

How did COVID-19 Affect Education and What can be Learned Moving Forward? A Systematic Meta-Review of Systematic Reviews and Meta-Analyses

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The COVID-19 pandemic drastically impacted the educational sector on a global front. A plethora of research has been conducted to better understand the effects that the pandemic had on education as a whole, including investigations into different topics (e.g., school closures, e-teaching and learning, mental and physical health), populations (e.g., students, teachers), and levels of education (e.g., school, higher education). To summarize the available literature on education during the pandemic both qualitatively and quantitatively, many systematic reviews and meta-analyses have begun to emerge. With the present systematic meta-review, we aimed to synthesize and combine this existing database to derive broader and more comprehensive insights that can aid educational stakeholders. We summarize and evaluate 43 systematic reviews, 4 meta-analyses, and 8 combined systematic reviews and meta-analyses published until November 2022 to provide a comprehensive narrative of how this crisis affected education and what can be learned moving forward.

Keywords: covid19, corona, education, meta, review

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1. Introduction

Education around the world has faced unprecedented challenges as a result of the COVID-19 pandemic. While there have been many epidemics in human history, including the plague, bird flu, and the Spanish flu, the impact of the COVID-19 pandemic has emerged as being unique in terms of its vast disruptions to society and education. According to the United Nations (2020): It has drastically shaken the socio-economic order of the world and impacted 63 million teachers and approximately 1.6 billion students at all educational levels in more than 190 nations across all continents. School

children around the world have missed an estimated 2 trillion hours—and counting—of in-person instruction (United Nations Children's Fund et al., 2022). As such, the resulting loss of learning prospects for young people are expected to amount to substantial costs for the global economy in the long run (Psacharopoulos et al., 2021).

The first phase of reaction to the COVID-19 pandemic was characterized by global lockdowns, health concerns, and general uncertainty. Many countries experienced national closures that involved full shutdowns of educational institutions, ranging from pre-primary schools to higher education institutions for extended periods of time. Classroom instruction was stopped, exams were cancelled or postponed, entrance exams and admission processes were delayed, universities were locked, and higher education students were asked to leave their dorms. The number of international students

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dropped drastically, and significant effects on the intellectual, emotional, and multicultural presence of education were observed (Tilak & Kumar, 2022).

Many believed that educational institutions would quickly reopen after being abruptly closed at the beginning of 2020. However, it soon became clear that schools and universities would not be reopening nor regular classes returning anytime soon, leading to a second response phase consisting of emergency remote teaching/learning. This instantaneous transition from on-campus to online learning was an *ad hoc* provision of online education that brought with it considerable changes in teaching and learning strategies for both teachers and students (Pelikan et al., 2021; Turnbull et al., 2021). Online teaching and learning characterized by digital tools, webinars, and online platforms became the new normal, leaving teachers and students with much to adjust to—especially given the abrupt transition and lack of information about when regular educational conditions would resume (Truzoli et al., 2021). Following these events as well as strict rules to control the spread of the virus and the eventual development and wide distribution of vaccines, education institutions cautiously started to reopen.

By the end of 2022, educational institutions in many countries resumed in-person operation and many aspects of teaching and learning reverted to their pre-pandemic forms. Stimuli packages were coordinated and educators began tackling the learning losses and costs brought forth by the pandemic. However, this remains a slow process. Education was not a priority in the COVID-19 stimulus packages offered by most governments (accounting for only 2.9% of the total; see UNESCO et al., 2020) and the COVID-19 pandemic has left a lasting impact on the educational sector—the effects of which will be visible for years to come. It has challenged educational systems with dramatic cuts to established practices and the imposition of new requirements. Consequently, the vast differences in how individual students, teachers, and parents, as well as different educational institutions and systems managed to cope with this unprecedented crisis are still being understood. By understanding and analyzing these differences, we can not only identify vulnerabilities in pre-pandemic educational practices and areas for growth, but also use these insights to develop educational policies that can more effectively manage and mitigate future crises.

Given this background, considerable effort has been put forth by researchers across all stages of the pandemic to build a knowledge base of individual studies

that can shed light on the impact of the COVID-19 pandemic on education. Indeed, the number of COVID-19-related research articles has skyrocketed since the beginning of 2020, with pandemic-related works having grown to represent a large proportion of all published articles (Brainard, 2022). According to the Web of Science database, more than 8,000 works have been published between 2020 and 2022 containing the keywords COVID and school, university, or education in their title alone. This surge of research was encouraged by many journals having waived their publication fees regarding COVID-19-related topics and expedited their publication processes (Palayew et al., 2020). While fast-paced delivery of research output was undoubtedly important to share new evidence in a timely manner, it may have also come at a cost in terms of quality (e.g., reduced objectivity, less rigorous peer review processes to support speed of knowledge dissemination, etc.). Aside from this, the sheer number of publications made it challenging to keep up with research on this topic (Brainard, 2022). As such, to draw conclusions from the vast amount of unique research works that have assessed COVID-19-related educational experiences and to subject them to quality control, many meta-analyses and systematic literature reviews have emerged. These reviews were conducted at different stages of the pandemic and, given the wealth of research on COVID-19 and education, often attended to rather specific and overlapping issues, necessitating a comprehensive overview.

We address this with the present work in the form of a systematic review that combines the information from existing meta-analyses and systematic reviews. Such a review is important in terms of bringing the separate findings together in a single place to be compared, thereby facilitating more extensive conclusions about the current research status of how education was impacted by COVID-19, as well as future directions.

2. The Present Systematic Review

We conducted a systematic meta-review of systematic reviews and meta-analyses that investigated the impact of COVID-19 on education. This includes findings of both individual and educational factors that operated as protective or risk factors for different populations (e.g., students, teachers) within different levels of education (e.g., primary school, higher education), as well as reviews more generally assessing teaching and learning, school closures, and interventions to support educational populations with the ramifications of the pandemic. As such, this meta study should provide a comprehensive overview to better understand how COVID-

19 impacted education, expose gaps in current research, assess quality, and ultimately provide researchers, practitioners, and policy-makers with an overview of key outcomes and future directions.

3. Method

3.1 Literature Search and Eligibility Criteria

A search of systematic reviews and meta-analyses conducted between January 2020 and November 2022 was independently carried out by two co-authors using SCOPUS as well as the first 250 results from Google Scholar. Reference lists of the retrieved reviews were also scanned. We searched for reviews and meta-analyses that *systematically*¹ assessed COVID-19-related educational experiences in students and educators at primary, secondary, and tertiary levels. Our search term read as follows: “TITLE-ABS-KEY ((corona OR covid OR “cov-19” OR pandemic) AND (school* OR university OR college OR instructor OR pupils OR teacher OR teaching OR learner OR learning OR educat* OR undergraduate OR faculty) AND (meta-analysis OR review)) AND PUBYEAR AFT 2019”.

Search filters were set to include peer reviewed articles, book chapters, conference proceedings, and preprints published in English. Moreover, works were excluded if they were retracted or only review protocols, focused on a highly specific population (e.g., dentistry students in Austria) aside from those labelled as being at-risk (e.g., students with special educational needs), focused on a specific type of education (e.g., medical education, nursing education), or examined a mixed sample (e.g., the sample included a general population and did not explicitly investigate students or teachers).

3.2 Literature Screening Process

We used ASReview (van de Schoot et al., 2021), a machine-learning application, to enhance our title and abstract screening during the literature screening process. In ASReview, the researcher interacts with an active learning model to screen abstracts. Starting with a pre-selection of training articles by the reviewers, the algorithm iteratively changes its relevancy predictions for the remaining abstracts based on the researcher’s choices (relevant vs. irrelevant), thus aiding the selection process by grouping the records based on their relevance. Although it is possible to stop the screening process after a certain limit, we screened all abstracts to avoid false-negative decisions. Thus, ASReview was primarily used in the present study as a tool to reduce

screening time. In comparison to a conventional screening method, this AI-assisted and open-source technology affords a more effective and error-free screening process (van de Schoot et al., 2021). We used the default Naïve Bayes classifier, term frequency-inverse document frequency (TF-IDF) and feature extraction and certainty-based sampling.

3.3 Quality Rating

To gauge the quality of the included reports, two raters coded each of the reports with regard to quality criteria based on the AMSTAR 2 instrument (Shea et al., 2017). We chose AMSTAR 2 because it is a widely used and confirmed instrument incorporating both systematic reviews and meta-analyses. Given that this instrument was originally developed with regard to healthcare interventions, we selected and slightly modified the items to align with the scope of the present investigation. As AMSTAR 2 is not intended to generate an overall score, we present the quality criteria for each item (good inter-rater reliability: $\kappa = .84$). To provide a full overview of the covered research, we considered all works, irrespective of their quality, but used the ratings to assess overall confidence in the results of the review when interpreting their findings.

3.4 Data Availability

We present a full table of the reviewed studies and summaries of their findings (Table 1), a PRISMA flow diagram detailing the reports identified and included in our review (Figure 1), and the covered literature database as supplementary materials and in an open repository at <https://osf.io/9gudy/>.

4. Results and Discussion

4.1 Descriptive Information

As shown in Figure 1, our literature search identified 5806 records. After the removal of duplicates and retracted articles, we screened the abstracts of 5589 records and subsequently retrieved the full texts of 174 records. For two records, we were not able to retrieve a full text. After reading the full texts, a further 117 reports were excluded: of these, 65 were not systematic reviews or meta-analyses, 9 did not focus on COVID-19 and education, 2 were not in English, 38 pertained to a particular population or study program (e.g., dentistry students in Austria), and 3 addressed a general sample and not students or educators specifically.

Table 1 depicts an overview of all remaining 55 reports included in the systematic review. Most of them were systematic literature reviews ($n = 43$), followed by

¹ To operationalize *systematic*, we refer to the formulation of a research question and the identification of relevant individual studies (e.g., using specific search terms in literature databases), as well

as the summarizing of those studies using explicit methodology (see Khan, 2003).

meta-analyses ($n = 4$) or combined systematic reviews and meta-analyses ($n = 8$). Using thematic synthesis (Thomas & Harden, 2008), we identified seven major themes that these works addressed. Through the same process, we highlighted relevant subfields, including recommendations for practice and future research. While partly overlapping, they placed a key focus on different aspects related to how COVID-19 affected education: well-being of students ($n = 14$), well-being of educators ($n = 6$), school closures and other school measures ($n = 7$), e-teaching and learning ($n = 15$), interventions ($n = 3$), individual factors ($n = 5$), as well as at-risk groups ($n = 5$). While most reports were clearly classifiable into one of these categories, some addressed multiple aims and were thereby independently grouped by two of the authors into the most relevant category based on the predominant topic of the paper. Only one discrepancy arose, which was resolved through discussion between the authors. In terms of scope and addressed works, some reports were quite similar, however, the majority were different from each other and contributed unique insights.

Table 2 provides an overview of the quality criteria of the reports. These ratings show that the quality of the works was mixed, with more than two thirds not fulfilling basic criteria, such as the provision of review questions, search strategy, and inclusion/exclusion criteria (which are also fundamental PRISMA criteria). Many also did not ensure sufficient reliability with regard to study inclusion and data extraction.

Next, we summarize the results and recommendations derived from the individual reports across the seven identified themes (for further details and specific references, see Table 1).

4.2 Well-being of Students: Mental and Physical Health Problems

Students were uniquely affected by the COVID-19 pandemic due to drastic educational and lifestyle shifts related to physical isolation and the abrupt transition to virtual learning. Fourteen of the reviews retrieved from our literature search focused on examining mental health problems ($n = 12$) and physical health concerns ($n = 2$) in student populations.

Mental Health

Although the majority of the reviews ($n = 10$) focused on mental health in higher education students, some ($n = 3$) concentrated on mixed samples of school and

higher education students, and only one review explicitly investigated school students. Regardless of school level, students reportedly faced a host of challenges during the pandemic, including reduction of face-to-face communication and physical activity (Deng et al., 2021; Xiang et al., 2020), disruption of social environments due to school and campus closures (Liyana et al., 2022; Wang et al., 2022), as well as changes in career outlook and academic progress (Ebrahim et al., 2022; Zhu et al., 2021). These challenges carried the potential to exacerbate mental health problems, as elaborated below.

Prevalence of mental health problems. Across the assessed reviews, the pooled prevalence estimates² of anxiety and depression in students ranged from 28%–41% and 23%–39%, respectively. Comparatively, a large-scale study assessing 13,984 college students' mental health across eight countries prior to the pandemic reported 12-month prevalence rates of anxiety and depression to be 16.7% and 18.5% (Auerbach et al., 2018). Moreover, the prevalence estimates of stress and fear symptoms of students during the pandemic were 31% and 33% (Fang et al., 2022). From a longitudinal perspective, Buizza et al. (2022) concluded that most studies in their review (12 of 17 studies) found an increase in anxiety symptoms, depression, mood disorders, or personality disorders when comparing students before and during the pandemic. Paralleling this, increases in distress, loneliness, alcohol use, as well as issues with externalization and attention were also observed.

Differences in subgroups of students. Several reviews found differential effects of the pandemic for certain groups of students. This included higher rates of anxiety in females compared to males, higher anxiety and depression in sexual and gender minorities compared to their non-minority counterparts (Buizza et al., 2022), higher mental health problems in students living in rural compared to urban areas (Elharake et al., 2022), as well as in the US compared to Asian or European countries (Chang et al., 2021). Moreover, a higher prevalence of mental health problems was documented in students with financially poorer backgrounds and in those who lived alone compared to those who were financially stable and lived with others (Deng et al., 2021; Elharake et al., 2022; Jehi et al., 2022). Importantly, prevalence rates also differed depending on

² Reported are the pooled estimates based on the prevalence rates of mental health problems reported in the individual studies assessed in the different systematic literature reviews and meta-analyses.

the assessment tools used and the country investigated (see Deng et al., 2021; Fang et al., 2022).

Physical Health

The pandemic additionally impacted students' physical health as a result of increased screen time, less physical activity, as well as unhealthy behaviors and sleep problems linked to psychological distress (Cortés-Albornoz et al., 2022; Valenzuela et al., 2022). Specifically, Cortés-Albornoz et al. (2022) documented that most studies in their review (19 of 21 studies) found visual health in school students to worsen during the COVID-19 pandemic, while Valenzuela et al. (2022) found undergraduate students to have experienced sleep problems, and, interestingly, also increased sleep duration. Regarding the latter point, the authors noted that increased sleep duration may not necessarily be beneficial, as it can negatively impact time spent on school work, social relationships, and mental health.

Summary of Recommendations and Future Directions

Several recommendations for supporting students' well-being throughout crises such as the COVID-19 pandemic were suggested throughout the reports. First, the offering of widespread access to mental health screenings and counselling services via internet and telephone was considered an important support measure. This was especially the case due to students not having been able to leave their residences and clinics being physically closed at certain phases of the pandemic. Within this, interventions centered around mindfulness, meditation, time management, relaxation, and physical exercise were often mentioned as promising methods for improving student health. Similarly, the promotion of healthy behaviors such as regular exercise, healthy diets, sufficient sleep, practicing social media hygiene, and avoiding alcohol or drug use were frequently suggested as ways to protect student well-being. As variations in findings depending on the assessed country were also evident, future research should acknowledge country differences when considering responses to the pandemic and associated student well-being.

Adding to this, teachers were also reported to have played important roles in student well-being through connecting students to appropriate mental health resources offered by educational institutions, creating stability in students' lives through well-structured courses, and offering accommodations in extenuating circumstances (see also Kiltz et al., 2020). Ensuring that students had timely access to accurate and easily understandable information about the COVID-19 pan-

dem in relation to their studies was considered essential for reducing fear and anxiety levels.

4.3 Well-being of Educators: Less Studied but Similarly Affected

The pandemic also had an unprecedented impact on educators and their well-being. Considerably fewer reviews identified in our search focused on educators compared to students. Six reviews summarized the impact that pandemic-related changes had on different aspects of mental health in school and higher education teachers.

Mental Health

The rapid transition from established and familiar face-to-face teaching methods to online teaching threatened the well-being of school and higher education teachers (Daumiller et al., 2021). Specifically, this abrupt change came at a cost in terms of time and skill resources needed to convert learning materials to online contexts in a high-quality manner, and was marked by confusion, poor work-life balance, lack of confidence and support, as well as concerns about students' academic progress and welfare (Ozamiz-Etxebarria et al., 2021; Susilaningih et al., 2021; Zheng et al., 2022). In turn, high prevalence rates of mental health problems were observed in teachers during the pandemic, as elaborated on below.

Prevalence of mental health problems. In the reviews identified in our search, the pooled prevalence of anxiety, depression, and stress among teachers during the pandemic ranged between 10%–49.4%, 16%–59.9%, and 12.6%–62.6%, respectively. Moreover, in their review containing longitudinal studies that compared experiences of teachers before and during the pandemic, Westphal et al. (2022) noted that some studies reported a decrease in feelings of accomplishment and an increase in depersonalization and emotional exhaustion.

Differences between subgroups of teachers. Like with students, some groups of teachers appear to have struggled with their well-being more than others during the pandemic. This included teachers who were younger, female, had chronic health issues, and dealt with higher workloads (Ma et al., 2022; Silva et al., 2021). Moreover, while teachers in schools experienced higher prevalence rates of depression and anxiety, those in universities were comparatively less investigated but were also found to experience high levels of stress (Ozamiz-Etxebarria et al., 2021; Schwab et al., 2022).

Summary of Recommendations and Future Directions

Aside from teacher well-being being important in and

of itself (Hascher & Waber, 2021), ensuring that teachers are feeling well and healthy is considered a critical step in fostering high quality education for students. The most prominently reported suggestion aimed at supporting teachers' mental health in times of crises was to offer professional development opportunities geared at enabling teachers to optimally handle pandemic-related changes. Next, ensuring that teachers were provided with adequate materials and resources was considered a key factor (see e.g., Ozamiz-Etxebarria et al., 2021). This included the provision of sufficient IT support, technological software, and comfortable workspaces, as well as up-to-date information and resources to best plan their teaching and accommodate their students. Lastly, the provision of mental health resources to help teachers deal with the emotional and psychological ramifications of the pandemic, including stress management strategies such as physical exercise and breathing techniques, were highlighted as protective factors for their well-being.

4.4 School Closures and Other School Measures: Intended and Unintended Effects

We found seven systematic literature reviews that engaged with school closures and other school measures. Most of this research focused on primary and secondary schools, while higher education institutions were less frequently examined.

Effects of School Closures

In terms of school closures, multiple problems were identified, including:

Restrictions to students' right to education. A basic concern was that students' rights to education were restricted (Lorente et al., 2020). This issue is fundamental, as every human being has the right to a high quality education (Robeyns, 2006).

Learning losses. Despite the integration of remote learning, the results indicated learning losses similar to summer losses encountered by students with no teaching at all during the summer break ($d = -0.005$ *SD* to -0.05 *SD* per week; see Kuhfield & Tarasawa, 2020). These numbers are also mirrored by a recent meta-analysis reporting a pooled effect size of $d = -0.14$ (Betthäuser et al., 2023), meaning that in total, students lost out on about 35% of a normal school year's learning. This shows that the majority of remote learning initiatives put in place during the first round of school closings in spring 2020 were not effective for student learning. However, findings also showed little evidence for an accumulation of learning deficits over time that was frequently feared (Betthäuser et al., 2023). In this context, few studies found that using online learning tools had a favorable impact on students' achievement.

When favorable impacts were visible, this was mostly the case for students that were already familiar with working with online-learning programs and did not have to adjust to a new learning environment.

Loss of critical-school-based services. Besides learning losses, problems were identified regarding critical school-based services becoming inaccessible due to school closures (e.g., healthcare, programs for children with disabilities, nutrition programs). This was particularly problematic in different low-middle income countries where healthcare and nutrition was strongly embedded in school programs (Mayurasakorn et al., 2020).

Well-being and health. In addition to the disruption of daily routines, COVID-19 school closures were linked to mental and physical health concerns, particularly regarding negative emotional responses. These negative consequences became increasingly prominent the longer the lockdowns were in place. However, effects of school closures and larger societal lockdowns cannot be distinguished using data that is bound to the initial COVID-19 lockdown (Viner et al., 2022). The effects on well-being that were previously described are presumably the result of a variety of lockdown-related variables including social isolation, family stress, and general pandemic fears, as well as school closures. Nevertheless, there is compelling theoretical evidence that suggests school closures may have caused a significant fraction of these effects, especially harms to mental health by reducing social interactions with peers and teachers as well as limiting the role that schools play in supporting health-conscious behaviors among children and adolescents (Viner et al., 2022).

Increasing social inequalities. Alarmingly, school closures due to COVID-19 specifically impacted younger children and families with low socio-economic status (see Hammerstein et al., 2021, regarding student achievement). Children with disabilities and those from lower-income families were especially affected by school closures during COVID-19 because they no longer had access to school-based resources and essential services needed to bridge socio-economic gaps.

Other Measures

Besides physical closures of schools, additional measures were introduced which focused on enabling safer contact (e.g., mask wearing, hygiene, distancing, ventilation), reducing contact (reducing and alternating student numbers, reducing opportunities for contact), as well as surveillance and response (e.g., screening, testing, quarantine). However, these aspects were typically not comprehensively researched (Krishnaratne et

al., 2020).

Summary of Recommendations and Future Directions

Looking forward, when considering closing schools in times of crises, the findings of the assessed reviews suggest that it is crucial to conduct tailored benefit and risk assessments specific to the socio-economic environment, healthcare system, and educational resources in the area. Notably, most research conducted on school closures during the COVID-19 pandemic focused on developed countries. However, measures were implemented differently within different countries, further emphasizing the importance of considering the broader context that schools are situated in (Tadesse & Muluye, 2020). Adding to this, research should attend to potential unintended consequences of school closures (Kratzer et al., 2022), especially for students of low socio-economic status. Therein, investigating additional health and social implications of school closures, such as the quality of life of children and their families, lifestyles, screen time, education/learning, cognitive development, as well as social connections (including social media use) was suggested as an important step forward. Beyond this, on a micro level, educational policymakers should identify potential supportive measures that support time spent actively learning. On a larger scale, policymakers should identify potential corrective actions to aid students in their learning, to prevent academic failure, and to build up mental health resources that are easily accessible for all.

4.5 E-Teaching and Learning: Opportunities, Challenges, and Psychological Impacts

Regarding e-teaching and learning, 14 systematic-reviews and 1 meta-analysis were assessed. Most of these examined advantages and disadvantages of e-teaching during COVID-19. Some considered specific aspects such pedagogical implementations (Aisha & Ratra, 2022; Ibna Seraj et al., 2022), digital tools (Deepika et al., 2021), or students' attitudes, satisfaction, and learning outcomes (Masalimova et al., 2022; Nakhoda et al., 2021; Panagouli et al., 2021). Others engaged deeply with the roots of the problems that emerged and how they could be addressed (Na & Jung, 2021). All types of formalized educational levels (primary, secondary, and tertiary education) were considered, as well as the specific perspectives of students and teachers.

While a few studies sought to evaluate the merits of e-teaching and learning in general (e.g., Camilleri & Camilleri, 2022), most researchers were cautious about contrasting the digital education brought on by COVID-19 with regular digital education (Hodges et

al., 2020). As opposed to well-planned online programs, this crisis-driven ad hoc "emergency remote teaching" was characterized, on the one hand, by a rapid transition frequently without adequate preparation for curricula, timetables, guidelines, technology infrastructure, content rights, etc., and on the other hand, by professional development for teachers and students to ensure successful teaching and learning (Bergdahl & Nouri, 2021).

With regard to advantages, disadvantages, psychological impacts, and recommendations for e-teaching and learning, these works addressed the impact of the change from face-to-face to virtual teaching on education, students' experiences and performance, the specific tools used to facilitate e-teaching, the respective policymaking, and the issue of equality (disparities between different social groups and its impact on accessibility and equity).

Opportunities

Multiple benefits and opportunities of e-teaching and learning were consistently identified in the covered works, extending beyond the emergency online teaching during COVID-19 (e.g., Aisha & Ratra, 2022; Deepika et al., 2021; Saikat et al., 2021). These include: **Accessibility.** Through e-teaching, increased freedom and convenience for students to study and voice their ideas beyond time and geographical location were noted, along with wider access to education without discrimination. Especially during physical closures of secondary and tertiary institutions, e-learning was a sensible alternative for academic continuation.

Efficiency. Online programs were described as having the potential to be cost-effective, as they allow for saving on maintenance costs on physical campuses and reduce travel/commutes to and from colleges, meetings, conferences, and seminars. Regarding the latter point, the time cut down on commuting can be used more effectively for teaching and learning. Beyond this, online modes of education allow for learning material to be stored and updated more efficiently, and students can skip and repeat materials according to their own needs. **Individualization.** It was acknowledged that e-learning can facilitate more individualized and thus effective learning, through self-regulation at one's own pace, higher autonomy, personalization, tracking of own progress, and opportunities for self-assessment.

Convenience. E-learning was noted as being more integratable with other aspects such as physical activity compared to traditional learning forms, thus also allowing for healthier lifestyles in general.

Resources. E-learning allowed access to more resources and opportunities to reuse them (e.g., rewatch

videos) as well as a rich potential for interaction, discussion, and communication, also within large lectures. **Digital literacy.** Through exposure to technology itself, technological literacy gaps can be addressed and expertise in online media fostered. This also allows for better preparation for technology-reliant job markets (however, the amount, duration, and difficulty must be adapted to the level of learners).

Further skills. E-learning included innovative and additional methods to foster collaborative skills, self-regulation skills, problem-solving skills, etc.

Impetus for change. The transition to e-learning exposed problems within the system and pushed educators to advance technological acceleration.

Challenges

Despite these opportunities, the quick transition to e-teaching and learning caught most teachers, institutions, and governments off guard (Fernández-Batanero et al., 2022). The key challenges and disadvantages of e-teaching and learning that were identified in the reviews were:

Communication. Due to lacking face-to-face contact, difficulties were noted with building, maintaining, and sustaining relationships, developing rapport, providing clear instructions, facilitating student engagement, and teaching with little feedback (especially when not seeing students' faces/reactions). Group work was also more complicated to facilitate, and increased external distractions and interruptions were noted. Also, on an organizational level, clearer strategies regarding communication and collaboration tools were called for.

Availability. Students often complained about teachers not being available. Teachers, in turn, complained about difficulties answering students' questions in real time and a lack of direct control over the learners in general.

Assessment. A key challenge was redesigning evaluations so that they fairly and reliably captured performance, especially in practical courses.

Misuse. Fraudulent acts by students (e.g., academic dishonesty) were observed, as well as concerns regarding data protection and breaches of privacy.

Workload. Increased workload, not only for teachers, but also for students, was also frequently mentioned

Inadequacy. E-teaching was mostly not considered a complete substitute for traditional education because of its inherent limitations. This is especially true regarding learning requirements demanding hands-on instruction, practical work and fieldwork, live discussions, and/or, or specific laboratories; especially in numerical, experimental, medical, artistic, and communication fields.

Cost. Students and teachers struggled with acquiring

adequate equipment and programs due to high prices.

Digital literacy. Further support was noted as being necessary for teachers in their learning curve to be able to transition to hybrid and blended learning.

Technical difficulties. Many technical difficulties emerged, including internet access and reception. Teachers faced numerous obstacles when trying to reach all students and when seeking to improve their work due to lacking resources.

Digital divide. Especially non-tech savvy teachers and students were unprepared and poorly equipped. Also for students without access to the necessary digital tools, e-learning was a large setback. Noted were large differences in the accessibility and quality of e-learning and teaching stemming from students' and institutions' economic backgrounds. As we will elaborate on later, this exacerbated differences between privileged and underprivileged students worldwide (Panagouli et al., 2021).

Psychological Impacts

Besides these insights into e-teaching and learning specifically, several issues were revealed that further compromised well-being of students and teachers above and beyond the issues already noted before the pandemic (Aisha & Ratra, 2022). Among these most frequently noted were:

Worries. Worries, stress, doubts, and concerns about the e-learning curriculum were articulated. Anxiety was increased due to a lack of interpersonal communication. Students were particularly worried about potential academic loss and the changed instructional delivery.

Distress. Students and teachers were often already overwhelmed, and the transition to e-teaching was considered an additional stressor. Individuals frequently felt intimidated, and reported low confidence due to online teaching and the delay in their study progress.

Work-life balance. Boundaries between academic and personal life ran the danger of becoming blurred, which was further increased when individuals were isolated at home.

Concentration and motivation. Prolonged screen time affected concentration and students reported a lack of motivation. Moreover, teachers reported feeling exhausted with regard to online teaching.

Summary of Recommendations and Future Directions

Taken together, the pandemic was considered a much-needed push for change in terms of digitalization. E-teaching and learning during the pandemic catalyzed innovations in education, proving the flexibility and

convenience that teaching and learning online can provide. However, as observed during the pandemic, e-teaching and learning also comes with a series of challenges, and still more educational technology is available than can be applied for learning (Guppy et al., 2022). To reach its full potential of becoming as effective as face-to-face teaching (Francescato et al., 2006), future research is essential. Key suggestions to improve online teaching and learning experiences noted throughout the reviews include the following:

Policymaking. The inequalities created through e-teaching need to be understood and mitigated, and accessibility and equity needs to be ensured.

Training. Students and staff alike should be supported in terms of their motivation and digital literacy. Especially for rapid transitions, the difficulties and insecurities encountered by teachers regarding the implementation of such an educational mode need to be considered.

Tools. High-quality, accessible, user-friendly, error-free tools and platforms are required.

Diversity. A variety of learning resources should be provided to avoid monotony when learning online.

Feedback. Providing and receiving feedback needs to be ensured.

Student-centeredness. Effective e-learning environments should be centered around the individual students to meet their educational requirements.

Clarity. Instruction and expectations should be transparent and clear.

Psychological impacts. E-teaching and learning bring a series of psychological impacts with them, especially under rapid transitions such as during the pandemic. This highlighted the necessity of taking care of the psychological well-being of students and teaching when learning online.

Blended and hybrid learning. Looking forward, a promising potential for enriching traditional learning formats lies in combining or switching between online and offline components, allowing students to interact with instructors, peers, and course material in both traditional classroom settings and online (Guppy et al., 2022).

Further research. More research should be directed at examining the effectiveness of and the differences between traditional and online education to help teachers improve digital education techniques and development.

4.6 Interventions: Evidence on Specific Programs to Support Students

To support students in dealing with the ramifications of the COVID-19 pandemic, different interventions were developed to foster mental and physical health, and in turn effective learning and adjustment. Specifically,

three reviews identified in our search summarized the effectiveness of different types of online interventions used to promote health and mitigate anxiety and depressive symptoms among students. Notably, these interventions solely focused on higher education students, however, no reviews were identified which examined interventions aimed at supporting school students or teachers (who are characterized by substantially different learning needs).

Characteristics of Online Well-being Interventions

Individual vs. group focus. While some interventions operated on an individual-level basis where students were asked to complete programs or materials independently with varied levels of support from trainers and psychologists, other interventions were group-based and entailed the provision of wider spread services to a larger number of students while promoting the exchange of experiences and building of support networks.

Platforms and delivery methods. In terms of virtual platforms used to host the different interventions, Zoom, Google Meet, Microsoft Teams, and Adobe Connect were reported as being frequently used. Regarding specific delivery methods, video conferencing, online chat tools, emails, discussion forums, and processing of asynchronous materials such as watching videos or reading information were most often mentioned.

Techniques. Regarding the different techniques used to promote well-being in students, mindfulness techniques (e.g., meditation interventions), cognitive behavioral therapies, dialectical behavior therapies, social support measures, online Isha Upa yoga, positive psychotherapy strategies, and breathing training programs were frequently reported.

Number of sessions and duration of interventions. The number of sessions and duration of interventions varied substantially, with some interventions consisting of as little as one standalone session, and others consisting of as many as 88 sessions across upwards of eight weeks.

Effectiveness

The majority of the online interventions were effective in promoting well-being of higher education students during the pandemic based on evidence from randomized clinical trials, quasi-experimental studies, and cohort or case-control studies (da Silva et al., 2022; Malinauskas & Malinauskiene, 2022; Riboldi et al., 2022). Within this, particularly online group mindfulness techniques and web-based cognitive behavioral therapies (da Silva et al., 2022), multicomponent online positive

psychology interventions (Malinauskas & Malinauskiene, 2022), and individually catered cognitive behavioral therapies, dialectical behavior therapies, and mind-body practice techniques (Riboldi et al., 2022) emerged as being effective.

Summary of Recommendations and Future Directions

In terms of practice, the assessed reviews suggest that online interventions represent a promising way forward in supporting students both within and beyond crises like the COVID-19 pandemic. Such interventions have the added benefit of being more cost-effective, easily accessible, and better positioned to cater to a wider and more geographically varied group. Research wise, interventions conducted during the pandemic should be examined more thoroughly to consider the effectiveness of specific strategies, stages of the pandemic in which such strategies were most effective (using longitudinal evidence), and relevant control variables.

Individual Factors: Risk Factors and Resources

Throughout the COVID-19 pandemic, students and educators differed in how they handled and experienced pandemic-related ramifications, where some fared better than others despite having seemingly similar external circumstances. To shed light on relevant factors that may have contributed to these differences, a total of five systematic reviews assessed different individual-level factors in students and educators and how they mattered for their experiences throughout the pandemic.

Motivation and satisfaction. Students' motivation and satisfaction were considered important for their online learning experiences throughout the pandemic. Specifically, while their motivation levels mattered for their perceptions of and engagement in online learning, their satisfaction with education mattered for their well-being and subsequent online learning (Aznam et al., 2022). Learning structure, classroom interaction, facilities, and trainer knowledge were found to contribute to students' motivation and satisfaction.

Study strategies. The study strategies that students employed throughout the pandemic also had an impact on their online learning experiences, where students' personal responsibility in learning activities, use of strategies, and self-regulated learning became increasingly important (Boström et al., 2021). Specifically, strategies used to avoid procrastination, set goals, self-monitor, self-instruct, and self-reinforce were particularly relevant. Moreover, the importance of the experience of authentic learning, as well as students' self-efficacy in how well they believed they could perform

and handle the new online learning context were highlighted as important factors that mattered for their learning during the pandemic.

Social media use. Students' usage of social media during the pandemic had mixed effects on their mental health, including positive and negative effects, and in some cases, no statistically significant effects at all (Haddad et al., 2021). Following these mixed findings, it was suggested that a focus should be placed on preventing problematic social media use in students through moderation techniques rather than complete abstinence. This could be done by encouraging students to consciously assess their social media usage patterns in terms of how salient their use of social media is, whether they exhibit impulsive use of social media that negatively impacts their learning, or whether they experience mood modifications and feelings of withdrawal from social media. Moreover, the establishment of media-free times, such as while eating meals or during studying can be helpful. Importantly, social media was also considered to be an effective informational tool for quick and widespread access to information about the pandemic and surrounding regulations.

Personality traits. Students' personality traits were also found to be associated with their learning experiences and well-being throughout the pandemic (see Morfaki & Skotis, 2022). Specifically, while agreeableness was linked to learning, it was also associated with perceived anxiety. Similarly, openness was associated with learning, self-efficacy, and satisfaction, yet also anxiety. Extraverted students reported lower course achievement and intrinsic motivational regulation as well as increased anxiety, presumably due to the online focus and loss of face-to-face learning opportunities. Lastly, conscientiousness emerged as being beneficial and was consistently associated with academic achievement, self-efficacy beliefs, and effective learning styles.

Coping mechanisms. Teachers often used coping strategies to deal with the ramifications of the pandemic. The most frequently used coping strategies that were considered beneficial for their mental health entailed reaching out for social support, physical exercise, taking part in leisure and spiritual activities, as well as reading and listening to music (Nang et al., 2022). Of these strategies, seeking social support was marked as the most popular strategy.

Summary of Recommendations and Future Directions

Looking forward, a focus should be placed not only on implementing broader strategies to support students and educators during crisis situations, but also on

the importance of considering individual differences and tailoring approaches to those who may particularly struggle. The reviews captured by our literature search indicate that “one size fits all” approaches, although more feasible, may be shortsighted. Individuals’ levels of motivation and satisfaction, study strategies, personality traits, and coping tendencies mattered for their experiences during the COVID-19 pandemic and should thereby be further acknowledged in future research and practical initiatives.

4.7 At-Risk Groups: Assessing and Closing the Gaps

As previously noted, the educational experiences of certain groups were more strongly affected by the COVID-19 pandemic than others. A total of five systematic reviews specifically addressed disadvantaged groups. A common finding across all reviews was that across most of the aforementioned outcomes, students from disadvantaged backgrounds were statistically significantly more and persistently negatively affected. This was due to a variety of obstacles, including long-term educational disengagement, digital exclusion, poor technology management, and increased psychosocial difficulties. Besides identifying at-risk groups, the respective studies also elucidated factors explaining why these groups were particularly affected, and allowed for the formulation of takeaways of which gaps need to be closed and how, in future crises, such divides can be mitigated.

The specific at-risk groups identified included (1) individuals from poor and underdeveloped countries, (2) individuals with special educational needs and other disadvantages (e.g., hearing difficulties), (3) individuals from families with low socio-economic status, particularly those who already had contact with social services, as well as (4) underprivileged students with subpar access to quality education, including those who started school behind or were already at the risk of disengagement.

Relevant Factors

Necessary equipment and technology. Especially for poorer and disadvantaged students, the availability of tools (such as computers to use for studying) was a prominent issue.

Accessibility and usage of learning materials. Many students struggled due to limited access to learning materials (e.g., due to existence of appropriate materials or lacking internet connection). Parents of children with special needs reported that they spent considerable time and effort catering learning material to the individual needs of their children. Further, availability does not

guarantee quality online education for all groups. Instead, special training, quality measures, and additional features (e.g., captioning) may be required. Most importantly, this raises awareness of the need for educational systems to leverage teaching practices that can be easily implemented even amidst environmental crises and be more accessible during pandemic emergencies.

Routine change. Especially for students with special educational needs (e.g., students with Autism), routines were considered essential to lessen stress while encouraging a sense of order. Students’ routines were disturbed when the lockdown started due to conflicting expectations and pressures from school, other agencies, and home working commitments. Many families struggled with changing existing and/or new routines and relieving pressure.

Partnerships and collaboration. Crucial roles were performed by the interplay of authorities, educators, parents, and specialists in enhancing students’ educational outcomes. Problems were frequently complex, and perspectives of everyone involved in education need to be included (García-Louis et al., 2022).

Special needs. It was considered essential to offer special attention to those with special needs during such unprecedented changes (e.g., counselling and psychological services). Isolation left students feeling lonely and cut off from relationships with their peers, teachers, and the rest of their school community (Bakaniene et al., 2022). Inclusive education, however, aims to enhance a student’s functioning and learning results by assisting them through the creation of supportive communities and by providing extra services, educational aids, or accommodations (Couper-Kenney & Riddell, 2021). Parents and parent-teacher collaboration and communication were noted as being important for their children’s achievement. Thus, in crises, parents also need to be provided with the time and resources necessary to support their children, especially in terms of at-home learning.

Summary of Recommendations and Future Directions

Systemic imbalances, which have long hindered the academic progress of disadvantaged students, were clearly made worse by COVID-19. Often, the interconnection of a lack of resources, difficulties with mental health, and other aspects such as food hardship affected how students and their families responded to the pandemic. Given that it was mostly social inequities that already existed prior to the pandemic and severely limited the access of these at-risk groups to educational and employment opportunities, which in turn led to vast

economic, food, and housing insecurity (García-Louis et al., 2022), it is critical that the aforementioned inequalities be acknowledged by institutional leaders and addressed at a national policy level (United Nations Children's Fund et al., 2022).

5. Conclusion

COVID-19 affected the educational sector on a global front. A vast amount of research was conducted within the (first) three years of the pandemic, illuminating the effects that the pandemic had on education. The pandemic also demonstrated the incredible ability of science to pivot amid a crisis. However, we still lack efficient methods for choosing, organizing, and presenting new findings in a way that maximizes comprehension and application. Even for experts in their respective (sub)fields, it was, and still is, difficult to remain up to date with the enormous number of papers being published on COVID-19. This is problematic, as urgent overviews are required in times of crises for science, policy, and practice. Even though overviews are available, the quality of these research syntheses are not universally adequate for transfer into policy (van de Schoot et al., 2021).

Therefore, in this paper, we provided an overview of systematic reviews and meta-analyses that investigated the impact of COVID-19 on education. In our systematic meta-review, seven major themes emerged that were addressed by previous syntheses: (1) the mental and physical health of students and (2) educators, (3) the role of school closures and other school measures, (4) e-teaching and learning and the opportunities, challenges and impacts it brought with it, (5) interventions that were conducted to support students, (6) individual-level factors that made a difference, as well as (7) specific at-risk groups who particularly experienced disadvantages.

Specifically, the pandemic led to a time of anxiety and tense conversations about the existential crisis of humanity. Lockdowns, institutional closures, worries about continuing studies, and dim employment prospects all contributed to mental health problems in students. Early on in the pandemic, learning deficiencies quickly appeared and have not significantly narrowed since. Additionally, unexpected and ill-prepared distance learning, poor digital connectivity, subpar technology, and the inability of students to interact directly with peers and teachers strained students' mental and physical health, resulting in intense emotional anguish. In higher education, many students found the process of learning during COVID-19 to be so unpleasant that they ran the danger of losing interest in learning and

deciding to drop out. Moreover, it has also been difficult for teachers to work under such circumstances, and as a result, many have left the academic field and are looking for alternative employment to support themselves (Tilak & Kumar, 2022).

Moreover, as documented, an institution's and students' economic background significantly determined the quality of online learning and teaching, bringing along a new level of inequality among students worldwide (e.g., only 34% of students in Indonesia reported having a computer at home for academic work, compared to over 95% in Denmark, Slovenia, Norway, Poland, Lithuania, Iceland, Austria, Switzerland, and the Netherlands; OECD, 2020). Thus, the pandemic has revealed yet another ominous facet of educational disparity that transcends geographic and economic disparities (Tilak & Kumar, 2022).

5.1 Limitations

Several limitations need to be considered when interpreting the findings of this systematic review. First, we only included topics that were relevant enough to have already been examined within multiple research works and in turn, within existing systematic literature reviews or meta-analyses. The inductive process of deriving categories based on existing studies provided us with insights into the directions in which research on the effects of COVID-19 on education is headed. Numerous systematic overviews existing is a strong indication of a topic's relevance. However, a more theory-based approach to pre-selecting (sub)topics may have provided different results. Second, although we brought together an immense amount of research findings, there is still a significant amount of primary research being reviewed on this topic at the time of publication. It also takes time to include already published work in systematic research syntheses. Although research syntheses focused on this specific time frame are necessary, the accelerated speed of publications during the pandemic and the urgency of robust findings may decrease their half-life/usefulness, which may in turn affect the implications proffered by this meta-review. Third, some reviews included forecasts as actual data of documented losses and based their conclusions primarily on this information (Zierer, 2021). Such practices are highly misleading, especially when seeking to inform the public debate on these topics. Finally, it is too early to evaluate the long-term effects of the pandemic on education and it is important to be cautious when making predictions based on the available evidence collected thus far.

5.2 Implications

The quote “In the Middle of Difficulty Lies Opportunity” (attributed to John Archibald Wheeler), applies well to research practices and education alike in post pandemic times. What can we learn from the recent global crisis, and which opportunities lie ahead?

As this will certainly not be the last crisis, the science community needs to be prepared and should consider changing their research practices. Robust, reliable, and trustworthy findings from different disciplines will be needed, ostensibly necessitating a trade-off between speed and rigor in doing research. More and higher quality collaboration between researchers and disciplines as well as increased open science is needed to this end. Although many researchers already worked in a highly collaborative manner and shared data and pre-prints, joint and open research still needs to be intensified. This also pertains to the review articles we considered: a substantial number of reviews addressed the same topic and were published within the same year and journal, partly with subpar quality. These efforts would likely have been improved if researchers worked together right away and delivered fewer and higher quality outputs. This should also aid in informing policymakers and the public. In all phases of the pandemic, and also now, it has become evident that policymakers *are* listening to researchers after all. Researchers pooling their efforts will therefore be an important asset in steering future crises.

In the midst of constant change, young people need a feeling of stability to digest, adapt, and develop new coping mechanisms. For many, education offers a great deal of stability. As we progressively recover from the pandemic, we must nurture the next generation to prepare them for the tragedies that will inevitably happen again but that we cannot predict. At the same time, COVID-19 increased the fission of our societies in many ways, including how unequally different groups were affected. These groups need to be more strongly considered to understand the effects of crises better (e.g., comparison of different groups sheds light on causal impacts) and to mitigate their effects (e.g., supporting those with lower human capital as a result of the pandemic, also through lifelong learning). Specifically, the impact of the pandemic on education has highlighted the socioeconomic setting in which only select groups may live and learn in safety. In addition, there was considerable variation in how different countries responded to the challenges of the pandemic, and in turn, the associated impact on the education systems, students and teachers. More evidence is needed draw-

ing on comparative research using equivalent approaches and measures. Thus, global efforts should be made to relaunch national and international education equity activities. Increased worldwide awareness of inequities might constitute a window of opportunity for programs promoting educational equity.

Moving forward, it is up to national educational policymakers to be aware of these impacts and engage with the disciplines of educational and psychological research to put policies in place to lessen or even reverse adverse effects. This is arguably the most important societal responsibility for the post-COVID era to take on.

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Table 1
Overview of the Reviewed Studies

Study	Type	k	Focus	Sample	Period	Key findings
						Well-being of Students
Buizza et al. (2022)	SLR	17	Changes in mental health and lifestyle	College students	Jan '20 to May '21	- College students experienced more anxiety, mood disorders, alcohol use, sedentary behavior, and internet use, as well as decreased physical activity when comparing their pre- and post-COVID-19 data - Female students, as well as sexual and gender minority youth reported poorer mental health conditions
Chang et al. (2021)	MA	16	Prevalence of anxiety and depressive symptoms	College students	Jan '20 to Nov '20	- Prevalence of anxiety symptoms during COVID-19 was 31% (95%CI: 23–39%) across the studies sampled - Prevalence of depressive symptoms was 34% (95%CI: 27–41%) - Prevalence of anxiety and depressive symptoms differed across students from different countries - Prevalence of depressive symptoms was higher in females compared to males
Cortés-Albornoz et al. (2022)	SLR	21	Effects of remote learning on visual health	School students	Jan '20 to Jan '22	- Children had more rapid myopia progression, increased frequency of dry eye and visual fatigue symptoms, and signs of vergence and accommodation disturbances such as acute acquired concomitant esotropia and convergence insufficiency during the pandemic
Deng et al. (2021)	SLR + MA	89	Depressive symptoms, anxiety symptoms, and sleep disturbance	Higher ed students	Jan '20 to Jan '21	- Prevalence of depressive symptoms, anxiety symptoms, and sleep disturbances was 34%, 32% and 33%, respectively - Differences based on location, diagnostic criteria, education, study year, financial situation, living arrangements, gender - Prevalence of depressive and anxiety symptoms higher compared to pre-pandemic prevalence in similar populations
Ebrahim et al. (2022)	SLR + MA	90	Psychological well-being	University students	Jan '20 to Sep '20	- Prevalence of anxiety symptoms was 29.1% (95%CI: 20.9–39.0) - Prevalence of depression symptoms was 23.2% (95%CI: 15.7–32.9)
Elharake et al. (2022)	SLR	16	Mental health	School and college students	Jan '20 to Jul '21	- Students reported feeling more anxious, depressed, fatigued, and distressed compared to pre-pandemic times - Risk factors such as living in rural areas, low family socioeconomic status, and being a family member or friend of a healthcare worker were associated with worse mental health
Fang et al. (2022)	SLR + MA	104	Prevalence of psychological stress	School and higher ed students	Jan '20 to Mar '22	- Prevalence of depressive symptoms: 32.0% (95%CI: 28.0–37.0%), anxiety symptoms: 28.0% (95%CI: 24.0–32.0%) - Prevalence of stress symptoms was 31.0% (95%CI: 23.0–39.0%), fear symptoms: 33.0% (95%CI: 20.0–49.0%) - Prevalence differed by gender, epidemic stage, region, education stage, student major and assessment tool
Fekih-Romdhane et al. (2022)	SLR + MA	59	Prevalence and risk factors of psychotic experiences	High school and college students	Until Jan '22	- Lower self-reported psychotic episode rates (12.50%; 95%CI: 7.06%–21.19%) for high school and college students during COVID-19 than before
Jehi et al. (2022)	SLR	37	Anxiety	Higher ed students	Mar '20 to Jun '21	- More than one-third of higher ed students suffered from anxiety during the early stages of the pandemic - Being a female, living in rural areas, facing financial hardship, working full-time, spending the quarantine in isolation, worrying about infection, uncertainty of future, reduced sleep quality, and transitioning to online learning associated with increased anxiety
Li et al. (2021)	SLR + MA	27	Mental health	College students	Dec '19 to Oct '20	- Prevalence of depression was 39% (95%CI: 27–51%), prevalence of anxiety was 36% (95%CI: 26–46%) - Prevalence of depression (60%, 95%CI: 46–74%) and anxiety (60%, 95%CI: 46–74%) in non-Chinese students higher than Chinese students (26%, 95%CI: 21–30% and 20%, 95%CI: 14–26%) - Prevalence of depression (54%, 95%CI: 40–67%) and anxiety (37%, 95%CI: 26–48%) higher after March 1 than before (21%, 95%CI: 16–25% and 19%, 95%CI: 13–25%)
Liyanage et al. (2022)	SLR	36	Prevalence of anxiety	University students	Sep '20 to Feb '21	- Prevalence of anxiety in university students was 41% (95%CI: 0.34–0.49) - Prevalence lowest in Asia: 33% (95%CI: 0.25–0.43), Europe: 51% (95%CI: 0.44–0.59), USA: 56% (95%CI: 0.44–0.67) - Prevalence of anxiety in females: 43% (95%CI: 0.29–0.58), males: 39% (95%CI: 0.29–0.50)
Valenzuela et al. (2022)	SLR	72	Sleep	Undergrads	Jan '20 to Dec '21	- Undergraduates experienced increased sleep duration, as well as sleep pattern disruption during lockdowns - Several psychological, behavioral, environmental, demographic, and socio-economic factors were associated with sleep changes
Wang et al. (2022)	SLR + MA	16	Prevalence of fear	College students	Dec '19 to Nov '21	- Moderate amount of fear, according to average score across studies being 17.60 (95%CI: 16.4–18.8) on the Fear of COVID-19 Scale (interpretation: mild fear ≤ 17, moderate fear 18–23, severe fear ≥ 24) - The mean of COVID-19 fear in women (17.1, 95%CI: 16.6–17.6) higher than in men (15.2, 95%CI: 14.3–16.1) - Highest fear in Israel, Russia, and Belarus (21.6, 95%CI: 20.8–22.3), lowest in Europe (16.5, 95%CI: 15.3–17.8)
Zhu et al. (2021)	MA	176	Mental health	Post-secondary students	Until May '21	- Prevalence estimates of clinically elevated depressive and anxiety symptoms were 30.6% (95%CI: 27.4–34.0%) and 28.2% (95%CI: 24.6–32.1%), respectively - Month of data collection and geographical region were significant moderators

						Well-being of Educators
Ma et al. (2022)	SLR + MA	54	COVID-19 pandemic-related anxiety, stress, and depression	School teachers	Dec '19 to Jul '21	<ul style="list-style-type: none"> - Prevalence of stress: 62.6%, 95%CI: 46.1–76.6%, anxiety: 36.3%, 95%CI: 28.5–44.9%, depression: 59.9%, 95%CI: 43.4–74.4% - Experiences of psychological issues associated with gender, online teaching, job satisfaction, teaching experience, and workload - Protective factors included regular exercise and provision of technical support for online teaching
Ozamiz-Etxebarria et al. (2021)	SLR + MA	8	Prevalence of anxiety, depression, and stress	School and higher ed teachers	Dec '19 to Jun '21	<ul style="list-style-type: none"> - Prevalence of anxiety, depression, and stress: 17% (95%CI: 9–28%), 19% (95%CI: 15–24%, and 30% (95%CI: 17–46%) - Higher anxiety in Asia compared to other continents and in school teachers compared to university teachers - Higher stress levels in university teachers compared to school teachers
Silva et al. (2021)	SLR	6	Prevalence of anxiety, depression, and stress	School and higher ed teachers	Jan '20 to Aug '21	<ul style="list-style-type: none"> - Prevalence of anxiety in school and higher ed teachers from 10% to 49.4%, considerably higher in a study conducted in Europe - Prevalence of depression ranged from 15.9% to 28.9%, being considerably higher in a study with teachers who worked in schools - For stress, a considerably higher prevalence was found in Europe (50.6%) compared to studies conducted in the Americas (12.7%)
Susilaningsih et al. (2021)	SLR	5	Quality of work-life	Lecturers	Jan '20 to June '21	<ul style="list-style-type: none"> - Online learning during COVID-19 reduced the quality of work-life of lecturers - Causative factors include poor psychological well-being, frustration regarding IT use, and reduced work-life balance
Westphal et al. (2022)	SLR	17	Stress and burnout	K–12 teachers	Jan '20 to Aug '22	<ul style="list-style-type: none"> - Some indication that burnout increased during the COVID-19 pandemic - Little differences in stress and burnout experienced by K–12 teachers compared to other occupational fields - Individual factors associated with burnout: personality, self-efficacy in online teaching, and perceived vulnerability to COVID-19
Zheng et al. (2022)	SLR	52	Techno stress for online activities	University teachers	Dec '19 to May '21	<ul style="list-style-type: none"> - Teachers experienced techno stress during the COVID-19 pandemic - Absence of infrastructure, lack of guidance and assistance for non-expert online teachers increased techno stress
						School Closures and other Measures
Amate et al. (2021)	SLR	13	Repercussions of COVID-19 measures on primary education	Primary school students + teachers	Jan '20 to N/S [Jul '21]	<ul style="list-style-type: none"> - Problems identified: right to education, repercussions for teachers, students, and family spheres, emergence of social inequalities that were less noticed before - Challenges for teachers: transition from face-to-face to e-teaching, remote work - Role of family enhanced for teaching-learning processes
Chaabane et al. (2021)	SLR	10	Impact of school closure on child and adolescent health	-	Jan '20 to Sep '20	<ul style="list-style-type: none"> - Critical school-based services inaccessible (e.g., healthcare, programs for children with disabilities, nutrition programs) - Significant decline in hospital admissions and pediatric emergency department visits - Impacts on child and adolescent mental (e.g., anxiety, loneliness, sadness, frustration) and physical (e.g., increased BMI) health - Increase in child stress, sadness, frustration, indiscipline, and hyperactivity; alteration or breakdown in daily routines - Widening educational disparities due to the lack of support (parents, remote learning)
Hammerstein et al. (2021)	SLR	11	General and differential effects of school closures in spring 2020 on achievement	Primary + secondary school students	Mar '20 to Apr '21	<ul style="list-style-type: none"> - Negative effect of COVID-19-related school closures on student achievement, comparable in size to findings of research on summer losses ($d = -0.005 SD$ to $-0.05 SD$ per week; see Kuhfield & Tarasawa, 2020) - Positive effects on achievement primarily observed for students who already worked with online learning software before and increased its use during school closures
Khan (2021)	SLR	39	Evaluation of school measures following the lockdown	-	Mar '20 Jul '20	<ul style="list-style-type: none"> - Increased levels of disruption in teaching, especially in the migration from face-to-face teaching to online learning - Importance of the social contact between educational institutions, the communities in which they operate, and the stakeholders that they serve
Kratzer et al. (2022)	SLR	18	Unintended consequences of measures implemented in the school setting	Primary and secondary school students and staff	Jan '20 to Mar '21	<ul style="list-style-type: none"> - Broad range of unintended consequences, including educational (e.g., hearing difficulties due to masks, disruptive behaviors of students), physical, physiological, environmental, and socio-economic outcomes - However, unintended consequences only sparsely researched and no evidence of a comprehensive or coherent body of research on these outcomes
Krishnaratne et al. (2020)	SLR	42	Measures implemented in the school setting	Primary and secondary school students and staff	Jan '20 to Oct '20	<ul style="list-style-type: none"> - Structural and environmental measures include physical distancing, ventilation, removal of furniture, cleaning schemes - Surveillance and response measures included testing, tracing, and symptom screening as well as isolation, quarantine, and reactive school closures - Most of the studies were mathematical modelling studies with varying quality - Relatively few studies focused on structural/ environmental measures and surveillance and response measures - Most studies considered the presence (and sometimes varying intensity) of other non-school-related co-interventions
Viner et al. (2022)	SLR	36	Health and well-being outcomes associated with school closures during first wave	Students, teachers, and parents	Jan '20 to Sep '20	<ul style="list-style-type: none"> - High psychological distress (18% to 60% of children and adolescents above thresholds for risk of psychological difficulties) - No significant increases in suicides; increased anxiety and trauma, increased sense of connection with school (but not peers and family), worsening student behavior, inattention and hyperactivity, increased sleep problems, lower life satisfaction and well-being - Associations between school closure and health outcomes could not be separated from broader lockdown measures

						E-Teaching and Learning
Abu Talib et al. (2021)	SLR	47	Impact of shift to e-learning in early 2020 on education	-	Jan '19 to N/S [Oct '20]	<ul style="list-style-type: none"> - Mixed recommendations regarding merits of e-teaching - Key disadvantages: inequality of access, inadequacy of online teaching, poor communication quality, technical difficulties, increased workload and stress, low technological literacy, difficulty in assessment of student engagement and performance, poor work-life balance, and some privacy concerns - Key advantages: flexibility and convenience, discussion and communication, effectiveness as a didactic tool, efficiency, decreased costs, increased exposure to technology, impetus for change
Aisha and Ratra (2022)	SLR	19	Opportunities, challenges and psychological impacts of sudden shift to e-teaching	Primary, secondary, and tertiary education students + teachers	Jul '20 to May '21	<ul style="list-style-type: none"> - Online education influenced interests and experiences of students and teachers with an immense impact on their overall psychology - For effective implementation of online and blended education, psychological well-being of students and teachers should be taken care of with properly designed instructions, adequate infrastructure or resources and satisfactory technological skills
Amelia et al. (2021)	SLR	21	Digital transformation and impact of e-learning on pedagogy in primary schools	-	Jan '20 to N/S [Sep '21]	None articulated
Camilleri and Camilleri (2022)	SLR	31	Costs and benefits of e-learning technologies	-	Jan '20 to Mar '22	<ul style="list-style-type: none"> - Costs: mixed satisfaction with quality of online learning, lacking preparedness/training of instructors, vast differences in quality of e-teaching formats, worries about academic progress, increasing divide due to lacking internet access, physical problems due to increased time in front of screen - Benefits: potential to foster learning and retention, provision of support, more convenient access
Deepika et al. (2021)	SLR	45	E-learning modalities used during onset of COVID-19	-	Jan '20 to Mar '20	<ul style="list-style-type: none"> - E-learning as convenient way to continue teaching and learning during the pandemic and beyond - Learning management systems can integrate content delivery, record maintenance, assessment and feedback processes - Though many barriers and challenges are in the way of successful implementation of e-learning, necessary to step forward with e-learning technology
Fernández-Batanero et al. (2022)	SLR	29	Impact of shift to e-teaching	Students and teachers in higher ed	Jan '20 to Apr '22	<ul style="list-style-type: none"> - Benefits: flexibility, self-efficacy, remote learning, social distance, ease of use - Limitations: lack of resources, mental health, digital literacy of teachers, student assessments, workload, communication quality, student engagement and motivation, technical aspects, financial aspects, lack of experience
Ibna Seraj et al. (2022)	SLR	45	Pedagogical trends and assessment practices in emergency e-teaching	Students and teachers	Mar '20 to Apr '21	<ul style="list-style-type: none"> - Advantages: teachers'-students' positive experience, cost-saving, flexible learning, time-saving, collaborative learning, conductive learning, effectiveness, good medium, synchronous teaching methods - Challenges: course integration with technology, internet issues, lack of interaction, technical infrastructure, devices, training, motivation, distraction, time management, lack of technological literacy, increased workload, organizational preparedness, limited communication, unequal learning changes
Masalimova et al. (2022)	SLR	27	Students' attitudes about e-learning	University students	N/S [Jan '20] to N/S [Nov '21]	<ul style="list-style-type: none"> - Mixed findings on students' attitudes (some positive, some negative) - Mostly moderate to high levels of satisfaction - Students articulate preferences for face-to-face learning
Na and Jung (2021)	SLR	8	Challenges in online teaching and design opportunities	University instructors	Jan '20 to May '21	<ul style="list-style-type: none"> - Challenges: managing/conducting online classes, using online learning platforms/software, teaching class effectively, interacting with students, making students participate and learn, course preparation, solving technical issues - Causes: lack of skills, infrastructure issues, need for adjustment, external distractions, facility issues, not being in the same place, lack of support/direction, rapid transition, software issues
Nakhoda et al. (2021)	MA	24	E-Learning satisfaction	University students	N/S [Jan '20] to N/S [Mar '21]	<ul style="list-style-type: none"> - Overall moderate levels of satisfaction - Medical students less satisfied than others, possibly due to more practical courses
Nasution et al. (2022)	SLR	53	Effectiveness, outcomes, challenges of emergency online learning	-	Jan '20 to Aug '20	<ul style="list-style-type: none"> - Effectiveness: largely noted as high - Learning outcomes: mixed results on students' achievement - Learning challenges: lack of internet access, teachers' incapacity to use technology, nervousness when using technology, teacher interaction, students restricted learning facilities, pressure and disturbances
Panagouli et al. (2021)	SLR	42	Academic performance during online learning	Students, aged 8-22	N/S [Jan '20] to N/S [Nov '21]	<ul style="list-style-type: none"> - Mixed findings regarding effectiveness: some reporting learning losses, few reporting benefits - Good communication between teachers and parents, and interactive and interesting learning material, supportive for learning gains - High-achieving and older students profited more than disadvantaged and younger students

			and modified educational methods			<ul style="list-style-type: none"> - Students from non-privileged areas less likely to participate at all in online lessons - Parents report difficulties of their students regarding discipline and self-regulation despite parental support - Students with neurodevelopmental disorders or special education needs struggled the most (e.g., ADHD, dyslexia)
Saikat et al. (2021)	SLR	22	Benefits and challenges of mobile learning	Learners and educators	Jan '20 to N/S [Jun '21]	<ul style="list-style-type: none"> - Benefits: adaptability, saving time, flexibility at own time, more participants in given course possible - Challenges: content issues, lack of technological literacy, lack of resources, preparing materials time-consuming and complicated (especially for older instructors), lack of communication, evaluation, connectivity, data protection and privacy, as well as increased motivational, problem-solving, psychological, and economical issues
Turnbull et al. (2021)	SLR	26	Role of educational technologies in the transition from face-to-face to online teaching and learning activities	-	Feb '20 to Oct '20	<ul style="list-style-type: none"> - Technologies used: role of Zoom to replicate face-to-face instruction online, adapting learning management systems as "first points of access", use of social media in online delivery - Challenges regarding transition: reconciling synchronous/asynchronous delivery, technology access, online competence, academic dishonesty, privacy and confidentiality - Lessons learned: institutional support, training, blended learning, learning communities
Xue and Crompton (2022)	SLR	50	How the pandemic influenced educational technology research	Mostly undergrads	Dec '19 to Jan '22	<ul style="list-style-type: none"> - Influencing factors: online teaching self-efficacy and multimodality of materials as central factors triggering student participation and success - Effectiveness: multiple aspects of success (experience, adaptation, more positive attitudes towards live chat as help-seeking tool) - Challenges: social isolation, lack of interactivity, self-regulated learning, technical problems, methodological aspects - Role of teachers: professional development required, teachers' proficiency, confidence, and motivation in using digital technology improved
Interventions						
da Silva et al. (2022)	SLR	13	Online group interventions for mental health promotion	College students	Dec '19 to Jan '22	<ul style="list-style-type: none"> - Online interventions effective in helping the mental health of college students during social isolation and in reducing symptoms of anxiety, depression, and stress - All identified group intervention methods showed satisfactory and promising results
Malinauskas and Malinauskiene (2022)	MA	10	Psychological interventions for reducing stress, anxiety, and depression	University students	Jan '20 to July '22	<ul style="list-style-type: none"> - The random control trials (RCTs) of interventions reviewed indicated a trend in effectiveness of internet-based interventions for reducing stress, anxiety, and depression in university students during COVID-19 - Significant effects from the included RCTs with interventions for reducing stress and depression were established - Psychological internet-based interventions may reduce depression and stress among university students; more research is needed to determine their effectiveness in reducing anxiety
Riboldi et al. (2022)	SLR	8	Digital mental health interventions for anxiety and depressive symptoms	University students	Jan '20 to Jan '22	<ul style="list-style-type: none"> - Regarding anxiety symptoms, digitally delivered cognitive behavioral therapy, dialectical behavior therapy, and mind-body practice techniques emerged as valid strategies, while digital positive psychology and mindfulness-based interventions showed mixed results - For depressive symptoms, digitally delivered dialectical behavior therapy and positive psychology interventions have some efficacy
Individual Factors						
Aznam et al. (2022)	SLR	50	Motivation and satisfaction in online learning	School and higher ed students + teachers	Dec '19 to Dec '20	<ul style="list-style-type: none"> - Significant change in motivation and satisfaction with online learning during pandemic in which students struggled with limited learning - Special efforts should be made by policy makers in addressing and meeting the needs of student learning activities, especially increasing their motivation and level of satisfaction
Boström et al. (2021)	SLR	46	Effects of pandemic on students' study strategies	Higher ed students	Jan '20 to Jan '21	<ul style="list-style-type: none"> - Students' study strategies changed to some extent during pandemic, with more emphasis on own responsibility and need for a developed teaching strategy to align with the changing framework related to the emergency provision of distance education - Students should develop metacognitive strategies
Haddad et al. (2021)	SLR	6	Impact of social media on mental health	College students	Jan '20 to Jan '21	<ul style="list-style-type: none"> - Excessive or problematic social media use during the COVID-19 pandemic was correlated with worse mental health outcomes that could be mitigated by dialectical thinking, optimism, mindfulness, and cognitive reappraisal
Morfaki and Skotis (2022)	SLR	9	Online learning experiences under the lens of broad personality	Higher ed students	Sep '21 to Feb '22	<ul style="list-style-type: none"> - Students' personality traits impacted their learning experiences and well-being throughout the pandemic - Agreeableness was linked to learning and perceived anxiety - Openness was associated with learning, self-efficacy, and satisfaction, yet also anxiety - Extraverted students reported lower course achievement and intrinsic motivational regulation as well as increased anxiety - Conscientiousness was associated with academic achievement, self-efficacy beliefs, and effective learning styles
Nang et al. (2022)	SLR	52	Teacher technostress and coping mechanisms	School and higher ed teachers	Dec '19 to Aug '21	<ul style="list-style-type: none"> - Teachers used coping strategies to deal with the ramifications of the pandemic - The most frequently used coping strategies entailed reaching out for social support, physical exercise, taking part in leisure and spiritual activities, reading, and listening to music - Seeking social support was marked as the most popular strategy.

At-risk Groups						
Aljedaani et al. (2022)	SLR	34	Barriers of deaf and hard-of-hearing students	Students	Jan '20 to N/S [Jun '22]	<ul style="list-style-type: none"> - Technology-related challenges: unavailability of hearing devices, disruptions during online lessons, lack of familiarity with online devices - Education system-related challenges: e-learning as a significant barrier for deaf students, lipreading restricted due to masks - Physical accessibility challenges: especially in underdeveloped countries, remote learning as significant struggle for students with auditory access needs - Health-related challenges: mental health as most critical challenge, students with hearing disabilities showed four times more symptoms of anxiety, depression, and emotional challenges than other students
Bakaniene et al. (2022)	SLR	17	Challenges of online learning for children with special educational needs	School-age children, their caregivers and school staff	Jan '20 to May '21	<ul style="list-style-type: none"> - Main challenges: inequities of resources and access to technology, lack of accommodations, routine change, and social isolation - Faced by families and school professionals were the same in all countries regardless of differences between the educational systems and living conditions - Main strategy implemented to address barriers and/or challenges: communication and collaboration between teachers and parents
Coles et al. (2022)	SLR	69	Factors for poorer educational outcomes exacerbated by COVID-19	Disadvantaged school students in Australia	Jan '20 to Jul '20	<ul style="list-style-type: none"> - Key disadvantaged groups: young children who started school behind, older students already at risk of disengagement from school, children and young people who have had contact with the child protection system - Individual factors: health (early health problems, early developmental delay, poorer home learning environments, poor parenting practices, neglect, abuse, and maltreatment), social (lack of peer connectedness, acceptance, and social exclusion), economic (increased family stress, poor family relationships, less access to high quality care and support programs), educational (academic, behavior, mental health difficulties and truancy, lack of teacher support, poor peer, school, teacher connection)
Dobosz et al. (2022)	SLR	11	Home-schooling of children with special educational needs and disabilities	Parents of students with special needs	Jan '20 to Sep '21	<ul style="list-style-type: none"> - Children with special needs faced additional challenges - Substantial minority found that pandemic yielded positive effects (time spent together), whereas most parents with children with special needs reported being negatively impacted by the pandemic - increase in difficulties due to COVID-19 may have hindered parents' ability to cope with stress of parenting special needs children
Ndibalema (2022)	SLR	11	Constraints of transition to online distance learning in in developing countries	Higher ed students in developing countries	Jan '20 to N/S [Dec '21]	<ul style="list-style-type: none"> - Major issues in developing countries: blind turning to online distance learning solutions, lacking personal and institutional readiness to e-learning, little consideration of social-emotional challenges - Individual teacher factors: technological literacy, lack of technical support, lack of pedagogical ICT knowledge, reluctance to adopt new technological solutions, lack of readiness - Individual student factors: digital divide due to economic disparities, lack of digital culture, lack of readiness, anxiety, fear and stress due to sudden change, lack of devices due to economic disparities, poor home learning environment - Individual institutional factors: inadequate equipment, poor and unreliable internet access, missing standards, policies, and guidelines for e-teaching, administrative hindrances, lack of digital culture

Note. Unless otherwise specified, all findings are directly related to the COVID-19 pandemic. "SLR" denotes systematic literature review, "MA" meta-analysis, and "k" refers to the number of included primary studies. The "sample" column specifies if the authors restricted their report to a specific sample, if this was not the case, this is denoted with "-". Some studies did not mention their search period. We specify this with the acronym N/S, followed with a maximum estimate in square brackets that is based on the publication dates of the included articles as well as the submission date of the review itself.

Table 2
Quality Assessment of the Reviewed Studies

Study	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.3	2.4	2.5	2.6	3	4.1	4.2	4.3	4.4	5.1	5.2	6.1	6.2	7.1	7.2	8.1	8.2	8.3	8.4	8.5	9.1	9.2	10	11	12
Well-being of Students																																
Buizza et al. (2022)	1	NA	NA	1	1	1	1	0	0	0	1	1	1	0	0	1	0	1	0	0	0	2	NA	NA	2	1	NA	NA	1	1	0	1
Chang et al. (2021)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	2	NA	NA	2	1	0	1	0	1	1	1
Cortés-Albornoz et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	NA	NA	1	1	NA	NA	1	0	0	1
Deng et al. (2021)	1	NA	NA	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	2	NA	NA	2	1	0	1	0	1	1	1
Ebrahim et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	2	NA	NA	2	1	0	1	1	1	1	1
Elharake et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	NA	NA	2	1	NA	NA	0	0	0	1
Fang et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	NA	NA	2	1	0	1	1	0	0	1
Fekih-Romdhane et al. (2022)	1	NA	NA	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	0	0	0	2	NA	NA	2	1	1	1	1	1	0	1
Jehi et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	NA	NA	2	1	0	0	1	0	0	1
Li et al. (2021)	1	NA	NA	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	0	0	0	2	NA	NA	2	1	1	0	0	0	0	1
Liyanage et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	1	NA	NA	1	1	1	1	0	1	0	1
Valenzuela et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	2	NA	NA	2	2	1	0	1	1	0	1
Wang et al. (2022)	1	NA	NA	1	0	0	0	1	1	1	0	1	1	1	0	1	1	0	0	0	0	2	NA	NA	2	2	1	1	1	1	1	1
Zhu et al. (2021)	1	NA	NA	1	0	1	1	1	1	1	0	1	1	1	0	1	0	1	1	0	0	2	NA	NA	2	2	1	1	1	1	1	1
Well-being of Educators																																
Ma et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	1	0	1	0	1	0	0	0	2	NA	NA	2	1	0	1	1	1	1	1
Ozamiz-Etxebarria et al. (2021)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	2	NA	NA	2	1	0	1	1	1	1	1
Silva et al. (2021)	1	NA	NA	1	1	1	1	0	1	1	0	1	1	1	0	1	0	1	0	0	0	2	NA	NA	2	1	1	1	0	1	0	1
Susilaningsih et al. (2021)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	NA	NA	0	1	NA	NA	0	0	0	1
Westphal et al. (2022)	1	NA	NA	1	0	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	2	NA	NA	2	1	NA	NA	0	1	0	1
Zheng et al. (2022)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	NA	NA	0	0	NA	NA	0	0	0	1
School Closures and other Measures																																
Amate et al. (2021)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	1	1	1	1	0	1	2	NA	NA	2	0	NA	NA	0	0	0	1
Chaabane et al. (2021)	1	1	NA	1	1	1	1	0	1	0	0	1	1	1	1	0	0	0	0	0	0	2	2	1	2	2	0	0	0	0	0	1
Hammerstein et al. (2021)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	1	0	1	0	1	0	0	0	1	NA	NA	1	1	0	0	1	1	1	1
Khan (2021)	1	NA	NA	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	NA	NA	1	0	NA	NA	0	0	0	1
Kratzer et al. (2022)	1	1	NA	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	0	1	1	2	2	NA	2	2	NA	NA	0	0	0	1
Krishnaratne et al. (2020)	1	1	NA	1	1	1	1	0	1	0	0	1	1	1	1	0	0	0	0	1	1	2	2	NA	2	2	NA	NA	0	0	0	1
Viner et al. (2022)	1	1	0	1	1	1	1	1	1	0	0	1	1	1	0	1	0	1	0	0	0	2	1	0	1	2	NA	NA	1	0	0	1

Full List of Quality Criteria**Q1: The research questions and inclusion criteria for the review mentioned:**

Q1.1: Population (Yes = 1 OR No = 0)

Q1.2: Intervention (Yes = 1 OR No = 0 OR NA)

Q1.3: Comparison group (Yes = 1 OR No = 0 OR NA)

Q1.4: Outcome (variables of interest) (Yes = 1 OR No = 0)

Q2: The authors state that they had a written protocol or guide established prior to conducting the review that included (note: reference to PRISMA criteria alone is not considered sufficient, it must be made clear that these guidelines have been established prior to conducting the review):

Q2.1: Review question(s) (Yes = 1 OR No = 0)

Q2.2: Search strategy (Yes = 1 OR No = 0)

Q2.3: Inclusion/exclusion criteria (Yes = 1 OR No = 0)

Q2.4: A risk of bias assessment (Yes = 1 OR No = 0)

Q2.5: A meta-analysis/synthesis plan, if appropriate (Yes = 1 OR No = 0)

Q2.6: A plan for investigating causes of heterogeneity (Yes = 1 OR No = 0)

Q3: Did the authors explain their selection of the study designs for inclusion in the review? (Yes = 1 OR No = 0)**Q4: Did the review authors use a comprehensive literature search strategy?**

Q4.1: Searched at least 2 databases (relevant to research question) (Yes = 1 OR No = 0)

Q4.2: Provided key words and/or search strategy (Yes = 1 OR No = 0)

Q4.3: Searched the reference lists / bibliographies of included studies (Yes = 1 OR No = 0)

Q4.4: Searched for grey literature (Yes = 1 OR No = 0)

Q5: Did the review authors state that they performed study selection in duplicate?

Q5.1: At least two reviewers independently agreed on selection of eligible studies and achieved consensus on which studies to include (note: a second person checking the correctness of a rating does not qualify, as this would not be independent) (Yes = 1 OR No = 0)

Q5.2: Two reviewers selected a sample of eligible studies and achieved good agreement (at least 80 percent), with the remainder selected by one reviewer (Yes = 1 OR No = 0)

Q6: Did the review authors perform data extraction in duplicate?

Q6.1: At least two reviewers achieved consensus on which data to extract from included studies (Yes = 1 OR No = 0)

Q6.2: Two reviewers extracted data from a sample of eligible studies and achieved good agreement (at least 80 percent), with the remainder extracted by one reviewer (Yes = 1 OR No = 0)

Q7: Did the review authors provide a list of excluded studies and justify the exclusions?

Q7.1: Provided a list of all potentially relevant studies that were read in full-text form but excluded from the review (Yes = 1 OR No = 0)

Q7.2: Justified the exclusion from the review of each potentially relevant study (Yes = 1 OR No = 0)

Q8: Did the review authors describe the included studies in adequate detail?

Q8.1: Described populations (Yes in detail = 2, Yes somewhat = 1, OR No = 0)

Q8.2: Described interventions (Yes in detail = 2, Yes somewhat = 1, OR No = 0 OR NA)

Q8.3: Described comparators (Yes in detail = 2, Yes somewhat = 1, OR No = 0 OR NA)

Q8.4: Described outcomes (Yes in detail = 2, Yes somewhat = 1, OR No = 0 OR NA)

Q8.5: Described research designs (Yes in detail = 2, Yes somewhat = 1, OR No = 0)

Q9: *If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?*

Q9.1: The authors justified combining the data in a meta-analysis (Yes = 1 OR No = 0 OR NA)

Q9.2: They used an appropriate weighted technique to combine study results, adjusting for heterogeneity if present (Yes = 1 OR No = 0 OR NA)

Q10: *Did the review authors account for risk of bias in individual studies when interpreting/ discussing the results of the review? (Yes = 1 OR No = 0)*

Q11: *Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review? (Yes = 1 OR No = 0)*

Q12: *Did the review authors carry out an adequate investigation of publication bias and discuss its likely impact on the results of the review? (Yes = 1 OR No = 0)*

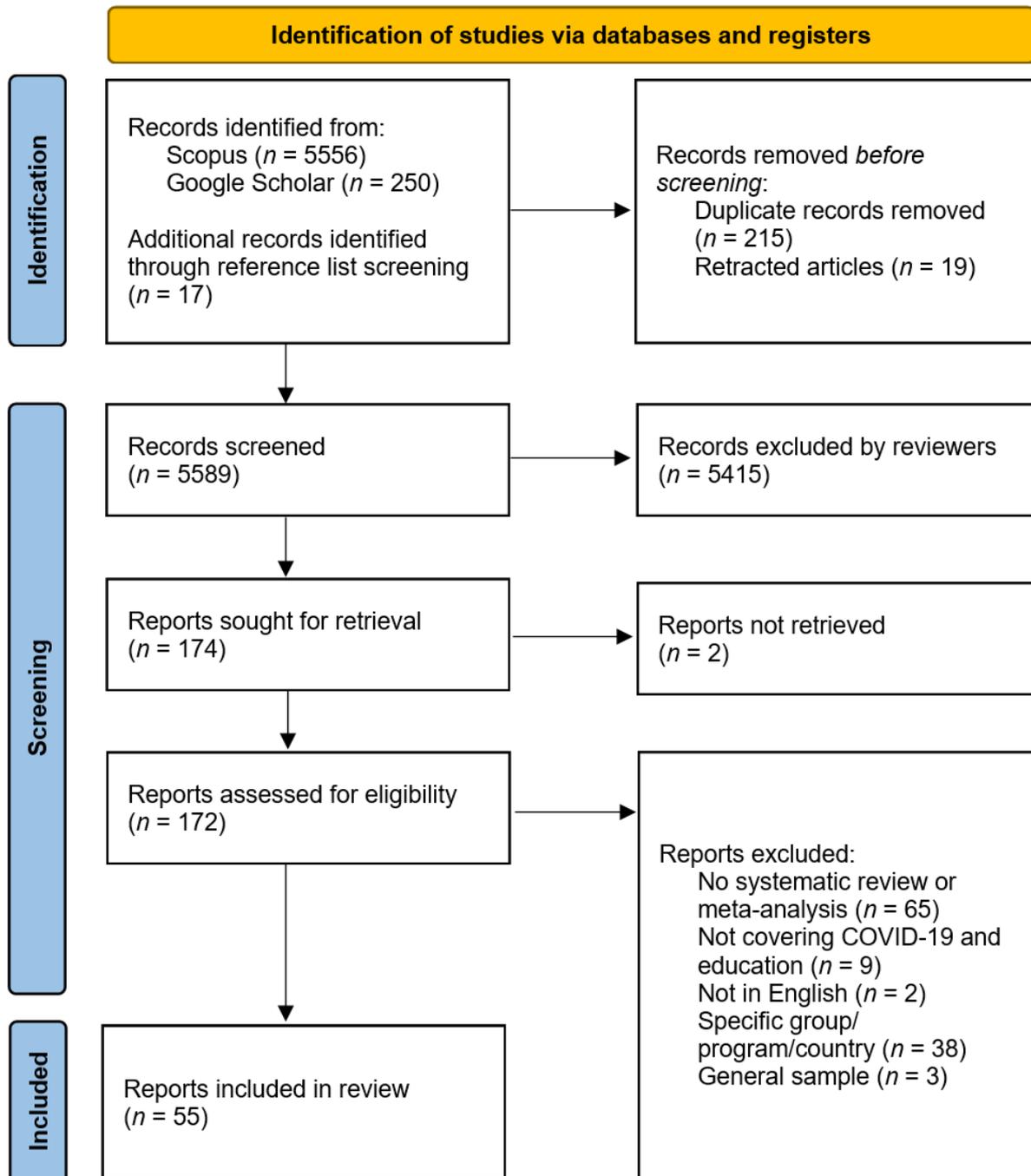


Figure 1. PRISMA flow diagram illustrating the reports identified and included in the systematic review.