



EFFECTIVENESS OF ONLINE TEACHING DURING THE PANDEMIC

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Abstract

The COVID-19 pandemic forced an unprecedented, large-scale shift from in-person to online teaching across primary, secondary, and higher education worldwide. This paper systematically reviews empirical studies published during and after the pandemic to evaluate the effectiveness of online teaching, identify determinants of success, and synthesize evidence on learning outcomes, engagement, equity, and wellbeing. Findings show mixed outcomes: many studies report declines in average learning outcomes and widening inequalities, while targeted online interventions and well-designed synchronous/asynchronous blends improved outcomes for some groups. Key determinants include access to devices and connectivity, instructor digital pedagogy and assessment design, student motivation and self-regulation, and institutional support. The paper concludes with practical recommendations for policymakers and institutions to strengthen online teaching for future emergencies and hybrid education models. ([PMC](#))

Keywords

Online teaching, COVID-19, effectiveness, student engagement, digital divide, remote learning, pedagogy

1. Introduction

The COVID-19 pandemic (2020–2022) produced the largest and fastest global experiment with remote education in history. Schools and universities closed physical campuses and shifted to



online delivery, often with minimal preparation. This emergency remote teaching differed from planned online education in design, resourcing, and teacher readiness. Understanding how effective this rapid transition was — for learning, engagement, equity, and wellbeing — is essential to guide future decisions about online and blended education. Recent systematic reviews and meta-analyses point to a measurable negative impact on average learning achievement while also highlighting specific contexts and designs where online delivery worked well. ([PMC](#))

2. Objectives

This paper aims to:

1. Synthesize empirical evidence on the effectiveness of online teaching during the pandemic.
2. Identify critical factors that influenced success or failure (technological, pedagogical, learner, and institutional).
3. Draw practical recommendations for improving future online and hybrid education responses.

3. Literature review

3.1 Overall learning outcomes

Meta-analyses and large-scale studies find that the pandemic negatively affected student learning on average, with learning losses varying by context and subject. Di Pietro et al.'s meta-analysis and related studies show a general decline in achievement attributable to school closures and disruptions, though the magnitude varies across countries and age groups. ([PMC](#))



3.2 Evidence of benefits in some contexts

Not all studies report net losses. Some empirical analyses indicate that carefully implemented online instruction — particularly when combined with active learning strategies and timely formative feedback — mitigated losses or even improved performance in specific cohorts. For example, quasi-experimental work found positive effects for some online interventions that replaced low-quality in-person instruction. ([PMC](#))

3.3 Student engagement and psychological factors

Student engagement was a strong predictor of online learning success. Systematic reviews during 2020–2024 highlight self-efficacy, motivation, and emotion regulation as central drivers of engagement and persistence in remote learning. Lack of social presence and lower intrinsic motivation decreased engagement for many students. ([olj.onlinelearningconsortium.org](#))

3.4 Digital divide and equity

Multiple studies and UN/UNESCO syntheses document that the shift to online learning exacerbated existing inequalities: learners with poor internet, no personal device, or limited parental support experienced larger setbacks. Technology dependence "super-charged" inequality where access and supportive home environments varied widely. ([Axios](#))

3.5 Teacher perspectives and challenges

Teachers reported four major categories of challenge: technological (platforms, connectivity), pedagogical (adapting materials, assessment), psychological (stress, workload), and managerial (course organization, student monitoring). Professional development and institutional support significantly influenced instructors' ability to deliver quality online teaching. ([ScienceDirect](#))



4. Theoretical framework

This review draws on three complementary frameworks:

- **Constructivist learning theory**, emphasizing active learner engagement, social interaction, and scaffolded tasks — which supports the value of synchronous discussion, collaborative projects, and structured feedback in online settings.
- **Self-determination theory (SDT)**, which highlights autonomy, competence, and relatedness as motivators for sustained engagement — key factors when students must self-regulate in remote learning. ([PMC](#))
- **Digital divide framework**, which focuses on access (first-level), usage (second-level), and outcomes (third-level) inequalities — to analyze how technology and context shape differential effects of online teaching. ([Axios](#))

5. Methodology (systematic review)

5.1 Search strategy

Databases searched included PubMed/PMC, Web of Science, Scopus, Education Resources Information Center (ERIC), and key publishers (Frontiers, Elsevier, Springer, Wiley). Search terms combined keywords: “online teaching”, “remote learning”, “COVID-19”, “pandemic”, “effectiveness”, “student outcomes”, “engagement”, and “inequality”. Searches covered literature published between January 2020 and May 2025.

5.2 Inclusion and exclusion criteria

Included: empirical studies, systematic reviews, meta-analyses, and policy reports that examined learning outcomes, engagement, equity, or teacher experience for pandemic-era online



instruction. Excluded: opinion pieces without empirical evidence, pre-2020 online education research unrelated to pandemic implementation.

5.3 Data extraction and synthesis

From eligible studies we extracted: country/context, education level (primary/secondary/higher), sample size, research design (experimental/quasi/observational/survey), outcomes measured, and key findings. Narrative synthesis was applied due to heterogeneity in methods and outcomes across studies. For quantitative comparative statements, we prioritized meta-analyses and large-scale datasets. Representative high-impact studies are cited in the results. ([Frontiers](#))

6. Findings / Synthesis

6.1 Learning outcomes: mixed but often negative

- Several meta-analyses and broad studies report average declines in student achievement associated with pandemic disruptions, though the effect size differs by subject, age, and country. For example, pooled evidence suggests notable declines in reading and mathematics for many primary and secondary students. ([PMC](#))
- Conversely, targeted online programs with strong instructional design and monitoring sometimes produced neutral or positive effects, especially in higher education where students and instructors could adapt more quickly. ([PMC](#))

6.2 Engagement and self-regulation are decisive

- Studies consistently identify student self-efficacy, motivation, and self-regulation as key predictors of success. Where instructors used interactive pedagogies, regular formative assessment, and peer activities, engagement and outcomes improved. ([ResearchGate](#))

6.3 Equity: access and home environment matter most



- Evidence shows substantial heterogeneity: learners without reliable internet or a quiet study space experienced the largest setbacks. The digital divide translated into unequal learning loss, with disadvantaged students disproportionately affected. International reports emphasize that technology-dependent responses amplified pre-existing inequalities. ([Axios](#))

6.4 Teacher preparedness and institutional support

- Teacher digital pedagogy and the availability of training and institutional resources strongly correlated with better online teaching outcomes. Institutions that invested in training, LMS integration, and clear assessment policies had smoother transitions and better student experiences. ([ScienceDirect](#))

6.5 Mental health and wellbeing

- Remote learning increased isolation and stress for some learners; diminished social contact was implicated in reduced motivation and attention. Psychological support and community-building activities helped buffer these effects. ([PMC](#))

7. Discussion

The evidence paints a nuanced picture: emergency online teaching was not uniformly effective or ineffective. The variations in outcomes reflect interactions between design quality, learner characteristics, and socio-economic context. Carefully designed online instruction — with active learning, prompt feedback, and opportunities for synchronous interaction — can approach or meet the effectiveness of face-to-face teaching for motivated and well-resourced learners. However, without addressing access gaps and teacher training, online delivery risks widening inequality and producing net learning loss at population scale. These conclusions align with



multiple systematic reviews and international assessments that highlight both potential and pitfalls of rapid online adoption. ([Frontiers](#))

8. Practical recommendations

8.1 For policymakers

- Invest in universal access: prioritize reliable broadband and device programs for low-income families to reduce the first-level digital divide. ([Axios](#))
- Support blended models: encourage hybrid strategies that combine the strengths of in-person and online teaching, especially for practical or skills-based subjects.

8.2 For institutions and administrators

- Provide targeted professional development in digital pedagogy: focus on online assessment design, student engagement techniques, and inclusive practices. ([ScienceDirect](#))
- Standardize LMS and platform support, with central resources (templates, modules, technical helpdesks) to reduce teacher workload.

8.3 For teachers

- Prioritize active learning and regular formative feedback; use short synchronous sessions for interaction and asynchronous modules for content delivery. (olj.onlinelearningconsortium.org)
- Monitor student engagement and wellbeing; build peer communities and quick check-ins to maintain social relatedness.

8.4 For researchers



- Focus on longitudinal studies to track long-term effects and the differential recovery of learning loss across demographics. Meta-analytic work should disaggregate by context and subject.

9. Limitations

- The rapid, heterogenous nature of pandemic research limits comparability; many studies used convenience samples or self-reported measures.
- This review is narrative due to methodological diversity; a full meta-analysis would require stricter inclusion homogenization and access to effect sizes across studies.
- Publication lag and regional variation mean new evidence may refine these conclusions; policymakers should combine research evidence with local diagnostic assessments.

10. Conclusion

Online teaching during the pandemic produced mixed effects: it revealed both the promise of digital pedagogy and the dangers of unequal access and inadequate preparation. Where institutions and teachers invested in pedagogy and support, online instruction could be effective; where access and support were lacking, learning losses and widened inequalities followed. Moving forward, investment in infrastructure, teacher training, inclusive design, and robust evaluation will be critical to harness online teaching's benefits while avoiding its harms.

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