



**IB: Review of Literature on
Student Outcomes in
Online Learning**

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EXECUTIVE SUMMARY

Recent research has examined the main outcomes and indicators of success associated with online instruction, comparing them with those relevant to face-to-face instruction. This report explores the literature on online learning outcomes, focusing on both academic and non-academic markers of success.

Academic outcomes, as measured in educational settings, capture traditional markers of student success including program completion, retention, and performance metrics like grades, GPA, test scores, and certificates or diplomas. Non-academic outcomes, on the other hand, capture a broader range of student experiences and outcomes that may be influenced by both online and face-to-face instruction. These can include factors such as satisfaction with learning, motivation, engagement, and self-directed learning. This report provides a comprehensive overview of the key outcomes and indicators of success associated with online instruction. It explores both academic and non-academic outcomes and discusses the role of instructional design in influencing student success in online learning environments.

Purpose:

The overarching purpose of this report is to provide the IB with an overview of the research landscape relating to online learning, to better situate IB stakeholders' understanding of the context in which the DP online pilot operates.

Research Questions:

Towards that goal, this literature review examined targeted four core research questions:

1. **Learning outcomes:** What are the main outcomes and indicators of success (academic and non-academic) that are targeted, discussed, and reported on in the literature on online instruction. How do they compare with those relevant to face-to-face instruction?
2. **Comparative outcomes:** Are there any differences in student outcomes in online settings based on student characteristics, types of platforms, type of funding (i.e., public vs private), geographical location, and use of hybrid/blended experiences?
3. **Benefits:** What are the benefits of online instruction in comparison to face-to-face instruction?
4. **Challenges:** What are the challenges of online instruction in comparison to face-to-face instruction?

Key Findings:

Overall, this literature review suggests that online learning can produce comparable rates of course completion, examination performance, and student satisfaction when compared to traditional face-to-face instruction. However, instructional design choices have a significant impact on both student educational attainment and long-term academic success. For that reason, this report also provides an overview of key instructional design factors that can influence student academic and non-academic outcomes in online learning.

More specifically, we found:

- **Learning Outcomes (academic):** The most discussed outcomes and indicators of academic success explored in the literature include:
 - Course completion (i.e., the the number of students who successfully meet the requirements of the course and receive credit),
 - Attrition (i.e., the number of students who DO NOT successfully complete their program of study),
 - Academic performance (i.e., student performance on assessments of knowledge, skill, or understanding), and
- **Contradictory research findings:** In the context of these outcomes, comparisons between online and face-to-face learning are contradictory. Some studies indicate that well-designed online courses can lead to comparable, or even improved outcomes, others highlight persistent underperformance particularly in virtual schools serving younger students. Much research suggests that instructional design choices are a critical factor in determining successful outcomes in online learning.
- **Learning Outcomes (non-academic):** The most commonly discussed outcomes and indicators of non-academic success explored in the literature include:
 - Student motivation and engagement (i.e., student buy-in to their own learning)
 - Social-emotional wellbeing (e.g., students' sense of belonging, social interactions, and overall mental health),
 - Self-regulation (i.e., student-directed efforts to manage and direct their own learning goals and activities, while monitoring their cognition, motivation, and behavior).

- **Contradictory research findings:** There is a general perception that online learning brings greater potential for challenges in student health and wellbeing, and a portion of the literature aligns with this perception. However, research is contradictory and finds that there can be a positive correlation between online learning and mental health, particularly in instructional contexts that adopt self-directed learning approaches.
- **Comparative outcomes:** While there is a need for further research related to comparative outcomes based on student characteristics, the research reviewed suggests younger students (i.e., 12-16) may face a steeper learning curve with online learning, and that female students may outperform male students in a number of domains. Similarly, there may be differential outcomes based on socio economic status, race/ethnicity, and prior exposure to online learning, although further research is required.
- **Benefits:** Literature emphasizes two core benefits related to online learning. These center around increased flexibility and expanded accessibility for students who may not otherwise be able to participate fully in learning experiences.
- **Challenges:** The literature also emphasizes a range of challenges related to online learning. These center around the potential to exacerbate existing inequities as students from low-income backgrounds, rural areas, or those with limited technology access experience more substantial barriers to success. Similarly, there is a challenge related to student wellbeing, and a need to ensure that online environments foster a sense of belonging for students and are intentionally structured to support students' mental health.

In addition to these findings related to the research questions, our review of the literature also suggests the following:

- **Instructional design choices are highly influential:** Student outcomes in online learning are not determined by technology alone. This is perhaps one of the central messages we hope to convey in this review. While comparative research tends not to be definitive, there is alignment in the literature on the view that instructional design choices matter and are influential in shaping student outcomes. Course design, student characteristics, instructor presence, family/community support, and a learner's self-regulation skills all play a critical role.
- **Need for Specialized Instructor Training:** Effective online teaching requires a distinct skill set. Professional development must focus on online pedagogy, facilitating interaction, and creating engaging learning experiences within digital spaces.

- **The Importance of Student Engagement:** Motivation, active participation, and a sense of community are essential drivers of online learning success. Course design and instructor strategies that foster engagement are paramount.

Recommendations:

In the context of instructional design choices, it may be useful for the IB to consider the following with respect to the online DP pilot:

1.Modality and Course Structure

- Utilize a mix of synchronous and asynchronous learning methods. Synchronous learning is preferred for complex discussions or introducing new concepts due to the increased engagement it offers. Asynchronous learning, on the other hand, can supplement learning by providing opportunities for reflection and self-directed learning.

2. Pacing and Clarity

- Ensure clear expectations and provide accessible resources to contribute to positive learning outcomes. Coursework pace should accommodate differences in students' digital awareness and technology literacy.
- Educators should focus on creating environments that support active engagement and student autonomy, allowing learners to progress at their own pace.

3. Personalization

- Offer options for students to customize their learning pace, approach, or curriculum elements to address diverse learner needs, thereby increasing engagement and success rates.
- Design courses that allow for the development of self-directed learning skills, considering students' unique learning needs and dispositions.

4. Access to Resources

- Ensure clear and easy access to all necessary learning materials to maintain engagement and facilitate independent learning. Accessibility to the internet and technological resources is crucial, especially considering the varied socioeconomic backgrounds of students.

5. Interactions (Student-to-Student, Student-to-Teacher, Student-to-Course)

- Design collaborative assignments with clear goals and guidelines to support peer engagement and use platforms with robust discussion forums and interactive tools.
- High levels of interaction between students and teachers/facilitators improve course completion rates and satisfaction. Use instructional strategies that promote frequent and meaningful interactions.
- Monitor how students interact with course content and activities to identify those who may need additional support. Courses designed with high interactivity can lead to better engagement and learning outcomes.

6. Supportive Learning Environment

- Recognize the importance of family and school support in designing online learning experiences. Effective communication and support systems are essential for student success in online learning environments.

7. Professional Development for Educators

- Prepared educators with access to technology and professional development in online teaching practices are critical for student success in online learning environments.

By integrating these instructional design elements, K-12 online learning can be made more effective, engaging, and accessible to all students, addressing their diverse needs and learning styles.

This report

The remainder of this report is structured to first describe the approach we took to conduct the literature review. We then describe findings related to each of the four research questions, and also describe a summary of the research and recommendations related to instructional design choices.

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BACKGROUND AND METHODS

Purpose

The purpose of this literature review is to define existing knowledge on the topic of student outcomes in online learning settings and to ground the IB's understanding of the research landscape related to online learning. Conducted by the Center for Research Evaluation (CERE) at the University of Mississippi, this literature review is designed to address one overarching learning question: **What are student outcomes and experiences in online learning settings?**

Specific Aims

Towards that goal, this literature review focused on the following research questions:

1. Learning outcomes: What are the main outcomes and indicators of success that are targeted, discussed, reported on in the literature on online instruction? How do they compare with those relevant for face-to-face instruction?

- **Academic:** (e.g., program retention/attrition, participation, completion indicators, grades/GPA/test scores/diplomas; university admissions)
- **Non-academic:** (e.g., skills and competencies not typically measured by academic assessments, particularly those linked to IB's Approaches to learning framework; student motivation and engagement; student wellbeing; socio- emotional learning)

2. Comparative outcomes: Are there any differences in student outcomes in online settings based on the following conditions:

- Student demographic characteristics
- Type of platforms utilized and their technological affordances (e.g., social collaboration tools, augmented/virtual reality)
- Type of funding (e.g., public vs private schools).
- Geographical location of the students and instructional staff.
- The range of hybrid/ blended experiences.

3. Benefits: What are the benefits of online instruction in comparison to face-to-face instruction?

4. Challenges: What are the challenges of online instruction in comparison to face-to-face instruction?

Approach

To address these questions, CERE conducted a search for extant literature, using established educational research databases: JSTOR, ERIC, LearnTechLib, ProQuest, Google Scholar, and Education Source. This search was supplemented by additional reviews of recent synthesis articles produced by established educational organizations.

Inclusion Criteria

Publication Range: Publications published between 2014-2023, with a weight on post- 2020 educational implementations.

Publication type: peer-reviewed literature, meta-analyses and syntheses of research, individual articles cited in recent meta-analyses and syntheses of research, white paper and research briefs prepared by reputable organizations.

Target student population: students in middle and secondary/high school education (12-19 years old) . Students enrolled in their first/freshman year of undergraduate/higher education were also included within this age range.

Categories of online learning settings: Fully online and hybrid or blended instruction.

Search Terms

- online learning + K-12
- online learning + K-12 + outcomes
- online learning + K-12 + outcomes + academic
- online learning + K-12 + outcomes +academic (sub word - grades, GPA, diploma, university admission)
- online learning + K-12 + outcomes+ non-academic
- online learning + K-12 + outcomes+ non-academic (sub word - motivation, engagement, satisfaction, wellbeing)
- online learning + K-12 + experiences + challenges
- online learning + K-12 + experiences + benefits
- online learning + K-12 + outcomes + comparative comparison
- K-12” and “online learning” and “course completion
- K-12 + Online learning + Academic outcomes + course completion or program completion or graduation rates.

Description of Articles

After initial screening, 92 articles met the inclusion criteria; we excluded 41 articles due to lack of methodological rigor, incompatibility with inclusion criteria following additional review, or lack of peer-review. Following this initial round of reviews, CERE identified gaps in the existing literature after initial review and conducted additional searches. These searches yielded 21 articles that met our search criteria, and 14 of them also met our inclusion criteria. Following both the initial and secondary searches, this review includes a final list of 65 peer-reviewed articles, meta-analyses, and reputable sources that meet our inclusion criteria.

After excluding publications that do not meet the inclusion criteria, CERE also assessed and categorize all included articles based on research design (i.e. original research, meta-analyses of literature).

- Original, Empirical, Peer-Reviewed Articles: 44
- Meta-Analyses, Synthesis of Literature: 17
- Research Briefs and White Papers: 4

FINDINGS

Learning Outcomes

Academic Outcomes

What are the main outcomes and indicators of success that are targeted, discussed, and reported on in the literature on online instruction?

Academic outcomes represent traditional measures of student success in educational settings and include program course completion/retention/attrition rates, participation levels, and academic performance metrics such as grades, GPA, test scores, standardized assessments, and certificates/diplomas. Within this domain, we identified three key indicators of success when reviewing the literature on online instruction:

Course Completion: Course completion indicates the number of students who successfully meet the requirements of the course and receive credit: i.e., students who complete the term of enrollment in an individual course or program of study. In the literature explored here, this is measured in terms of course enrollment at term start and end dates, records on course retention, and assessment scores. Course completion is a key indicator utilized in the literature in both online and face-to-face learning outcomes. Overall, we examined 5 papers that utilized course completion as a metric for academic success. (Xu et al., 2023; Borup et al., 2019; Turley and Graham, 2019; Hart et al. 2019)

Attrition: Attrition refers to the number of students who *do not* successfully complete their program of study. In this review, CERE found 4 articles that measured academic outcomes through attrition. (Hart et al., 2019; Molnar et al., 2017; Shea & Bidjerano, 2014; Yan et al., 2023).

Academic Performance: Test performance refers to student outcomes on assessments of knowledge, skill, or understanding in a given area. In the literature sampled, assessments were conducted in various formats in both digital and in-person formats; test/exam scores, final course grades, standardized assessments, and course projects. Overall, we examined 8 papers that utilized academic performance as a metric for academic success (An et al., 2021; Batdi et al., 2023; Cano, 2022; Hamlin et al., 2023).

How do these indicators of success compare with those relevant for face-to-face instruction?

The potential for online learning to impact academic outcomes is a subject of intense interest and ongoing research. While flexibility and increased access are key advantages of online learning, questions remain about whether students achieve at the same level as those in traditional face-to-face environments. The research picture is, at times, contradictory. Some studies indicate that well-designed online courses can lead to comparable or even improved outcomes, while others highlight persistent underperformance, particularly in virtual schools serving younger students.

Course completion

Throughout this review we have found inconsistent reference to the concepts of course completion and student retention, and attrition. For the purpose of this review, course completion refers to the act of successfully meeting the requirements of an individual course, class, curriculum, or module and receiving credit or certification of completion. Course completion is one of the main outcomes and indicators of success identified in online learning. In our examination of the literature, we find evidence that course completion rates for students enrolled in online learning programs can be similar to that of face-to-face educational environments, with some exceptions for students with reduced accessibility and students enrolled in online courses for the first time or for credit recovery purposes.

In our search, CERE found varied outcomes in course completion of online courses with a focus on the role of instructor-student interaction and course commitment. Understanding the factors impacting course completion is key for institutions hoping to improve outcomes. This includes careful consideration of pacing, recognizing that students' digital literacy levels can influence their ability to successfully complete online coursework, and the impact of student self-regulation skills needed to thrive in less structured environments.

- **Reduced Completion Rates:** Online developmental courses appear to have lower completion rates than their face-to-face equivalents. This affects both the initial developmental course and subsequent gatekeeper courses. (Xu et al., 2023; Borup et al., 2019).
- **Self-Regulation as a Factor:** Student success in online developmental courses seems tied to their ability to self-regulate, indicating that these courses might place a greater demand on self-management skills than traditional courses. (Borup et al., 2019).
- **Interaction vs Completion Time:** Courses with higher levels of student-teacher interaction show better completion rates than those designed with less interaction. However, high-interaction online courses can require as much time to complete as face-to-face options. (Turley and Graham, 2019)

- **"Lag" in Online Completion:** Students in online courses may demonstrate a lag in completion time compared to face-to-face students. This applies to course completion, overall enrollment rates, and students continuing the course sequence online (Hart et al. 2019).

Key Takeaways:

- Online developmental courses need additional student support structures to address the potential for lower completion rates.
- Educators must consider the impact of increased interaction time when designing online courses.
- Institutions need to be aware of the "lag" factor, potentially adjusting expectations and timelines for online students.

Attrition

CERE reviewed four articles that examined the effects of online learning on student retention and attrition; findings suggest that while some studies indicate comparable attrition rates between online and face-to-face instruction, others suggest lower attrition rates—often linked to course design, student-teacher engagement, and digital literacy. Research suggests that student background, age, and prior academic performance play significant roles in course completion and retention rates in online learning environments.

- **Teacher Support & Retention:** Teacher support appears vital for student retention in online learning settings, particularly when traditional (face-to-face) enrollment remains an option (Hart et al., 2019).
- **Long-term Impact on Outcomes:** Students taking online courses for the first time might experience reduced long-term academic outcomes like persistence and graduation readiness when compared to students in face-to-face instruction (Hart et al., 2019).
- **Technology & Interest as Mediators:** Teacher support indirectly impacts a student's intention to continue online learning. This effect is mediated by technology usefulness and depends on the student's level of interest. Students with lower perceived interest in online learning may be more reliant on teacher support compared to students with

higher interest in online learning are reliant on technology's ease of use when faced with low levels of teacher support (Yan et al., 2023).

- **Lower Online Graduation Rates:** Graduation rates for full-time online and blended learning students remain substantially lower than those in traditional, face-to-face learning (Hart et al., 2019; Molnar et al., 2017).
- **Atypical Finding:** Interestingly, one study found increased odds of graduation for community college students taking online courses in their first year. However, specific factors like full-time enrollment and uninterrupted study seem to contribute to this outcome (Shea & Bidjerano, 2014).

Key Takeaways:

- The importance of teacher support in online learning is clear, especially to maintain student retention.
- Understanding how technology and student interest interact with teacher support can optimize online learning experiences.
- Lower online graduation rates highlight the need for institutions to address student success factors in online learning.

Standardized test performance

Test performance is identified as a key indicator of academic achievement in both face-to-face learning environments and in online learning. While this statement holds true, CERE was unable to identify a wide range of sources that speak directly to test performance in online learning environments. Most studies found spoke to academic achievement; a similar measure of performance but one without reliable and consistent measures of success. In our review, CERE found that studies, whether through availability of data or convenience, employed the use of final grades or overall GPA and class standing to measure achievement. Of the research CERE reviewed pertaining to academic performance, we find no empirical research that employed standardized examinations or assessments to assess student achievement.

Academic performance

The relationship between online learning and academic performance is complex. Studies suggest that well-designed, well-implemented online courses can lead to positive—even improved—academic outcomes for some students. Key factors include high-quality instructional design, engaging learning activities, opportunities for collaboration, and the

teacher's ability to create an online 'presence.' However, research also highlights the persistence of virtual school underperformance, particularly in early grades, where the lack of in-person structure and support might disproportionately challenge students.

Improved Outcomes

- **Meta-analysis supports positive effects:** A large-scale meta-analysis suggests online learning can lead to significant improvement in academic achievement compared with face-to-face instruction (Batdi et al., 2023). Personalization, flexibility, rich resources, collaborative activities, interaction, building community, and clear course design are associated with positive online learning outcomes (Batdi et al., 2023).
- **Specific case improvement:** One study found statistically significant improvement in academic performance for students in an online distance learning program compared to their face-to-face counterparts (Cano, 2022). However, academic performance was rated “proficient” in both brick-and-mortar and online learning.
- **Unexpected math gains during COVID:** Students showed improved math performance during COVID-related school shutdowns compared to the prior year. This included a narrowing of the performance gap between low-performing and high-performing students (Spitzer & Musslick, 2021).

Similar Outcomes

- **No significant difference during COVID:** A mixed-methods study found no significant difference in student academic achievement between online and face-to-face instruction during the initial COVID-19 pandemic (An et al., 2021).
- **Comparable first-time online course outcomes:** Students taking an online course for the first time had similar academic outcomes as those taking the same course face-to-face (Hart et al., 2019).

Reduced Outcomes

- **Virtual schools underperforming:** Overall, virtual schools have lower acceptable performance ratings compared to traditional and blended schools (Molnar et al., 2017).
- **Stronger negative impact for younger students:** Elementary and middle school students in virtual schools may experience more significant negative impacts on academic achievement than high school students (Hamlin et al., 2023).

Key Takeaways:

- Online learning can produce positive results, but quality of implementation matters greatly.
- The COVID-19 pandemic studies show unique circumstances can lead to unexpected outcomes, both positive and negative. This highlights the need for contextualized research.
- The persistent issues with virtual school performance and graduation rates point to ongoing challenges needing systemic solutions.

University admission

As the digital realm becomes increasingly intertwined with traditional educational practices, questions surrounding the efficacy and implications of online learning for university admissions have emerged as a focal point of academic inquiry. However, despite the growing prominence of online education, there remains a conspicuous gap in empirical research and systematic review addressing its impact on university admissions processes. CERE conducted multiple searches across a variety of reputable platforms and found no direct study pertaining to the outcomes of online education and university admissions. Any literature that directly spoke to this topic was found to be outside the scope of this review or not suitable for inclusion.

Key Takeaways:

- There is a notable gap in the literature relating to the relationship between online learning in middle/high school and university admission outcomes.

Non-Academic Outcomes

Non-academic outcomes encompass a broad range of student experiences and outcomes that may be influenced by both online and face-to-face instruction. Traditional measures of success, like academic performance, only tell part of the story. Online learning environments have potential to shape students' social-emotional well-being, motivation and engagement, and the development of crucial self-regulation skills. This section explores the nuanced ways in which online learning shapes a student's holistic development. CERE identified three key indicator groups related to non-academic outcomes when reviewing the literature on online instruction:

Student Motivation & Engagement, Student Health & Wellbeing, and Self-Regulation. We explore each of these domains in the sections that follow.

What are the main outcomes and indicators of success that are targeted, discussed, and reported on in the literature on online instruction?

While research has primarily focused on academic outcomes in online learning, there is a growing body of evidence suggesting that online learning can both influence—and be influenced by—non-cognitive outcomes. Our review of the research suggests there are four core outcome domains that appear to be prevalent in the research on online learning.

Student Motivation and Engagement: Research investigates how factors unique to online settings, like course design, student autonomy, and the role of the instructor, can either enhance or diminish student motivation and active participation in their own learning. In all, we examine 8 articles that speak to student motivation and engagement. Findings indicate that understanding the drivers of engagement within online spaces is crucial for promoting student ownership and a sense of purpose (Bergdhal & Bond, 2022; Borup, 2016; Chiu, 2021).

Social-Emotional Well-Being: While online learning can present challenges in building connections, research examines how virtual environments can impact students' sense of belonging, social interactions, and overall mental health. We examine 8 articles that speak to potential benefits, along with concerns raised by educators and explores strategies for creating inclusive online communities that nurture student well-being (Al Mazrooei et al., 2022; An et al., 2023; Li et al., 2023).

Self-Regulation: Self-regulated learning refers to a process that involves efforts to manage and direct complex learning activities in which learners set goals and attempt to monitor their cognition, motivation, and behavior¹. Success in online learning often hinges on students' ability to manage their time, focus in a less structured environment, and navigate digital spaces responsibly. We examine 2 articles that examine how online courses can foster essential self-regulation skills, while also addressing the need to cultivate positive online etiquette (Chiu, 2021; Xu et al., 2023)

Digital literacy: Digital literacy includes the ability to effectively use digital devices as well as the ability to create and edit online communications, while also operating in a manner that is

¹ Definition adapted from Xu et al., 2023, which cited Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation*. New York: Academic Press, and Zimmerman, B. J., & Schunk, D. H. (2011). *Handbook of self-regulation of learning and performance*. New York, NY: Routledge

responsible, safe, and legal online (Chiu, 2021). In our review of digital literacy we find 2 articles that speak to non-academic outcomes.

How do these indicators of success compare with those relevant for face-to-face instruction?

Student Motivation and Engagement

Educational literature acknowledges the critical role that of student motivation and engagement play in learning experiences (Chiu, 2023). Within this field, there have been concerns—many expressed in research outside the time scope of this literature review—that suggest online learning environments can result in reduced interaction (teacher-student; student-student; Osguthorpe & Graham, 2003) which can lead to feelings of isolation (McDonald, 2014) that reduce students' motivation to learn (Osguthorpe & Graham, 2003), and thereby affect academic outcomes such as graduation and retention (Angelino, Williams & Natvig, 2007; Borup et al., 2014). **Within the context of this literature review, there is limited research that directly compares online student motivation and engagement to that of face-to-face learning. However, several studies indicating challenges related to motivation and engagement in online learning environments.**

One survey study (Basar et al., 2021) assessed student motivation and found that online secondary school students had low motivation to participate in online learning and a preference for face-to-face instruction. In a series of interviews with educators in an online learning academy, educators raised several concerns about student engagement in an online learning environment (Borup, 2016). These centered around the difficulty of forming close relationships with peers due to lack of physical proximity; the nature of online interactions being less social; and student resistance to communicating with peers even when students are offered opportunities to do so. According to one educator: “We have some [students] who are really loners—they don’t necessarily want to have the interaction with their classmates.” Educators believed there was a close relationship between students’ abilities to form connections with their peers and motivation to engage in online learning activities. Qualitative interviews with online students and teachers in Hong Kong also suggest that online learning environments can make it more challenging for students to build a sense of belonging because of the comparatively “less warm and expressive environment” (Chiu, 2021, pp.3334). Chiu (2021) also found there was a lack of emotional engagement between online students and their instructors as demonstrated in comments such as “I did not belong to class [X]”; “I found I did not know the teachers and classmates well.”

This is supported by later studies (e.g., Borup and Archambault, 2023) which argue that many online learners need higher levels of intentional assistance to support the level of engagement needed for academic success. Conceptually, Borup et al (2020) argue there are three types of engagement that advance a student's ability to engage in online or blended learning: affective, behavioral, and cognitive engagement, and that differing types of communities (some including actors not officially associated with the course) can help to advance the three types of online engagement needs. This is supported by some empirical research in the online learning environment: Giron-Garcia and Boghiu-Balaur (2021), for example, found that students with higher levels of engagement in online tasks ("cybertasks") demonstrated higher academic achievement on their final exam. While these are not direct empirical comparisons to face-to-face environments, they reflect a general perception that students in online learning environments are likely to experience greater difficulties in motivation and engagement in comparison to face-to-face counterparts. Much of the literature within this space is therefore dedicated to exploring strategies for supporting interactions so that online learning environments can maximize the potential for student motivation and engagement. For example:

- Dehganazadeh (2023) illustrates the potential for gamification to contribute to increased student motivation.
- Turley and Graham (2019) suggest that increased student-teacher interaction may increase motivation.
- Zuo et al (2022) show that when students see online learning platforms as useful, this can positively impact their motivation.
- Bergdahl and Bond (2022) suggest that work pace, lesson design, and addressing potential issues with student self-efficacy all play a role in preventing disengagement (Bergdahl & Bond, 2022).

As Borup et al (2019) argue: the question should not be if students should engage in online learning, but rather "What support systems do you need to be successful in online learning?". The section below on instructional design explores the literature on these strategies in more detail.

Key Takeaways:

- There is limited research that directly compares student motivation and engagement in online learning environments to that of face-to-face learning.
- However, there are a number of studies indicating there may be potential for low or challenging levels of motivation and engagement in online learning environments.
- Much of the literature addresses strategies for supporting student interactions so that online learning environments can maximize potential for motivation and engagement, framing the question as “what support systems do you need to be successful in online learning” rather than “should students engage in online learning?”

Student Wellbeing

Similar to the discussion around student motivation and engagement, there are few studies that directly compare student health and wellbeing across online and face-to-face learning environments. That said, there is a general perception that online learning brings greater potential for challenges in student health and wellbeing (e.g., Dehganazadeh et al., 2023; An et al., 2021). Teachers express worry about student safety and overall wellbeing in online-only learning environments, specifically because they no longer have the ability to monitor students’ access to adequate nutrition and familial support (An et al., 2021). As above, recent studies have tended to focus on issues related to health and wellbeing in online and blended contexts—often brought about by the COVID-19 pandemic—rather than exploring comparative research across the modalities. One recent meta-analysis (Al Mazrooei et al., 2022) suggests online learning can contribute to increased stress, unhealthy lifestyles, and reduced physical activity. Studies within this meta-analysis suggested that online students and instructors reported increased fatigue, sleep reductions, back pain, headaches, eye strain, and excessive eating as outcomes brought on by the pandemic-induced rapid transition to online learning (Al Mazrooei et al., 2022). Hu et al (2022) conducted a series of interviews with principals, teachers, and students in an online education context. Interviewees felt that rural students in online schooling experienced differential effects on mental health, perhaps in part brought about by the digital divide, differences in class cultures, and differences in cultural values.

In contrast to these findings, Nash (2023) conducted a scoping review on self-directed online learning and mental health, reporting conflicting results within this domain. Among the articles in that scoping review, Li et al (2023) found a positive correlation among self-directed learning, online learning, and positive mental health—though these authors adopted a specific definition of self-directed learning (Li et al., 2023). Giron-Garcia and Boghiu-Balaur (2021) also found positive effects on mental health—a consequence of the move away from standardized face-to-face learning towards more self-directed, personalized learning approaches. Consistent

with this, Ong et al (2022) also found that online learning had the potential to contribute to positive mental health outcomes, so long as students can self-direct their learning. Manalo et al (2022), in a study of a public secondary school in the Philippines, found that most students adjusted positively to online learning; however, they did struggle with the COVID-19 pandemic—and not online learning itself. Twelve subsequent articles, though not all relating to students in middle and high school (Tagogue et al, 2022; Shepherd et al., 2021; Shao et al., Perkins et al., 2021) found there were negative effects of online learning on mental health.

As with student motivation, the literature also demonstrates a similar focus on the question of “how can we best support student mental health in online environments?” In this regard, Herman and Gill (2023) find that creating a sense of community and belonging is crucial to student wellbeing and can be built through intentional focus on social-emotional learning (SEL) models, which emphasize personalized growth for online students (Herman & Gill, 2023). Additionally, explicitly teaching self-regulated learning (SRL) strategies and using SRL interventions may help mitigate student stress and enhance academic outcomes in online settings (Xu et al., 2023).

Key Takeaways:

- There are few studies that directly compare student health and wellbeing across online and face-to-face learning environments.
- There are strategies that can help to support student wellbeing and mental health in online learning contexts, such as using SEL learning models and self-regulated learning strategies.
- There is a general perception that online learning brings greater potential for challenges in student health and wellbeing, and a portion of the literature aligns with this perception. However, research is contradictory and finds that there can be a positive correlation between online learning and mental health, particularly in instructional contexts that adopt self-directed learning approaches.

Self-Regulation

While there are similar gaps in the comparative research base, emerging research suggests potential for online learning to advance the development of self-regulation skills among online learners (Chiu, 2021). Qualitative interviews with n=54 students and teachers from 48 schools in Hong Kong suggest that teachers and students see online learning as an opportunity to build students’ self-regulation skills. Because of the comparatively less structured environment, online learning offers opportunities for students to set goals, monitor performance, regulate, and take control of their own learning. In the students’ words: “I was unable to get immediate help from the teachers; therefore I studied different solutions online and picked the best one for the homework” and “In face-to-face lessons, my teacher presence encouraged me to not monitor my learning. Basically, they did it for me.” (Chiu, 2021, pp. 3331-3332). Chiu (2021)

analyzed interview transcripts using self-determination theory (SDT) as a guiding framework, and overarchingly argued that online learning helped to advance the autonomy domain of SDT, but presented challenges for competence and relatedness (Chiu, 2021). In this way, literature explores the notion that online learning can help students “learn how to learn.”

As described in the section above, there are intentional strategies that can be used to build students’ levels of self-regulation (SRL) in online learning contexts. Xu et al (2023) conducted a scoping review that analyzed 163 studies (note: 70% in higher education and 18% at the secondary level) and found that in the majority of intervention studies (63%) the SRL intervention had positive effects on learners’ academic performance. Most interventions also used multiple SRL strategies in order to maximize the potential benefit of these initiatives.

Key Takeaways:

- Consistent with other areas, there are gaps in the comparative literature base related to self-regulation.
- However, emerging literature suggests there is potential for online learning to advance the development of self-regulation skills among online learners.

Digital-Literacy

While not a broadly discussed outcome, some articles examined the potential for online learning to build digital literacy skills. For example, Chiu’s interviews with online students and teachers in Hong Kong also suggest that online learning is seen as a mechanism to build digital literacy skills through opportunities to repeatedly engage in technical skills through trial and error (Chiu, 2021; Bedenlier et al., 2020). Students and teachers described developing digital communication skills through the life of the intervention, but also felt that digital literacy was a prerequisite for successful participation in online learning. That said, some students described spending a lot of time and effort in learning how to use the educational technology in order to learn online—this could be a frustrating and discouraging experience. Earlier research (Bedenlier et al., 2020; Chiu, 2021) suggests that students with stronger digital literacy are more likely to emotionally engage in online learning; thereby contributing to the engagement-performance cycle that has been discussed above.

Key Takeaways:

- While not a broadly discussed outcome, some articles examined the potential for online learning to build digital literacy skills.

Instructional Design Factors

A core finding from our review of student outcomes is that “it depends” in online learning. Mode of delivery does not incontrovertibly shape student outcomes; rather, our review suggests that effective instructional design is the backbone of successful online learning. Content needs to be engaging, well-organized, and paced with flexibility to accommodate diverse learners. A mix of synchronous and asynchronous methods can be powerful, with choices guided by the subject matter and students' learning needs. Regular tracking of student engagement, paired with timely, personalized feedback, is also paramount. Review of the literature yielded two primary areas of instructional design elements - those relating to course structure and those relating to interactions.

Course Structure

Modality (synchronous vs asynchronous): Instructional modality is a critical consideration when designing effective online learning experiences for students. Schueler and West's (2023) research on stakeholder perceptions of an online summer learning program suggests that synchronous learning, when students are learning in a “live” online environment with others, is preferred for complex discussions or when introducing a new concept due to the opportunity for increased engagement that it provides. Additionally, Bergdahl and Bond (2022) found that synchronous learning when supported by lessons requiring active participation reduced student disengagement.

Asynchronous learning, or online learning that occurs independently and in a non-live setting, can serve as a valuable supplemental learning resource (Mann et. al, 2021). Yang, Li, Majumdar, and Ogata's (2023) exploratory research found that embedding opportunities for reflection in self-directed learning can support academic achievement. Despite this, Schueler and West's (2023) study found that across different stakeholder groups (students, teachers and parents) asynchronous elements were perceived to be less engaging and less effective than synchronous elements.

Subject matter may also influence decision-making around instructional modality. While not explored extensively in the research base, Zeng and Luo's (2023) meta-analysis of synchronous and asynchronous learning studies found that mathematics courses may be more suitable for online learning. They examined 14 studies conducted between 2006 and 2022. The total sample size was 1,098 participants for the synchronous learning condition and 804 participants for the asynchronous learning condition. Across all studies reviewed by Zeng and Luo (2023), a trivial to small effect was found for asynchronous learning.

Pacing and Clarity: Clear expectations and accessible resources significantly contribute to positive learning outcomes (Batdi, Dogan, & Talan, 2023; Bergdahl & Bond, 2021; Pulham and Graham, 2018). Pulham and Graham's (2018) meta-review demonstrated that instructional design is a key consideration for online teaching including teacher competency related to pacing, curriculum, scheduling and learning styles. Bergdahl and Bond's (2022) case study also highlights the importance of course work pace. Bergdahl and Bond (2022) indicated that course work pace should account for differences in digital awareness or technology literacy of students alongside educator expectations and course design. This is supported by Chiu's (2023) qualitative study examining student engaging in K-12 online learning environments during the Covid-19 pandemic. Chiu's (2023) findings suggest that educators focus on creating online learning environments that support active engagement and student autonomy; providing students with the freedom to learn at their own pace and in a way that best suits their individual needs with reduced oversight or supervision. Batdi et al.'s (2023) meta-analysis of 104 studies of online learning also highlighted the importance of clarity in course design and clear expectations as instructional design factors that contribute to effective online learning experiences.

Personalization: Offering options for students to customize their learning pace, approach, or curriculum elements can enhance the learning experience. Personalization addresses diverse learner needs, increasing engagement and success rates (Pulham and Graham 2018; Li et al. 2023; Batdi et al., 2023). Flexibility in pacing is crucial, allowing students with varied digital literacy levels to find their rhythm. Batdi et al. (2023) identified personalization and learner-centered education among the key factors contributing to positive online learning experiences.

Johnson, Walton, Strickler, and Brammer-Elliott (2023) provide a systematic review examining online teaching practices in K-12 education in the United States. The authors synthesize research findings to identify effective instructional strategies, technologies, and professional development approaches for online K-12 educators. Through a comprehensive analysis of 251 articles, the paper provides insights into the current state of online teaching in K-12 settings and areas for future research and improvement. They found that several factors contribute to student success in online learning environments, including prepared educators, technology access and autonomy, students' developmental needs and abilities, and students' self-regulated learning skills. Following from this, Johnson et al., (2023) identified seven pillars of instructional practice that support student learning in online settings: evidence-based course organization and design, connected learners, accessibility, supportive learning environment, individualization, active learning, and real-time assessment.

This is supported by Li, Zhu, Yang, and Guo's (2023) quantitative research using structural equation modeling to analyze relationships between student-level factors and engagement in online learning. Li et al. (2023) found that students' information literacy, self-directed learning skills, and positive opinions toward learning positively predicted their online learning engagement. Moreover, the positive impact of self-directed learning skills on students' online learning engagement was significantly and largely enhanced through the mediation effects of positive academic emotions. Overall, Li et al. (2023) suggests that students' online learning engagement is largely augmented by enhancing their positive academic emotions in the presence of existing self-directed learning skills. Understanding that each student brings unique learning needs and dispositions and providing opportunities within courses to allow for students to develop self-directed learning skills necessitates that course design factor in personalization based on student level factors.

Access to Resources: Ensuring students have clear and easy access to all necessary learning materials is essential for maintaining engagement and facilitating independent learning (Batdi et al., 2023; Nortvig, Petersen and Hattesen-Balle, 2018). In their systematic review of studies focused on online learning during the Covid-19 pandemic, Mazrooei, Almaki, Gudna, Alnoor, and Sulaiman (2022) noted that accessibility to the internet, acceptable technological resources, and student and teacher skill in accessing online educational materials was of specific concern. This is further supported by Mawazi, Jamali, and Ebrahim(2023) review of Covid-19 and quality of education. Mawazi et al. (2023) found that some students may not have access to the technology or resources necessary to participate in virtual simulations. Basar, Mansor, Jamaludin, and Alias (2021) had a similar finding in their case study of online learning with secondary students in Malaysia. Basar et al.'s (2021) finding suggests that students' attitudes towards online learning may be influenced by their geographic location and access to resources. Additionally, the researchers found that while students may report access to technology and devices essential for course success, mitigating factors such as infrastructure, shared household use, and economic stability lead students to favor face-to-face instruction over online. Access to resources is a critical consideration when designing online courses that will need to be accessed by learners from across the globe.

Interactions

Student to Student Interactions: Designing collaborative assignments with clear goals and guidelines supports peer-to-peer engagement. Platforms with robust discussion forums and interactive tools can facilitate meaningful exchanges among students (Douglas et al. 2023; Batdi et al. 2023). Borup's (2016) mixed-method research noted that according to teachers a students' close relationship with their peers lent itself to motivation to engage in learning

activities and that student collaboration increased engagement. Borup (2016) suggested that collaboration is key to forming relationships in an online environment and this could be done via discussion boards as teachers found them more beneficial than some face-to-face interactions.

However, it is important to pay attention to the quality of implementation of discussion-based activities in order to have meaningful student interaction. Zheng, Lin and Kwon (2020) found that poorly designed online discussion assignments (i.e. student submits writing assignment response to prompt but do not have opportunity to respond or engage with other students or receive feedback) have a negative effect on student learning outcomes. This has the potential to be further compounded if students have negative interactions with peers which can contribute to feelings of isolation and decreased motivation (Borup, 2016).

Additionally, Douglas et al., (2023) provide further insights into the nature of online interactions and their impact on learning outcomes among high school students. Educator perceptions assigned importance to intentional relationship building with students, with increased discourse cited as a positive instructional tool. Despite being recognized as a positive instructional tool, Douglas et al. (2023) identify challenges with implementation related to teacher perceptions that students are not comfortable with direct interaction and scheduling as a persistent problem. Technological and curricular limitations may also arise, further disabling connections with peers. Student observations indicate that opportunities to engage in academic discourse are infrequent and often limited to interaction prompts embedded in the required curriculum (Douglas et al., 2023; Keaton and Gilbert, 2020). Douglas et al. (2023) imply that course development requires additional emphasis on academic discourse and peer-collaboration in online learning environments, with a focus on guided-discussion and collaborative assignments. Similarly, Keaton and Gilbert (2020) find that for students at an online high school, student to student interactions are not as prevalent as they would be in a traditional school. Challenges posed by differences in geography and time-zone than their peers and commitment to extracurricular activities were reported as key drivers of reduced peer interactions.

Student to Teacher Interactions: High levels of interaction between students and teachers/facilitators improve course completion rates and satisfaction (Turley and Graham, 2019; Borup et al., 2019). Turley and Graham (2019) found that students reported acceptable levels of student satisfaction across course offerings with varied levels of teacher-student interaction but experienced a general increase in satisfaction in areas in a course with higher levels of interaction. Additionally, the effect of increased student-teacher interaction led to higher completion rates compared to limited-interaction courses. Turley and Graham (2019) show

that limited student-teacher interactions can lower motivation and that increased interactions with students may increase motivation, but this is heavily dependent on teacher training and perceptions. Borup et al., (2019) identify the value that on-site facilitators bring in supporting online learning. Key supports provided include educator feedback, performance monitoring and motivation. For fully online schools and teachers, like those in the DP Online Pilot, it is important to identify ways to ensure that students and teachers build strong relationships and systems of support including timely feedback and progress monitoring.

Whiteside, Dickers and Tap (2017) discuss multiple instructional strategies that support student to teacher interactions. The authors suggest that in interactions, teachers should be prompt in responding to students, provide frequent feedback, and use humor and personal stories as appropriate.

Borup and Archambault (2023) advance the Academic Communities of Engagement (ACE) framework as a tool to help understand how to tailor support systems for students that increases affective, behavioral and cognitive engagement. This framework identifies supports that narrow the gap between independent engagement without support and the level of engagement for academic success. Cognitive engagement increases when students receive instructing and collaborating support, while behavioral engagement increases with troubleshooting and orienting, organizing and managing, and monitoring and encouraging progress. Affective engagement increases with facilitating communication, developing relationships, and instilling excitement for learning.

Borup and Archambault (2023) indicate two communities that facilitate online learning: the students' course community and their personal community. Course community includes teachers, other students, facilitators/mentors, aids, and other support staff. Parents/guardians and caretakers make up the students personal community. Borup and Archambault (2023) indicate that this community usually has more of a role early in a student's life as it becomes more difficult once a student reaches secondary school.

Student to Course Interactions: Monitoring how students interact with course content and activities helps identify those who may need additional support. Courses designed with high interactivity may demand more time commitment from students but can lead to better engagement and learning outcomes (Heinrich, Darling-Aduana, & Cheng, 2019; Turley and Graham 2019). Heinrich et al. (2019) found that students who were engaged and students who completed courses at night (moonlighting) were far more likely to complete course activities. Additionally, students who spent more time in their classes and completed more activities per day were more successful and less likely to have poor performance. Heinrich et al. (2019) also noted instructional strategies that were found to increase student online performance

including student note taking and note checking by instructors before test taking, weekly check ins, monitoring students through online systems, disabling courses due to lack of progress, and limiting the number of courses in which students were enrolled.

Like Heinrich et al. (2019), Zheng, Lin and Kwon (2020) found that students who logged in more time and stayed in the online learning platform longer had significantly higher final grades than others. Zheng et al.'s (2020) study investigated the impact of learner-, instructor- and course-level factors on online learning through use of hierarchical linear modeling and content analysis. Additionally, they found that project-based assignments and high-level knowledge activities were beneficial to learning outcomes – though not necessarily among students who took these courses for credit-recovery purposes. This suggests that the ways that students interact with course content (i.e. assignment and activity types) can influence student learning outcomes.

Opportunities for Family and School Support: While not directly related to interactions within the course, it is important to recognize the importance of family and school support when designing online learning experiences. Morgan (2015) advances poor implementation is the cause of poor online learning experiences. Lack of structures to check student attendance, monitor activity and monitor time spent online contribute to decreased student success in online learning. Schools need to build systems to ensure that students are engaging in online courses.

Borup and Archambault (2023) note the importance of the student personal community (i.e., parents/guardians and caretakers) in facilitating online learning for students. Similarly, Gonzalez-DeHass, (2022), Willems, Powers and Musgrove (2022) discuss the importance of involvement practices that value meaningful digital learning opportunities, parental concerns over the shift to digital spaces, parental confidence using technology, and utilizing technology to foster bi-directional communication to address parents' concerns as they support their children's digital learning. Bi-directional communication between online educators and parents can be an effective tool for building successful relationships, across diverse backgrounds. Gonzalez-DeHass et al. (2022) use of bi-directional communication offers educators the opportunity to express interest in and understand parents' concerns and build trust between schools and parents.

This is supported by Wang, Wang and Li's (2023) use of structural equation modeling to explore factors contributing to student achievement in K-12 online learning settings. Wang et al.'s (2023) study revealed that family involvement accounted for 50.45% of the direct effect associated with student academic achievement. Furthermore, school support accounted for 49.55% of the total effect on student academic achievement (mediated by online learning

engagement and the Big Five). These results highlight the importance of school and family support for successful online learning outcomes for students.

Key Takeaways:

- Modality of instruction plays an important role in online learning with synchronous learning preferred for engagement and complex discussions, with asynchronous learning supporting self-directed learning and guided reflection.
- Clear expectations, well-structured lessons, accessibility of resources, and maintaining a pace that accommodates diverse learners' needs are essential to successful online learning experiences.
- Allowing autonomy and personalization in elements of course content can boost student engagement and cater to diverse learning styles.
- Interaction is key; peer and instructor interaction provide collaborative opportunities for students and allow for timely feedback and support for instructors.
- Engaging families and provided school-based supports can lead to increased student achievement in online learning environments.
- While instructors should provide scaffolding support where necessary, fostering students self-directed learning skills are imperative to student success.

Comparative Outcomes

Age

While online learning is becoming increasingly prevalent across K-12 settings, there is a need for more targeted research on how a student's age specifically impacts outcomes within online environments. To date there are few comparative studies explicitly addressing this topic, although emergent findings generally suggest that **older students (e.g., high school; ages 16-19) tend to have more favorable outcomes in online environments when compared to their younger counterparts** (e.g., middle school; ages 12-16). For example, Hamlin et al (2023) investigated the academic performance of full-time virtual school students in Oklahoma across a four-year period (2016-2019). Using secondary data on student performance (ELA test scores) the study applied a fixed effects model comparing students who attended virtual schools to those who attended traditional brick-and-mortar schools. Although Hamlin and colleagues (2023) found an overall *negative* relationship between attending a virtual school and academic achievement, they also found that this negative relationship was stronger for elementary and middle school students than high school students. In short: elementary and middle school students struggled more than their high school counterparts. In particular, rural virtual schools in grades 3-8 had substantially lower levels of academic performance when compared to their peers at brick-and-mortar schools (Hamlin et al., 2023), suggesting an

interplay between geography and age. Heinrich et al., (2019) found a similar trend when differentiating 9th and 10th graders from 11th and 12th graders. Heinrich et al., (2019) examined the relationship between online instruction and math and reading schools among students in grades 9-12 at 46 high schools in an urban, Midwestern school district over a four-year prior (AYs 2014-2017). Overall, the research team also found a negative relationship between online course taking and math/reading scores—but, when the team removed 9th and 10th graders from their analysis model, researchers found that 11th and 12th graders earned significantly more credit and had significantly higher GPAs than face-to-face counterparts. Nevertheless, even when removing 9th and 10th graders, the 11th and 12th graders still did not show higher levels of student learning, as measured by their standardized reading and math scores (Heinrich et al., 2019).

Studies exploring somewhat younger students also find differences between students of different ages, with findings following the same general trend that younger students appear to have greater challenges. In a study examining n=148 extra-curricular English courses taken by more than 200,000 Chinese students, Pi et al., (2023) found that performance among middle grade students (in this study, grades 3-4, slightly younger than the age range targeted for this review) tended to drop out of online classes after significant milestones (e.g., after a midterm test). In contrast students in the higher grades (here, grades 5-6) tended to maintain a stable performance across the semester. Some of these differences may relate to younger students' metacognitive abilities and self-regulation (Pi et al., 2023). Building on these findings, Pi and colleagues (2023) suggest that younger learners might need more explicit guidance, clear pacing, and potentially more frequent synchronous elements to maintain focus and feel supported in online courses (Pi et al., 2023).

Key Takeaways:

- There is a need for further research in this area.
- The limited research we found suggests older students tend to have more favorable outcomes in online learning environments when compared to their younger counterparts.
- This may be due to younger students' developmental stage and developing metacognitive skills. Consequently, younger students may benefit from more explicit guidance, clear pacing, and attention to instructional design factors.

Gender

Consistent with much of the literature described above, **there does not appear to be a definitive answer on the role that gender plays in shaping student outcomes in online**

learning. That said, three studies (Boyle, 2023; Dehganade, 2023; and Mann et al., 2021) suggest that **male students may not perform as well as female students in online learning.** Mann et al (2021) examined a pre-pandemic sample of 62,910 students from a statewide online program that was primarily used as a supplemental learning resource. Using multi-level modeling (nesting students in schools; schools in districts), the study examined the role of various demographic characteristics on online school GPA and the likelihood of a student scoring lower than a C. In this study, students identifying as male had lower GPAs and were 1.86 times more likely than their female peers to score below a 70 in their online course (Mann et al., 2021). Boyle (2023) similarly found that females performed higher in both online and blended learning environments, and a systematic review of the use of gamification in K12 education suggested that female students performed better than male students in math (the subject being studied) but these differences were not statistically significant (Dehganadeh, 2023). At the same time, in a study of 919 students enrolled in eight online high school English language courses, Zheng et al., (2020) found that gender did not significantly predict final grades when also accounting for usage levels, special education needs, and reason for enrollment (specifically: for credit recovery). Taken together, these findings suggest there may be a potential gender gap in performance in online setting, although there is need for further investigation.

Key Takeaways:

- There is a need for further research in this area.
- The limited research we found suggests male students may not perform as well as female students in online learning.
- There is need for further research delving into whether this holds more broadly, and if so, why it may be the case.

Socioeconomic Status (SES)

Disparities in access to technology, internet connectivity, and at-home support are deeply intertwined with socioeconomic status. These factors **significantly impact student success in online courses and can create unique barriers for some learners within online environments** (Batdi et al., 2023; Mann et al., 2021).

We see evidence that **students from lower SES backgrounds do not perform as well as those from higher-income backgrounds in the context of online learning in a number of studies** (Mann et al. 2021; Golden et al., 2023) although much of this discussion relates to online learning in the context of the COVID-19 pandemic. In the statewide analysis described above, for example, Mann et al., (2021) found that online students with free lunch were 1.92

times more likely to attain a course average below 70, and students reduced lunch were 1.43 times more likely to have a course average below 70, as compared to those who were not on free or reduced lunch. Some studies suggest there may be similar differences in the US context based on race, however there is a strong connection to socio-economic status in the study. Having said that, there is also research to suggest online learning can be valuable in low income populations. Schueler et al., (2023) conducted a five-week, largely synchronous summer program that served approximately 12,000 incoming 4th to 9th graders, most of whom were low-income students of color. A representative sample of teachers, educator, parent, and student surveys suggest the curriculum was well received, perceived as high quality, and community members believed it led to gains in student learning.

It is plausible that access to technology, internet connectivity, and at-home familial support may go some way to explaining observed differences, particularly during the pandemic. More specifically:

- **Access to technology:** Students from low income families tend to be less likely to have access to technology and reliable, high-speed internet connectivity (Batdi et al., 2023; Golden et al., 2023; Heinrich et al., 2019) which impact their ability to engage in online learning. A number of studies suggest that length of time engaged in online learning is a significant and positive predictor of success in learning (Zheng et al., 2020; REFS); limited connectivity therefore impacts the potential for sustained engagement with online platforms. Relatedly, Basar et al., (2021) described a case study exploring students' perceptions of online learning at a secondary school in Malaysia and found that students' attitudes towards online learning can be influenced by access to resources (e.g., shared use of household technology and consistency in internet connectivity). In this way access to technology (or lack thereof) may play both a functional role, and an attitudinal one, in the relationship between SES and online learning.
- **At-home familial support:** Students from low SES backgrounds might face additional challenges if they lack adequate familial support or a dedicated workspace at home (Golden et al., 2023; Basar et al., 2021). As described by Keaton and Gilbert (2020), parents' roles can shift in online learning environments. As instructors come to become more like content creators and course designers, parents become responsible for day-to-day management and oversight. In this way, their level of engagement becomes a key predictor of success: one study examining data from 1,625 students across 132 online classes (Wang et al., 2023) found that family involvement in learning accounted for 50.45% of the total effect on academic achievement. Parents may not have a clear understanding of their role in online learning and may be left to guess what the

appropriate strategy for engaging their students may be (Keaton and Gilbert, 2020). Consequently, strategies for engaging parents in online learning environment can become a key consideration for instructional design. With that said, this finding also comes with a caveat: in Borup's (2016) study, teachers believed that overly engaged parents could become an obstacle to their child's learning; thus, the question of parental engagement may be akin to the 'goldilocks challenge' and seeking an effective balance.

Key Takeaways:

- Online students from lower socioeconomic backgrounds do not appear to perform as well as their counterparts from higher socioeconomic backgrounds.
- However, this is likely attributable to differences in access to technology, internet connectivity, and at-home familial support. These factors appear to have been particularly influential during the COVID-19 pandemic.

Type of Funding (e.g. Public vs. Private Schools)

The relationship between school funding and the success of online learning programs remains an under-researched area. While some studies touch on the potential for online learning across both public and private school systems, there is limited research that directly explores differences in outcomes across the two funding streams. Within the current literature base, we do see examples of online learning programs that contribute to academic gains at both public and private institutions. Cano et al., (2002), for example, describe a privately run senior high school in the Philippines with both face-to-face and online modalities. Their study, which examined the academic performance of 11th and 12th graders (as measured by average final grades) illustrated stronger academic performance amongst those in the online modality. Keaton and Gilbert (2020) similarly explore students within the context of a private online high school within a U.S. context; this study was more qualitative in nature and described a range of benefits, challenges, and instructional design factors that are described elsewhere in this review. Furthermore, Wang et al., (2023) explored the relationship between family support, school support, "Big Five" character development, online learning engagement, and academic achievement; Wang and colleagues found that school support affects academic achievement through online learning engagement and in particular, emotional engagement. However, the study did not account for differences in school funding type even though the sample included both private and publicly funded schools.

Key Takeaways:

- More comparative research is needed directly comparing outcomes in online programs across public and private settings to better understand the impact of funding models.
- While there is research related to online learning within the context of both private and publicly funded schools, this research does not explicitly focus on the effects of specific funding models.
- It may be valuable for future research to explore the nature of school supports offered at both public and private schools, as one way to examine the level of influence funding mechanisms exert on student experiences.

Geography

Geographical location, encompassing factors like **rural vs. urban settings, distance from learning centers, time zones, and access to reliable technology, appear to significantly influence the online learning experience for both students and instructors** (Mann et al., 2021; Keateon et al., 2020; Hu et al., 2020; Hamlin et al, 2023; Batdi et al., 2023; Basar et al., 2021). Broadly speaking, students in rural settings appear to be at a disadvantage in online learning (Batdi et al., 2023; Hu et al., 2022) although a number of studies suggest this is related to a higher likelihood of accessibility issues (i.e., technology and reliable internet) among rural students (Hu et al., 2023; Basar et al., 2021). In particular, Mann et al., (2021) found that students further from cities (e.g., those in suburbs or fringe rural areas) were more likely to experience challenges with online learning when compared to their urban counterparts. Hu et al., (2022) also found that urban students in the context of China have higher levels of digital literacy which can shape student engagement in online learning platforms. This same study found that instructional practices differed across urban and rural schools such that urban schools in their sample tended to hold more synchronous sessions; another potential factor influencing student participation and engagement. In this same study, Hu and colleagues observed reductions in mental health among students at rural online schools, suggesting a particular need for attention to student wellbeing within rural online contexts. Perhaps connected to engagement and wellbeing, Keaton et al., (2020) argue that challenges related to geography and time zones serve as some of the key drivers in reduced peer-to-peer interactions in online contexts; another marker of the student engagement that may influence overall learning outcomes.

Key Takeaways:

- Geographical location, encompassing factors like rural vs. urban settings, distance from learning centers, time zones, and access to reliable technology, appear to significantly influence the online learning experience for both students and instructors.
- Students in rural settings appear to be at a disadvantage in online learning.
- This may likely be a product of access to hardware, internet accessibility, and different types of engagement with peers and learning environments.

Hybrid & Blended Experiences

Hybrid and blended learning models offer the flexibility to combine online instruction with in-person experiences. This approach has the potential to expand learning opportunities by connecting students with local organizations, facilitating community projects, and promoting hands-on learning. In this section, we explore research on the potential for hybrid learning as a distinct modality. **Overall, our review suggests there is potential for hybrid learning to offer unique learning experiences, although there is no clear consensus about its impact on student learning.**

There are contradictory results among studies assessing differences in academic learning across online and hybrid environments (Boyle, 2023; Molnar et al., 2017; Nortvig, 2018). In a 2017 white paper describing the performance of online and blended schools in the United States, the National Education Policy Center argued that virtual schools were underperforming as compared to traditional and blended schools (Miron et al., 2017). At that time, state-based school-level performance data showed that only 37.4% of fully online schools received acceptable performance ratings, compared to 72.7% of blended schools. Graduation rates, however, were relatively comparable across the two school types (43.4% for fully online vs 43.1% for blended); but both were significantly lower than traditional brick and mortar schools (82.3%). Follow up data from the 2021-2022 school year suggest slight improvements in online school performance, with 41.2% of fully online schools receiving acceptable performance ratings and online graduation rates sitting at 65.1% (Marion et al., 2023), although there were no comparable performance ratings for hybrid schools due to the pandemic, and the 2022-2023 data have not yet been released. Somewhat in contrast, a dissertation from Boyle (2023), exploring fall, winter, and spring scores on Common Formative Assessments (CFA) among 2,433 9th grade ELA students in southwest Tennessee, found that students who transitioned from purely online learning to a blended learning environment had lower scores on the CFA at the end of the school year.

Much like the broader research on online learning, some authors argue there is “no one right way” to conduct hybrid learning; instead, there are a range of instructional design choices to be considered and aligned to specific student needs (Nortvig et al., 2018; Boelens et al., 2017). In a review of 623 literature sources relating to designing blended learning, Boelens et al (2017) identified four core design considerations: flexibility, strategies for facilitating interactions, strategies for facilitating learning, and strategies for fostering affective learning environments. Similarly, Nortvig and colleagues’ (2018) review of 93 articles found that instructional design choices and implementation characteristics were more important than delivery type. In particular, they found that educator presence, student-teacher-content interactions, connections between online and offline activities, and connections between campus and practice-related activities were key features that dominated the literature discussion.

Notwithstanding the above, blended learning environments offer several opportunities not present in purely online learning. These include opportunities for hands-on learning that may be difficult in the absence of in person events, for collaboration, and for connection (Jayakumar et al., 2022; Joia & Lorenzo, 2021; Müller et al., 2021). Blended learning environments also present a unique challenge for educators in that they also require distinct skills and professional development; one study has found that many educators in blended environments are not fully prepared for the unique nature of hybrid teaching and may also overestimate their skills in this domain (Parks et al., 2016).

Key Takeaways:

- As Nortvig and colleagues (2018) summarize: *“On the whole, our review of studies comparing F2F teaching to online and/or blended learning reveals that no inherent features of any of the three teaching formats produce either better or poorer learning outcomes for students.”*
- Instead, there are a range of instructional design choices to be considered and aligned to specific student needs.
- Blended learning environments also present a unique challenge for educators in that they require distinct skills and professional development.

Platform Type

For the purposes of this review, we also explored literature on different types of online learning platforms, seeking prior research on AI-powered tools; tools designed to promote social collaboration; and tools that use virtual or augmented reality. **There were relatively few studies that directly spoke to web-based learning platforms; these studies also varied in their methodological rigor and strategies for measuring implementation and**

outcomes. While many studies mention various online learning platforms and tools within the context of specific studies, we did not find a substantial amount of literature that focused on the affordances of specific platforms of tools.

AI/Machine Learning Tools

Our search identified two articles exploring AI- and machine learning-powered tools. Hsiao et al (2023) piloted an online course *Let's Learn to Use AI-Powered Tools to Become Autonomous English Learners* via an online platform (Taipei Cooc-Cloud) with students aged 15-17 in Taiwan. This course embedded three AI-powered tools (Linggle Write, Linggle Read, and Linggle Search; all designed by the authors) to provide AI-generated corrective feedback to English language learners. Forty-three students from ten senior high schools took the course in Autumn 2021 or Spring 2022. Study results show that the platforms were perceived positively, and that integration of new AI-powered tools into an online course requires a clear explanation of the rational, step-by-step instructions on how to use the tool, opportunities for practice, opportunities to reflect on and share user experiences, and opportunities for timely and direct feedback on performance from teachers and peers. Chao et al (2023) similarly conducted a pilot study with 28 journalism students at a public high school in Maryland. Chao and colleagues piloted use of *StoryQ*, a web-based machine learning and text mining tool to teach a 10-hour module on *Exploring Artificial Intelligence (AI) in English Language Arts*. StoryQ uses machine learning algorithms to build understanding of AI and machine learning through text-based prompts. Pilot feedback indicated that students found the module informative and enjoyable. Students also reported that it shifted their perceptions of AI, away from the notion that AI=robots and towards a more complex and nuanced understanding of the field. Student assessments also showed that students began to gain skills and understanding in foundational machine learning domains through the StoryQ platform.

Augmented/Virtual Reality

Augmented and virtual reality (AR/VR) offer exciting potential for immersive and engaging learning experiences. However, their effective integration into the classroom presents both opportunities and challenges. Below, we present the findings of the sole article that presented empirical research on the use of AR/VR in educational settings, although it is important to note that this study falls outside the primary age range for this review as it describes VR use in the context of English language learning at a PYP programme. The research conducted by Ashley-Welbeck & Vlachopoulos, (2020) investigated AR adoption in an Egyptian IB school, revealing a complex picture of teacher attitudes and student uptake of AR/VR technologies. Core messages from this study include:

- **Benefits:** Teachers saw opportunities to increase student vocabulary, improve pronunciation, and improve grammar and translation using the augmented reality application.
- **Challenges:** Ashley-Welbeck and Vlachopoulous (2020) identified three major issues with the AR application: technical difficulties (i.e., the technology did not work), student-related issues during the AR exercise (e.g., issues with sound/volume and motor skills that affected ability to hold the tablet), and a need to improve the actual application.
- **Teacher attitudes:** While teachers interviewed for this study considered themselves tech-savvy, some were cautious about the use of technology in the PYP and believed there were negative effects on students' health, social lives, and overall development. Even those who viewed technology as a positive development had concerns about its potential to negatively impact child development.

Social Collaboration Tools

Social collaboration within online courses has the potential to enhance learning, foster a sense of community, and combat feelings of isolation. However, research highlights that the effective use of collaboration tools in online learning presents challenges and opportunities. Borup (2016) points to research which suggests that asynchronous communication tools like discussion boards and emails are a hindrance to student communications, citing time commitment and disadvantages for students with reduced reading abilities. However, these tools are often essential to student success in online courses and have the potential to increase interaction for otherwise socially limited students (Borup, 2016). Douglas et al., (2023) also observe that while educators may insist on student engagement in online discussions, the lack of synchronous communication and vary time-zones make it difficult to actively enforce participation. It is imperative to acknowledge the barriers students and teachers face and develop strategies to create more meaningful student-to-student interaction in online environments.

- **Infrequent or Superficial Collaboration:** Peer collaboration can be limited in online courses, with students often uncomfortable with direct interaction and facing scheduling barriers. The focus tends to be on content-based discussion prompts rather than deeper discourse (Douglas et al., 2023; Keaton and Gilbert, 2020).

- **Resistance to Online Interaction:** Some students actively resist online communication, and a lack of physical proximity can hinder the development of social bonds (Borup, 2016)
- **The Potential of Discussion Boards:** When used effectively, discussion boards can facilitate collaboration and meaningful connection, sometimes even exceeding the quality of face-to-face interactions (Borup, 2016).

Key Takeaways:

- There is a need for further research that examines individual platforms and communication tools that aim to improve the quality and frequency of peer-to-peer and student-instructor interaction and collaboration.

Benefits

Beyond the topics discussed earlier in this review, the research on online learning centers on X core benefits to online learning: flexibility, broader access, and opportunities for non-traditional students. With that said, it should be acknowledged that the literature does not typically discuss these in “studies on the benefits of online learning”; rather, they reflect positive by-products we have observed in the research studies described throughout the rest of this review.

Flexibility

First, the literature on flexibility for online learners is broad (e.g., Batdi, Dogan, & Talan, 2023; Chiu, 2023; Morgan 2015). Flexibility in the online learning space can allow students to work on their classes on their own time, at their own pace, place, and perhaps pace of learning (Horn & Staker, 2014, as cited in Boelens et al., 2017). This can come in the form of personalized learning plans, individualized resources, and activity choices (Batdi et al., 2023). This is particularly the case for asynchronous learners, as learners can be located anywhere in the world and do not have to be located within the same time zone to align with synchronous class times (Boelens et al., 2017). This aligns with Chiu’s (2023) research on self-directed learning contexts, as the flexibility of online learning allows learners to take control over learning choices, work at their own pace, and also seek out multiple learning resources. As described above (Morgan, 2015; Xu et al., 2023), self regulated learning appears to be positively related with academic outcomes in online learning contexts; thus, the notion of flexibility may have both academic and personal benefits.

Accessibility and Opportunity

Another benefit is increased opportunities for students. Heinrich (2019), Morgan (2015), and Wang (2023) suggest that online learning provides greater opportunities for students who may traditionally be excluded from learning to participate in educational endeavors. This includes students who are pregnant, already parents, incarcerated, or have been expelled: all have an opportunity to take online classes and some online schools serve high proportions of these populations (Heinrich, 2019). Morgan (2015) also notes that students with disabilities can participate in learning when they otherwise would not be able to participate. Related to this, Wang (2023) notes that online learning also creates an avenue for parents to take ownership of their child's education.

Key Takeaways:

- Flexibility in the online learning space can allow students to work on their classes on their own time, at their own pace, place, and perhaps pace of learning.
- Online learning provides greater opportunities for students who may traditionally be excluded from learning to participate in educational endeavors.

Challenges

Teachers require online-specific Professional Development (PD)

The onset of the COVID-19 pandemic along with the shifts to online learning posed a significant challenge to educators, particularly those with little training in online education practices. Teacher professional development (PD) is recognized in the literature as an essential component to student success in online learning environments.

In the context of the COVID-19 pandemic, An et al (2021) argued that **the rapid shift to online learning exposed the lack of online-specific teacher training**, which hindered a transition to effective online instruction. Although somewhat dated, Archambault et al (2016) demonstrated that very few (4.1%) responding teacher preparation programs across nine states offered training in online instruction. At the individual educator level nearly nine in ten (88.3%) teachers in this study said their teacher preparation programs did not provide the opportunity to train in online instruction skills. Although Archambault and colleagues (2016) have observed some increased exposure to online teaching in pre-service field experiences, this area remains vastly underdeveloped. Perhaps consequently, in An et al's (2021) study, a majority of teachers expressed interest in receiving PD focused on online teaching strategies.

In addition to the absence of training, research also notes that online instructors require unique skills to succeed in online learning environments. For example, teachers with strong 'presence skills' (creating an engaging online atmosphere) have a positive influence on student learning outcomes (Pi et al., 2023). This implies specific PD needs in this area, as well as in online interaction strategies, as discussed in the section on instructional design. Blended teaching requirements are also distinct from entirely virtual teaching requirements, and many teachers who work in blended learning contexts may not have the full range of competencies needed for effective blended instruction (Parks et al., 2016). Parks et al (2016) also describe a need for online-specific PD to model successful blended and online practices and to include tools to measure their impact on student learning (Parks et al., 2016), while other research has found that intensive, extended PD programs can significantly enhance teacher confidence and expertise in online delivery (Cavanaugh & Roe, 2019).

Geography, Accessibility, Student characteristics

This report has also acknowledged the significant challenges associated with geographical location and the availability of services essential to online learning. Several studies found that students in rural areas might face limited internet connectivity, reduced access to suitable devices, and technological barriers that hinder their online learning success (Batdi et al., 2023; Golden et al., 2023; Hamlin et al., 2023). Challenges presented in this digital divide often impact students in rural and remote areas and create additional hurdles for students with reduced socioeconomic status. We also identify studies which show students from high-poverty backgrounds may experience exacerbated learning loss and difficulties due to limited technology and internet access (Golden et al., 2023; Heinrich et al., 2019; Hu et al., 2022). We also find that students from lower socioeconomic backgrounds may experience reduced familial support and additional challenges with engagement (Golden et al., 2023).

Emergency Remote Teaching

The abrupt shift to Emergency Remote Teaching (ERT) during the COVID-19 pandemic exposed both the challenges and potential of online learning on a massive scale. This unplanned shift to online learning presented several challenges for instructors and students alike. However, it also provided an opportunity to learn more about the effectiveness of online learning and identify factors that contribute to student success in online environments. Of these impediments to student success, technological barriers presented a significant challenge to online learning during ERT. Students and educators alike faced issues limited internet access, insufficient devices, and gaps in digital literacy (Al Mazrooei et al., 2022). Students and teachers alike struggled with feelings of isolation and a lack of social interaction inherent in the online environment (Al Mazrooei et al., 2022; Borup, 2016) with educators reporting feeling overwhelmed, anxious about their new online roles, and concerned for student well-being and

academic progress (An et al., 2021; Morgan, 2015). The reliance on online learning raised concerns about both the physical and mental health impacts on students due to factors like isolation, increased screen time and sedentary environment, and reduced social interaction (Al Mazrooei et al., 2022; Nash, 2023). As noted in the discussion of teacher professional development, the transition to online learning revealed the need for increased instructor training in designing and implementing courses virtually. While the learning environment experienced during ERT is not identical to programs delivered exclusively online, these challenges highlight the need for emphasizing teacher and student development to ensure success in online learning.

Academic Dishonesty

In our examination of the literature CERE found limited discussion of academic dishonesty in online learning environments. In their assessment of teacher perceptions at an exclusively online high school, Borup (2016) noted cheating as a drawback to online learning; often discussed as a potential outcome of peer-to-peer collaboration in online environments. However, the author also notes that educators did not find that academic dishonesty was pervasive in these environments, nor did it outweigh the benefits of facilitated, online interactions. Further, Morgan (2015) noted the increased potential for cheating in their criticisms of online learning.

CERE conducted additional searches in an attempt to provide a rich perspective on the challenges of online learning as they pertain to academic dishonesty, yielding few results that met the inclusion criteria for purposes. These searches revealed that while this is not an understudied area of online education, there has been little research done on the impacts of rapid deployment of online learning on students' propensity for academic dishonesty. Research that does exist in this area focuses on impacts across higher education and provides little exposition to the role of academic dishonesty in online, K-12 educational environments. The lack of research specific to students in early and late secondary education during, and following, periods of schools transitioning to online learning speaks to the need for developing an ongoing understanding of the role rapid transition to online learning may have on student academic dishonesty.

Key Takeaways:

- The rapid shift to online learning exposed the lack of online-specific teacher training; this is relevant because research also notes that online instructors require unique skills to succeed in online learning environments.
- The effective use of collaboration tools in online learning can present challenges for students.
- There are significant challenges associated with geographical location and the availability of services essential to online learning.
- Potential for academic dishonesty may be a drawback for online learning.
- There are residual stressors and anxieties associated with online learning as a result of the rapid transition to emergency remote teaching during the COVID-19 pandemic. It is important to acknowledge the differences between emergency remote teaching and intentional online learning.

CONCLUSIONS & RECOMMENDATIONS

The research presents a nuanced understanding of online learning's potential, along with the challenges that emerge in its application. Ultimately, online learning is a tool – its effectiveness depends on the quality of platform and user skill, both students and instructors. While online environments offer unique opportunities for flexibility, personalization, and increased access, realizing these benefits requires a proactive, multifaceted approach. Success hinges on addressing the digital divide, investing in intentional course design, supporting both students and educators in navigating online spaces, and prioritizing social-emotional well-being alongside academic goals.

The COVID-19 pandemic's abrupt shift to Emergency Remote Teaching (ERT) exposed both the potential and the limitations of rapidly implementing online learning. Overall, CERE finds that ongoing, rigorous research is needed to compare outcomes across various online learning contexts, age groups, and instructional approaches. This research must look holistically at how the interplay of design, support structures, and student characteristics influence success.

Based on the above review, and particularly drawing on our research on instructional design in the online context, it may be useful for the IB to consider the following recommendations in the context of the DP online programme:

1.Modality and Course Structure

- Utilize a mix of synchronous and asynchronous learning methods. Synchronous learning is preferred for complex discussions or introducing new concepts due to the increased engagement it offers. Asynchronous learning, on the other hand, can supplement learning by providing opportunities for reflection and self-directed learning.

2. Pacing and Clarity

- Ensure clear expectations and provide accessible resources to contribute to positive learning outcomes. Coursework pace should accommodate differences in students' digital awareness and technology literacy.
- Educators should focus on creating environments that support active engagement and student autonomy, allowing learners to progress at their own pace.

3. Personalization

- Offer options for students to customize their learning pace, approach, or curriculum elements to address diverse learner needs, thereby increasing engagement and success rates.
- Design courses that allow for the development of self-directed learning skills, considering students' unique learning needs and dispositions.

4. Access to Resources

- Ensure clear and easy access to all necessary learning materials to maintain engagement and facilitate independent learning. Accessibility to the internet and technological resources is crucial, especially considering the varied socioeconomic backgrounds of students.

5. Interactions (Student-to-Student, Student-to-Teacher, Student-to-Course)

- Design collaborative assignments with clear goals and guidelines to support peer engagement and use platforms with robust discussion forums and interactive tools.
- High levels of interaction between students and teachers/facilitators improve course completion rates and satisfaction. Use instructional strategies that promote frequent and meaningful interactions.
- Monitor how students interact with course content and activities to identify those who may need additional support. Courses designed with high interactivity can lead to better engagement and learning outcomes.

6. Supportive Learning Environment

- Recognize the importance of family and school support in designing online learning experiences. Effective communication and support systems are essential for student success in online learning environments.

7. Professional Development for Educators

- Prepared educators with access to technology and professional development in online teaching practices are critical for student success in online learning environments.

By integrating these instructional design elements, K-12 online learning can be made more effective, engaging, and accessible to all students, addressing their diverse needs and learning styles.

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