects may depend on task features (text length, question types, feedback, and whether readers have cues for depth of processing).

Discussion

Why might print support comprehension and attention?

Across the reviewed evidence, three mechanisms recur:

1. Time pressure amplifies medium differences. Meta-analytic and experimental findings converge on stronger screen disadvantages in pressured conditions.
2. Expository texts are more vulnerable. Clinton's meta-analysis indicates narrative reading often shows minimal differences, while informational/expository reading shows larger gaps.
3. Attention regulation differs by medium. Direct evidence shows weaker task-adaptive attention on screens under pressure (less reduction of mindwandering), which can undermine comprehension.

These mechanisms are consistent with the idea that print offers stable spatial cues and lower interaction costs (e.g., less scrolling), supporting deeper processing and sustained attention—especially when the reader must work efficiently.

Educational implications

Based on the evidence reviewed, educational practice can respond in practical ways:

- Match medium to purpose. For gist-level reading, screens may be adequate; for deep study, detail integration, and exam preparation, print (or print-like digital design) may offer advantages.
- Design "attention-supportive" digital reading. Reduce unnecessary scrolling, provide clear progress indicators, and encourage structured note-taking or retrieval practice to promote deeper processing. The importance of time constraints suggests that digital reading under pressure needs especially careful scaffolding.
- Reconsider digital testing assumptions. If comprehension scores systematically drop on screens for some groups (as shown in children's assessments), mode effects should be considered when interpreting outcomes and ensuring fairness.

Limitations and directions for future research

This review is limited to eight core sources, though the field is broader. Additionally, "digital reading" is not a single condition: device type, annotation tools, screen size, scrolling vs. paging, and reader familiarity can all influence outcomes. Future work should test which design features (e.g., pagination, built-in retrieval prompts, reduced distractions) can reduce mindwandering and support deep comprehension—especially in timed academic tasks.

Conclusion. The current evidence indicates a small but meaningful print advantage for comprehension, particularly for expository texts and in time-pressured contexts. Beyond comprehension scores, research suggests that attention regulation—especially task-adaptive control of mindwandering—may be a key driver of screen disadvantages under pressure. These findings do not imply that digital reading is inherently inferior; rather, they highlight when and why screens may underperform and point toward targeted educational strategies for designing more effective digital reading environments.

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