Systematic reviews of online learning and its effectiveness before, during and after Covid-19: Counteracting social isolation among post-secondary students

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Executive Summary

Background: The issue. Distance education (DE) in postsecondary education evolved as a means of serving the needs of students that, for whatever reason (e.g., distance, disability), couldn't attend standard classroom instruction. Communication was typically through the mail or telephone and materials (e.g., textbook) were shipped through the post office. With the arrival of computer-based technology much of this changed, except for the gap that was still present between institution and student with so-called Online Learning (OL). This interest spurred the development of dedicated offices of DE/OL, where courses were developed and teachers were "trained" on an institutional level.

This whole system was disrupted with the advent of Covid-19. Suddenly, students, faculty and staff weren't allowed on campus and campus-based courses were suspended. Students and teachers alike needed OL facilities and training that were not yet available. Some hoped that with

the many advancements in online teaching that attitudes towards OL would improve learning and that student achievement wouldn't suffer as a result. It may not have suffered a fatal blow, but the upward trend of OL's surge ended and our second order MA (*Stage one*) largely confirmed that during the period 2000-2001 OL is comparable to, but not significantly better than in-class (CI) instruction in terms of student's academic achievement. Other outcome measures (e.g., attitudes) have not been as well researched. However, the overall research questions relate to the possibility of the unintended consequences of OL.

Research Questions. The research team addressed the following research questions: 1) Does OL (COVID-driven) contribute to the phenomenon of social isolation? 2) If so, what categories of learners by age, gender, discipline, geographic location, socio-economic status, etc. are the most affected? 3) Does the promotion of social presence in OL counteract social isolation and increase learning satisfaction, engagement, and wellbeing? and 4) What preventive/ mitigating interventions (aka 'best practices') are recommended to ensure that various educational and social benefits are achieved?

Results. In *Stage one,* the summarized data from ten MAs on OL, published between 2000 and 2021, produced an overall weighted average effect size for achievement outcomes of $g^{++} = 0.085$, just about the same as Bernard et al. found in 2004 for non-technology forms of "stay-at-home DE," where the weighted average for these studies of around $g^+ = 0.05$. In *Stage two,* studies conducted during the pandemic indicate that the forced reliance on OL forms of instruction in postsecondary education may exacerbate the potential problems of social isolation and associated negative consequences. A number of potential solutions to this can be found in the literature. In *Stage three* the search for and description of the relevant case studies is currently underway. We hope to catalogue the instructional practices in OL characterized by the elevated potential of increasing interactions and counteracting negative societal and psychological outcomes of OL in postsecondary education.

Methodology. This project employed the methodologies of systematic review both quantitative (meta-analysis) and qualitative (meta-synthesis), second-order meta-analysis and second-order meta-synthesis (i.e., review of reviews) to derive a comprehensive picture of the outcomes of distance education/online learning (OL) academic achievement and attitude (i.e., the most common outcome measures in the literature). Generally speaking, the steps are as follow (Borenstein, Hedges, Higgins & Rothstein, 2009): Step 1 – formulate the problem, including

specification of search terms and inclusion/exclusion criteria; Step 2 – search the literature using search terms; Step 3 – select studies for inclusion using inclusion/exclusion criteria; Step 4 – gather information from studies (i.e., effect sizes and moderator variables); Step 5 – evaluate the quality of the evidence (i.e., bias analysis); Step 6 – interpret the evidence; and Step 7 – integrate the outcomes of research into prior literature; and Step 8 – present the results.

Key Messages. In *Stage one* a complete second-order MA could not be produced, as the outcomes measures across the reviewed sources were not completely compatible. However, a partial review of eight similar meta-analyses led to a modest outcome of $g++ = 0.084$ (i.e., low by most standards). In addition, we summarized the major messages derived from various relevant sources. Of utmost interest to this project were the research findings indicating that excessive use of technologies in general often lead to antisocial (aggressive) behaviours, and emotional instability. In *Stage two*, single meta-analyses and meta-syntheses that were conducted during/after the pandemic indicate that forced reliance on OL forms of instruction, where there is no or limited student-student or student-teacher interaction creates potential problems of social isolation and associated negative consequences may arise. *Stage three* yielded few quality, empirical studies, but we extracted concrete recommendations from past and recent studies on how to leverage technology to enhance social interaction with the pedagogy of course design, delivery and maintenance based on prior literature, combined with the current.

Final Report

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Background

For far too long the research on distance and blended learning has focused nearly exclusively on achievement outcomes. It made perfect sense in the conditions when these modes of instructional delivery were a matter of either the students' own choice or some special circumstances, like access to particular educational settings for students who would otherwise be deprived of the corresponding learning experiences due to their remote location, disabilities, etc. This situation existed up to the onset of pandemic (Covid-19), when learning at distance for that two-year period became almost an omnibus means of education and involved different categories

of students. Subsequently, the pressing need to more closely assess other types of outcomes – societal and psychological, above all – became paramount.

The Covid-19 pandemic has had a significant negative impact on society, including many aspects of formal education. As of now, we know much better a lot of things about the virus itself, reliability of testing, promising therapeutics for treating the disease, relative success/failure of mask wearing, lockdowns and travel restrictions, social distancing, etc., as well as about the legitimate concerns regarding detrimental side effects of these preventive measures on economy, mental health and other aspects of well-being, including elevated risk of drug abuse (Chiappini et al., 2020; Zaami et al., 2020 and domestic violence (Anurudran et al., 2020; Bradbury-Jones & Isham, 2020; Leslie et al., 2020), increase in number of suicides (McIntyre & Lee, 2020; Reger et al., 2020), delayed or cancelled treatments of other illnesses with no exception for non-elective surgeries and chemotherapy for cancer patients (La Torre et al., 2020; Negopdiev & Hoste, 2020). All these problems warrant serious reflection and balanced non-politicized discussion, but the main focus of this systematic review is on the issues related to education.

Among the most prominent challenges has been reduced physical presence in schools. There is widespread concern about student social isolation, expressed by professional communities in medicine, education and social work, as well as parents and teachers (Loades et al, 2020). For example, a recent study from the University of Ottawa confirms exacerbating feelings of loneliness and social isolation due to the interruption of interpersonal relationships for children and adolescents (Vaillancourt et al., 2021). Sustaining the teaching/learning function (including emergency teaching) has necessarily involved using online learning (OL) approaches, a practice likely to increase, especially in post-secondary education. The question is how to optimize these educational approaches by counteracting the pitfall of isolation while retaining desirable learning outcomes.

Of the highest conceptual relevance to this rather challenging task seems to be the framework of **Communities of Inquiry** (CoI), first formulated in Garrison et al. (2000; 2001). The CoI framework is rooted in Dewey's work and looks at educational experiences as interactive processes within reflective inquiry. Largely researched in the context of asynchronous collaborative online discussions (e.g., Garrison, Anderson et al., 2010), this framework describes learning as an applied cycle of collaborative inquiry from the realisation of the problem through its exploration and integration of the relevant knowledge to the problem resolution. In other

words, learners form and maintain a community of explorers motivated to jointly find knowledge-based solutions to common conceptual or applied problems. Thus, the framework postulates that to succeed, such communities need to have/develop and rely on three types of presence: *cognitive*, *teaching*, and *social*. These three types of presence underlie the key learning outcomes of students' actual and perceived learning and satisfaction.

Cognitive presence focuses on constructing meaning through critical reflection and discourse (i.e. collaborative interactions) and is defined as "exploration, construction, resolution, and confirmation of understanding through collaboration and reflection in a Community of Inquiry" (Garrison, 2007, p. 65). There is research evidence of strong positive connections between cognitive presence to students' actual learning and satisfaction (e.g., Hosler & Arend, 2012; Kang et al., 2014).

Teaching presence is defined by Anderson et al. (2001) as "design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educational worthwhile learning outcomes" (p. 5) and, as such, focuses predominantly on teacher-student and, to some extent, student-content interactions. It typically happens in the form of inquiry guidance, course/discourse design, organization, and facilitation, as well as classical direct instruction. Naturally, teaching presence typically has positive relationships with student perceived learning (e.g., Arbaugh, 2008; Kranzow, 2013) and student satisfaction (e.g., Abdous & Yen, 2010; Shin, 2003).

Social presence reflects human (i.e., focused on identity and relationships) learning experiences. It is defined as "the ability of participants to identify with the community, communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, 2009, p. 352). The concept of social presence is not a new one, with social psychologists first defining the concept with regards to nonverbal communication and behaviours (Argyle, 1969). As technologies (educational, in particular) have advanced, researchers have continued to investigate how various new media intersect with social presence, in terms of online communities of inquiry (e.g., Garrison et al., 2000 and 2001; Annand, 2011; Kreijns et al., 2014), computer-based conferencing (e.g., Gunawardena, 1995), and online adult education (e.g., Lowenthal, 2010).

Quite in line with the corresponding frameworks of social psychology, this multidimensional phenomenon encompasses affective and communicative components and

group cohesion (i.e., integrity of learning communities). Social presence supports cognitive engagement with the content of OL courses and may reduce (or help positive resolution) of social conflicts within the community. Unlike the other two types, social presence has weaker correlations with learning outcomes (e.g., Joo et al., 2011; Shin, 2003), but is strongly associated with satisfaction (e.g., Akyol & Garrison, 2008; Swan & Shih, 2005).

Among the three the latter is of direct relevance to the objectives of the current review, and we intend to concentrate efforts on closely researching how social presence has been represented in OL before and during the Covid-19 pandemic and what lesson could be learned to project to the future educational practices the most promising means of preserving, supporting and growing social presence.

Positive impacts of social presence are well documented in the educational research literature. For example, in a meta-analysis of social presence in education, Richardson et al. (2017) clearly indicated significant positive connection between social presence and learning satisfaction and also with self-perceived learning. Similarly, Lowe-Madkins (2016) showed that additional efforts to boost social presence in OL courses could result in higher levels of learning satisfaction and course retention. In other words, learners engaged with each other and in collaborative interactions with their teachers tend to have higher motivation for learning, are more likely to feel more positively about the educational process, and subsequently are more likely to succeed. This is exactly as our own research indicated: higher levels of interaction among students and teachers (Bernard et al., 2009), and especially purposefully designed for collaboration (Borokhovski et al., 2012), led to higher levels of learning achievement and satisfaction.

On the other hand, distance learning in general, has long been plagued with issues of isolation. Social isolation and loneliness are similar but distinct phenomena (Holt-Lundstad et al., 2017), generally characterized as related to a lack of social connections. Students have often reported feelings of isolation in OL, with a lack of human interaction often seen as a hindrance to learning (Sit et al., 2005), cited as a reason for attrition (e.g., Angelino et al., 2007; Boston et al., 2011) and likely responsible for the decision not to pursue post-secondary OL at all.

If we are to contend with this emerging issue of isolation, we must minimize the extent to which our educational systems are a primary contributor. Education is one of the key institutions in society impacting on social interaction, so the instructional strategies that are used must attend

to this critical role. Educational technologists have been aware of the challenges of fostering connection in OL for some time and are challenged to find solutions while maintaining academic standards.

There is a whole collection of instructional strategies, pedagogical approaches and technological solutions suggested to prevent or mitigate student social isolation in education. Among those, blended learning (BL) – i.e., a combination of OL and in-person teaching/learning events – is often named as the one with the highest potential to decrease social isolation. The pedagogical strategies used in BL are more interactive, and more "learner-centered," a characteristic that Schmid et al., (2014) linked to enhanced performance. Such approaches often utilize positive interdependence and peer-assisted learning (e.g., Laurie et al., 2020; Deshpande, 2017), and are thus pro-social (Van Ryzin et al., 2020). They also rely on the use of heterogeneous group assignments, hence increasing the diversity of learners in terms of background, interests, content knowledge, etc. The use of interactive technology in the design and implementation of these learning environments can help overcome feelings of isolation, but unlike the drawbacks of too much social media, it is done in a designed, constructive, mediated context (i.e., meaningful for learning). Common goals are provided/derived; creative methods for solving problems are co-constructed by the instructor, course content, and the learners.

Objectives of this Research

The SSHRC Program raises a serious concern: "Human inability to interact meaningfully without the intervention of technology could prompt questions regarding access, privacy, and ethics." Our educational system is provincially regulated, but community based. As our lives in a digital world become increasingly dependent upon technology, education is a "safe space" for fostering pro-social values. What more potentially impactful service exists than socially responsive educational programming? When neither BL, nor in-person practices are possible and education must take place entirely online (as was the case for most Canadian students during the two years of the pandemic), then steps should be taken to boost social presence and engagement in OL so that students are able to connect positively with peers and teachers.

To address the overarching research question "Does OL create social isolation, and if so, what can we do to counteract it?" this project employs the methodology of systematic reviews combining all its components – meta-analysis (systematic aggregation of quantitative empirical research), both first-order and second order and meta-synthesis (MA or systematic summary of qalitative data) to derive the most comprehensive picture of the outcomes of distance education, primarily online learning (OL) beyond typically considered academic achievement (i.e., how and how much OL affects psychological and societal outcomes of satisfaction, engagement, and social interactions – as opposed to frustration, demotivation and social isolation. The issue is of a special interest, since the Covid-19 pandemic forced numerous of higher education institutions to increase the use of OL instructional practices dramatically.

More specifically, the review addresses the following research questions:

- Does OL (especially, COVID-driven) contribute to the phenomenon of social isolation?

- To what extent does the promotion of social presence in OL counteract social isolation and influence learning satisfaction, engagement, and wellbeing?

- How much does what was reported in the research literature about social presence pre-pandemic align with the reality of OL during the pandemic?

- What preventive/mitigating interventions (aka 'best practices') could be recommended to ensure achieving various educational and social benefits?

Method

The project encompasses (as its major stages/components) the following systematic reviews and their derivatives:

At **Stage one** we conduct a second-order review (i.e., review of reviews), including a meta-analysis (MA) – if a sufficient number of relevant first-order MAs is available with the purpose of summarizing what is known on the issue of educational and societal outcomes of OL. The idea is to collect and review published meta-analyses, systematic and scoping reviews (i.e., conclusive/representative research overviews) in the subject area of social isolation/presence in OL environments conducted in the period immediately prior to the Covid-19 pandemic (2014 to 2019) and to systematically summarize their key themes and findings.

Stage two is intended as a regular (first-order) MA on research conducted during the Covid-19 pandemic or, in case, if some adequate reviews captured the major educational tendencies and research findings of that time, to summarize them for a comprehensive picture of the role social presence and student engagement play in the delivery of effective pedagogy in post-secondary institutions.

Finally, at **Stage three** we combine the most prominent quantitative and qualitative findings of the first two stages to identify and describe the 'best practices' capable of efficiently counteracting the negative societal and psychological effects of social isolation in postsecondary OL and/or to sketch a roadmap of how to deal with what will/should happen in the post-pandemic formal education.

In more detail, activities at each stage unfolded as follows:

Stage one: To locate relevant sources we searched the major databases in the field of education (ERIC, Education Source, ProQuest Education), related fields like Psychology (PsycINFO), and multidisciplinary databases (Web of Science Core, Academic Search Complete) for meta-analyses and systematic reviews on the topic of OL that report outcomes related to social presence/isolation, and student interaction/engagement. These database searches were supplemented with a search in Google Scholar to target both international research literature and reviews published as reports rather than journal articles. Searches were limited to publications in English dated between 2014 and 2019.

Our searches resulted in a number of publications suitable for a second-order MA (see Tamim et al., 2011 and Hew et al., 2021 for examples) with respect to learning achievement

outcomes, but insufficient for other outcome types. The latter were summarized in the form of a second-order review highlighting the key emerging topics and findings that followed the same systematic procedures with the exception of the effect size extraction and aggregation, as outlined below.

Conducting a second-order MA/review is not as onerous nor time consuming as a meta-analysis covering the equivalent time period. The truncated steps are as follows (where steps 4-7 only apply to MA): 1) Establish search and selection criteria; 2) locate meta-analyses that were done during the relevant period on the subject(s) of interest; 3) select meta-analyses and systematic reviews that fit the established criteria; 4) extract statistical data (effect sizes, standard errors, sample sizes); 5) calculate overall effect size(s) and adjust standard errors; 6) extract whatever moderator variables that can be found; 7) conduct moderator variable analysis; and 8) interpret results (for more information see Schmidt & Oh, 2013). The outcomes of this stage of the project provide a "baseline" for interpreting the review of the Covid-19 years.

Stage two: In this stage we intended to collect data that reflected OL educational practices during the pandemic with a possibility to conduct a limited *first-order* MA of the quantitative literature published during the period 2020-2022. We searched several bibliographic databases in the subject area of education, related fields, and multidisciplinary databases (as listed above for stage one) using appropriate keywords and controlled vocabulary to fully capture all key concepts.

Searches were limited to English studies published in 2020 or 2021 (advance online publications with of the year 2022 were also considered). A trial search of the above strategy in the ERIC (EBSCO) and in the Education Source (EBSCO) databases alone identified over 1,000 abstracts of potentially relevant publications. Additional databases, manual searches and sources of so-called 'grey literature' would bring the projected total returns up to or exceeding than 8,500, a number hardly manageable within the timeframe and resources of the current project. At the same time, we observed a number of potentially pertinent reviews published in the targeted period – given the importance of the topic, many researchers tried to summarize relevant data as they appeared (nearly in real time fashion). So, we made a decision to limit our data sources to reviews only, pretty much in line with the *Stage one* procedures.

We strongly believe that a MA of the relevant primary sources is still the most adequate and desirable measure for summarizing empirical data emerging from the research of the

pandemic period, as most of the identified reviews were rather scoping (than systematic) and of narrative (descriptive) nature, and as such, lack the rigor and precision of high-quality quantitative studies. However, to conduct a proper MA, we should allow more time for more methodologically sound primary research to be published. There is also an issue of adequate resources, so we have already applied to the SSHRC Insight competition hoping to enable a more comprehensive MA, better reflection of the data from the Pandemic years that continue to appear in the literature and that are probably less affected by the rash of the first attempts to summarize educational experiences of this challenging period. These reviews were necessary and timely, but perhaps limited in scope and rigor due to the truncated period/funding of the research program.

Stage three: For the purpose of meaningfully summarizing data from the other two stages of the projects we partly made used of a methodology called an Argument Catalogue (*Note:* argument cataloguing is more of a process than a product). The process typically includes defining the problem, establishing inclusion/exclusion criteria, identifying the literature and procedures for document retrieval, categorizing topics and messages found in the included documents according to a pre-established codebook, analyzing both *quantitative* and *qualitatively* data, and examining and interpreting the discovered patterns of findings. Argument cataloguing was successfully used in eLearn Canada and SSHRC-funded projects (Abrami, Bernard & Wade, 2006; Borokhovski et al., 2011) allowing us to analyze and combine data from otherwise incompatible sources. It provides a rigorous process to produce a balanced view of the evidence, helping answer *why* what works, thus gaining a deeper understanding of the phenomenon being examined. The final results are similar to a truncated meta-synthesis (i.e., a qualitative review). In this particular case, we used the principles of the described methodology to literally *catalogue* the best practices identified through reviews of the first two stages of the project to illustrate how the problems of social isolation in OL could be mitigated and student engagement and interaction boosted. That said, as discussed in the Results section, our ability to implement this approach was severely limited due to constraints.

To summarize the project stages and the corresponding procedures used, we conducted a review of reviews describing issues and outcomes of educational research of OL prior to Covid-19, during the pandemic, and then attempted to systematically reflect what applied means are capable of compensating for the problem of social isolation.

The complete search strategy and outcomes of its step-by-step implementation are presented below and reflected in the PRISMA flow-chart in the subsequent Results section.

Search strategy:

(online OR web-based OR distance OR remote OR virtual) N1 (learn* OR class* OR course* OR educat* OR instruct* OR university OR college)) OR (Zoom OR Skype OR "Microsoft Teams" OR "video conferenc*" OR "web conferenc*" OR "learning management system")

AND

("social presence" OR isolation OR interacti* OR engagement OR disengag* OR rapport OR "teacher presence" OR asocial* OR "anti-social" OR antisocial OR prosocial OR depression OR lonel* OR bonding OR satisfaction OR "self-efficacy" OR relationship* OR emotion* OR sadness OR melanchol* OR wellbeing OR well-being OR "well being" OR anxiety OR stress OR frustration OR "mental health")

AND

(meta-analysis OR "systematic review" OR "quantitative synthesis" OR "scoping review" OR "narrative synthesis" OR "narrative review" OR "evidence synthesis")

Searches were limited to publications in English dated between 2014 and 2019 and returned 556 total results. Searching in Google Scholar could not rely on advanced Boolean logic, so a series of searches were run varying the keywords in each; the first 3 pages of the search results were screened by title for relevant material and results added to Endnote. Sample searches include:

- "online learning" meta-analysis isolation undergraduates
- "remote learning" meta-analysis wellbeing undergraduates
- psychological wellbeing undergraduate students "online school" meta-analysis.

Searches using Google returned a further 98 results, for a total of 624. After duplicates were removed using Endnote bibliographic management software, we were left with 440 abstracts to review. Two coders processed the abstracts and marked those that appeared relevant for full-text retrieval; relevant publications specific to the Covid-19 period (i.e. reports looking at the impact of Covid-19 on online learning) were sorted out into a separate collection for review in Stage two. A total of 338 studies were excluded at the abstract stage, leaving 56 reports for full-text review in Stage one and 46 for full-text review in Stage two. Out of 56 reports preselected for

Stage one, fourteen were discarded and 42 retained, while nineteen were excluded from **Stage two**, leaving a collection of 27 included reviews.
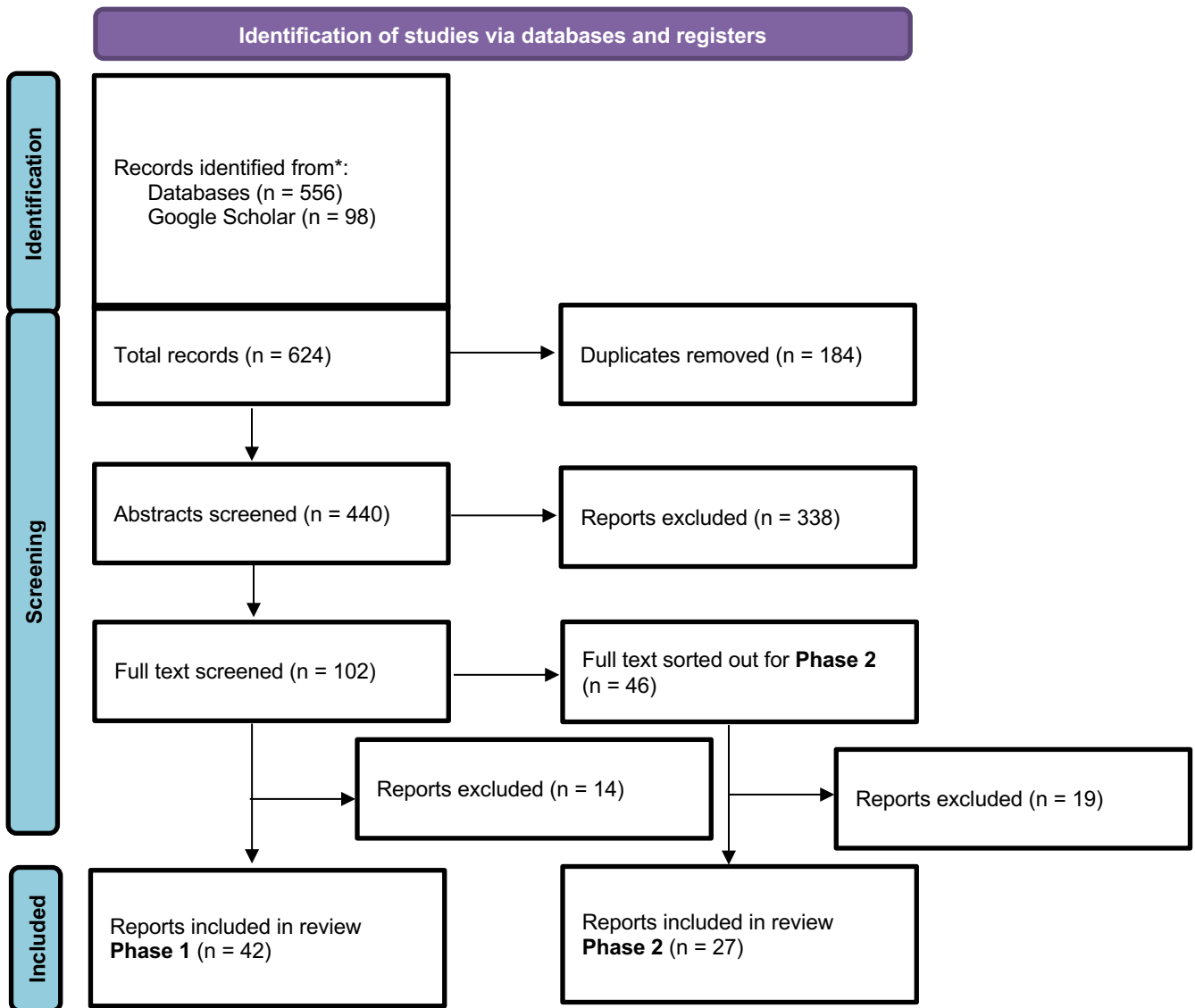
Results

Systematic searchers in multiple databases identified slightly over 440 potentially informative research documents: meta-analyses, systematic, scoping, and narrative reviews of possible relevance to the project objectives. This number, after removal of duplicates and through the thorough screening of abstracts, was reduced to 56 most relevant sources for the full-text review in Stage one and 46 – in Stage two. All inclusion/exclusion decisions were based on double-coder independent review carried out by experienced members of our research team. Agreement rates were: 90.6% (Cohen's kappa of 0.81) and 82.2% (Cohen's kappa of 0.74) – for abstract screening and full-text review, respectively. The main reasons for excluding studies from the further consideration were:

- Irrelevant outcomes (i.e., a given review does not consider outcomes associated with actual/self-perceived learning, learning satisfaction, behavioural or psychological outcomes that could be linked to social isolation in OL) – 73.5%;
- Not a targeted population (i.e., the research deals with age groups and academic levels other than students in postsecondary educational institutions) – 21.8%;
- Not a targeted modality (i.e., the research does not address OL) – 12.2%.

The sum of the reported percentages exceeds one hundred because in many cases several exclusion reasons coincided within the same paper. There were also more rare cases of so-called descriptive/opinion articles or research on special-needs students (e.g., learners with physical or neurological impairments or learning disabilities). The latter is of some clear applied importance, but is not entirely compatible with the reviews of studies conducted in regular educational settings, and as such, deserve to be addressed in a dedicated separate review.

The PRISMA flow-chart diagram that follows shows the results of abstract screening and review of the full-text documents (Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow et al., 2021).

Identification of studies via databases and registers

Identification

Records identified from*:
    Databases (n = 556)
    Google Scholar (n = 98)

Total records (n = 624) → Duplicates removed (n = 184)

Screening

Abstracts screened (n = 440) → Reports excluded (n = 338)

Full text screened (n = 102) → Full text sorted out for **Phase 2** (n = 46)

Reports excluded (n = 14)

Reports excluded (n = 19)

Included

Reports included in review
Phase 1 (n = 42)

Reports included in review
Phase 2 (n = 27)

Findings: Stage one

Learning achievement outcomes

Only one outcome category – namely, actual (objectively measures academic achievement) learning outcomes – was represented in the reviewed literature in an amount sufficient for conducting a second order MA. Originally, we identified 11 MAs of achievement outcomes in OL.

As per standard MA review procedures, we first conducted a set of analyses intended as checks for potential publication bias and outliers.

1) *Duval and Tweedie's trim and fill* analysis and the related funnel plot (available in Appendix A. According to the random effects model, the observed point estimate and the corresponding 95% confidence interval (in parentheses) is $g^{++} = 0.169$ ($CI_{L-U} = 0.03, 0.31$). The *trim and fill* analytical routine and examination of the funnel plot found the distribution to be fairly symmetrical and in no need for imputation of any 'missing' studies. In other words, no publication bias was detected.

2) *Classic Fail-Safe* analysis indicated that it would require 16 potentially 'missing' null-effect studies to render the observed overall weighted average effect size non-significant (i.e., to bring the calculated *p*-value above the pre-set alpha of 0.05). The resulting number of *Orwin Fail-Safe* was $N = 4$. In other words, only four potentially 'missing' null-effects, if added to the existing collection, would bring the observed combined Hedges' g^{1++} to the 'trivial' value of 0.1. These findings are largely in line with the overall observation of the OL research literature that finds this type of the instruction to be "as good as" but not necessarily much better than more traditional face-to-face (in-person) instructional interventions (e.g., Bernard et al., 2004). Naturally, the overall weighted average effect size in this collection of included meta-analyses is classified as small (in Cohen's terms, 1988), though statistically significant ($p = .02$), but only marginally stable.

3) *One-Study-Removed* sensitivity analysis identified as a potential outlier one relatively large effect of $g++ = 0.777$ that could constitute one of so-called 'large leverage' effect sizes capable of disproportionally influencing the overall findings. The summary table that follows is organized to account for its presence/removal within both Fixed and Random analytical models (i.e., reports the aggregated data with and without this particular effect size).

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[1] The use of plus signs after *g* (+ or ++) denotes whether the value is from a 1) meta-analysis + (i.e., review of original studies) or 2) a second-order meta-analysis ++ (i.e., review of meta-analyses).

Second-Order MA Summary Table.
Online Learning Overall Weighted Average Effect Size for Achievement Outcomes and Associated Heterogeneity Statistics: Final Data Set

Population Estimates	k	g++	SE	Lower 95th	Upper 95th
Online Learning: With the *ES* from Roberts (2011)					
Random Effects Model	11	0.169*	0.07	0.03	0.31
Fixed Effect Model	11	0.130*	0.05	0.03	0.23
Heterogeneity Analysis	$Q_T = 16.60$ ($df = 10$), $p = .084$, $I^2 = 39.77$				
Online Learning: Without the *ES* from Roberts (2011)					
Random Effects Model	10	0.085	0.05	-0.01	0.18
Fixed Effect Model	10	0.085	0.05	-0.01	0.18
Heterogeneity Analysis	$Q_T = 4.16$ ($df = 9$), $p = .901$, $I^2 = 0.00$				

* $p < 0.05$

As it is quite evident from the table above, despite non-significant findings of the publication bias analysis, the 'stand-alone' effect size of g++ = 0.777 is influential enough to impose, when removed from the distribution, the following two changes to the overall findings. One, while with its presence, the resulting overall average effect size (Random Effects Model) is statistically significant ($p = .02$), the removal of this potential outlier renders the resulting effect size non-significant ($p = .09$). Second, and no less importantly, removal of this effect size substantially reduces heterogeneity of the distribution. Non-significant, to begin with ($Q_{Total} = 16.60$, $p = .084$), it drops dramatically to a negligible level of $Q_{Total} = 4.16$ ($p = .901$) and makes the results of both analytical models identical. It means that there is no unexplained variability left in the resulting distribution ($I^2 = 0.00$). Under these circumstances, any subsequent moderator variable analysis is meaningless. Indeed, the purpose of such analysis is to explore potential sources of systematic variation in effect sizes – with no unexplained variability in the distribution there is nothing to analyse.

So, in terms of what was known prior to the pandemic, our second order MA largely confirmed that OL is compatible to (but not significantly better than) in-class (face-to-face) instruction in terms of academic achievements. The summarized data from ten MAs on OL, published in between 2000 and 2021, produced the overall weighted average effect size of $g^{++} = 0.085$.

Other outcome types

As noted earlier, neither of other types of outcomes was reported both frequently and consistently enough to enable a full-scale second order MA.

Data with regard to non-achievement outcome types were sparse, extremely heterogeneous and of different nature with the high predominance of narrative reviews over systematic reviews and MAs. Below we identified the most common categories of research themes/results as they were represented in our collection.

Most representative and consistent after the learning achievement outcomes was the collection of studies carried out in relation to the CoI framework. According to the results of our systematic searchers and review processes this collection encompasses three systematic reviews and three MAs of the issues related to the three types of presences in OL and their connections to actual and self-perceived learning outcomes.

Systematic reviews carried out within the CoI framework (Jan et al., 2019; Stenbom, 2018; and Redstone et al., 2018) jointly summarized about a hundred articles pertaining cognitive, teaching, and social presences in OL – their respective measures, preconditions and forms of manifestation, and impact on learning environments and outcomes. The findings of these reviews, and especially the last one, largely support the key points emerging from other related literature including those that we intend reiterate in the concluding remarks of this review. Namely, Redstone et al., (2018) emphasized the importance of instructional design in enabling and supporting all types of presence in OL environments and recommended, based on a number of primary research (e.g., Akyol et al., 2009a, 2009b; Shea & Bidjerano, 2012; Traver et al., 2014) incorporating synchronous face-to-face learning activities into OL, i.e., in a sense arguing in favour of BL arrangements. We already know about the BL advantages with respect to academic achievements (e.g., Bernard et al., 2014) This additional argument in favour of BL makes researchers' and practitioners' attention to this mode of instruction even more justified.

The three MA (Martin et al., 2022; Caskurlu et al., 2020; and Richardson et al., 2017) were not consistent enough in their reporting of findings to enable a meaningful second-order MA (that is not to mention that three cases of even identical types of effect sizes is hardly a sufficient number to aggregate in a form of a second-order MA). Even more importantly, these MAs treated *social* (two of them), *teaching* (two of them) and *cognitive* (just one MA) presences not

as outcomes (dependent variables in the OL educational studies), but as correlates of various measures of learning and satisfaction.

Nevertheless, their findings, especially with respect to social presence, deserve our special attention as they help to better understand the importance of students feeling belonging to / engaged with different aspects of educational environment and to better situate further research of the issue.

The earliest (and arguable the most relevant to our research questions) of the three, MA by Richardson et al. (2017) focused on social presence in its connection to learning satisfaction. It summarized findings from 26 primary research articles and reported a positive average correlation between social presence and satisfaction ($r^+ = 0.56$) and social presence and perceived learning ($r^+ = 0.51$). The strength of these associations was moderated by a number of variables, for example, was higher for Education disciplines than Business courses.

Caskurlu et al. (2020) also limited their MA just to one type of presence – teaching presence – in relation to the same two (self-reported) outcome types as in Richardson et al. Teaching presence was moderately correlated with perceived learning ($r^+ = 0.60$, $k = 23$) and with learning satisfaction ($r^+ = 0.59$, $k = 26$). Interestingly, they operationalized teaching presence by its three sub-dimensions and reported findings separately for each. Correlations with both subjective learning outcomes were stronger for the *instructional design* and *organization* sub-dimension, followed by correlations with *facilitating discourse* (i.e., actions aimed at maintaining students' interest, motivation, and engagement) and *direct instruction* (i.e., with the focus on the course content and teachers' professional expertise). In other words, sound instructional design plays the most important role in how teaching presence translates into self-perceived learning, and helps to maintain learning satisfaction, hopefully sufficient to counteract feelings of frustration, often associated with OL.

Finally, a MA by Martin et al. (2022) attempted to account for all three types of presences and their connections to both actual and self-reported learning outcomes. They found strong positive correlations between cognitive presence and both perceived learning ($r^+ = 0.66$) and learning satisfaction ($r^+ = 0.59$). Teaching presence was also quite strongly correlated with the same self-reported outcomes: $r^+ = 0.39$ (for perceived learning) and $r^+ = 0.51$ (for learning satisfaction). Similar in magnitude correlations were documented for social presence: $r^+ = 0.43$ (for perceived learning) and $r^+ = 0.45$ (for learning satisfaction). The weakest correlations were

shown for the measures of actual learning across the types of presence: $r^+ = 0.35$, $r^+ = 0.25$, and $r^+ = 0.20$; for teaching presence, cognitive presence, and social presence, respectively.

So, it appears that the CoI-identified types of presence have stronger connections with self-reported than with the objectively measures (actual) learning outcomes, i.e., their importance lies rather within the domain of motivation and feelings of fulfilment of interests and expectations then with the knowledge/skill acquisition per se.

The theme of student engagement also appeared in a number of reviews, but more from the perspective of how to better promote achievements. For example, Farrel et al. (2018) summarized approaches to engage students in the social work field. In particular, they reported that asynchronous communications appear to be more effective than synchronous in motivating and engaging students (e.g., Huang, Wang & Liu, 2015), though synchronous OL showed higher levels of critical thinking (e.g., Levin, He, & Robbins, 2006). Taken together these observations speak in favour of combining synchronous and asynchronous communication in OL (Zoumenou et al., 2015). Among the most effective means of engaging students Farrel with colleagues named substantial teacher involvement (e.g., Collins et al., 2014; Reushle & Mitchell, 2009), building relationships between instructors and learners (e.g., Levin et al., 2013; Noble & Russell, 2013), creating learning environments that encourage webbed connectivity (e.g., Noble & Russell, 2013), and implementing engagement activities as early and as often as possible (Williams et al., 2007). The authors also noted that student engagement plays an essential role in course retention (e.g., Bass & Ballard, 2012) and in promoting student satisfaction (e.g., Mitchell, 2014). However, the role of engagement in counteracting the effects of social isolation was outside of the scope of that review. A narrative review by Malik (2020) also names a number of similar practices for student engagement in OL, though it is more narrowly focused on Hispanic-Serving Institutions. Without addressing the nuanced differences between engagement (e.g., with the learning processes) and interactions/collaboration (e.g., predominantly among learners, including peer-assisted OL), the latter, receives a lot of attention in the reviewed literature (e.g. Saqr et al, 2022; Tibingana-Ahimbisibwe, 2020; Murimi, 2019; Papi, 2019; Colak, 2018; Boelens, 2017), mostly as an important precursor/correlate of learning achievements.

As stated earlier, other outcome types were represented rather sporadically. Besides academic achievement, learning satisfaction, and student engagement, in focus of the included

reviews of research were: *attrition* in OL courses (Laurier et al., 2020); *group skills* and *behaviours* (Zhang & Cui, 2018); *self-efficacy* (Chattavut et al., 2018); *self-regulation* and *critical thinking skills* (Zou et al., 2020); *social anxiety* (Sönmez, 2021), as well as relationships among the variables of consideration – with the most salient and relevant example of several reviews and MAs that addressed (though from different perspective and with various degrees of coverage) the connection between the three types of presence (*cognitive*, *teaching*, and *social*) in OL, on the one hand and the corresponding measures of actual and self-perceived learning and learning satisfaction, on the other (Martine et al., 2022; Caskurlu et al., 2020; Jan et al., 2019; Redstone et al., 2018; Stenbom, 2018; Richardson et al., 2017).

More specifically:

- Laurier et al. (2020) found that teacher-student interaction (alongside peer collaboration and tutoring) are among the most promising strategies to prevent student drop-out in OL

- A systematic review by Zhang & Cui (2018) summarized research on collaborative learning strategies in nursing education and concluded that such instructional strategies are not only useful for improving knowledge, but also instrumental in promoting student group skills and learning behaviours (e.g., class engagement), as well as motivation for learning, and self-confidence

- Self-efficacy, as the core outcome, was in the focus of a systematic review by Chattavut et al. (2018). It covered twelve years of primary empirical research of OL and categorized the factors that promote self-efficacy in OL. These are: prior *OL experiences* (the more learners familiar with the OL environments, the more likely they feel confident operating in them); *feedback and rewards* (as they reinforce motivation for and engagement with OL); *communication and interaction* (pretty much in line with a lot of previous research, including our own (e.g., Borokhovski et al., 2012, all types of interactions are instrumental in successful learning) in addition to positive effects on achievement that in turn reinforces self-confidence, such interactions promote interpersonal trust and knowledge-sharing behaviours (e.g., Tseng & Kuo, 2010, and support social networks of learners (e.g., Reychav et al., 2016); and last, but mot least, as of high relevance to the current project, social influence (defined by the authors as an individual's internalization of the subjective culture of a group which is referent for that person, (i.e., specific interpersonal agreements that the individual has made with others, in specific social

situations). The last factor may well explain why and even how self-efficacy may serve as an additional buffer capable of mitigating negative consequences of social isolation in OL

- Zou et al. (2020) dedicated their systematic review to language teaching in so-called flipped classrooms (a kind of BL environments that not only complement OL with in-person instruction, but also switch the typical order of the two – online mini-lectures precede in-class active learning facilitated and supported by teacher). Though, BL is not in the focus of our review, its role in overcoming limitations of entirely OL approaches is, without doubts, an essential one. Later we will speak in more detail of its comparative advantage over OL, especially with respect to enabling and promoting interactions among learners, it is worth noting that the findings by Zou and colleagues revealed that the flipped classrooms improved students' academic performance and learning motivation, as well as helped to develop their self-regulation, confidence, and higher-order thinking skills

- A systematic review by Sönmez (2021) contains observations that technology-supported education (which OL is a part of) may run risks of inadequate accessibility, insufficient experience in prior learning, especially with technological tools and application, but even more importantly, of social anxiety, student resistance, and mental fatigue.

To summarize major themes and findings of the reviews that composed the collection to inform Stage one objectives of our project, we reiterate that no complete second-order MA could be produced for outcomes other than academic achievement, as these other types of outcomes were incompatible across the reviewed sources. Instead we briefly summarized the major messages derived from various relevant sources as follows:

- Researchers largely agree that social presence is important for successful OL. Specifically, it is strongly positively associated with learning satisfaction and with the perceived learning (Richardson et al., 2017), as well as with students' course retention (Lowe-Madkins, 2017). Social presence, based on effective (meaningful emotional) communications, enhances group cohesion and sense of community in OL environments (Mykota, 2018).

- Similarly, all types of presence enabled by communities of inquiry (teaching, social, and cognitive) were positively correlated with both actual and perceived learning and with satisfaction (Martin, 2022). Teaching presence specifically is a strong predictor of students' satisfaction and learning outcomes in fully OL courses (Caskurlu et al., 2022).

- Satisfaction derived from social linkages with peers in collaborative and interactive distance education contributes to creating more authentic learning environments and helps to achieve deep learning (Papi et al., 2019).

- Of the utmost interest to the project were the research findings indicating that excessive use of technologies in general (including that in OL) can lead to antisocial (aggressive) behaviours, and emotional instability, resulting in decreased social interactions up to the level of diminished ability to create social bonds (Moraes Schwaickardt et al., 2021), whereas carefully constructed and implemented Web-based and computer-delivered interventions can be effective in reducing students' depression, anxiety and stress-related outcomes (Davies et al., 2014).

- Studies that focus on engagement, interaction, and collaboration in OL, either as precursors for learning success or outcomes of specific learning strategies usually do not extend analyses further beyond such connections and do not link these factors to their potentials for counteracting social isolation.

Finally, and probably most importantly, just one review of the direct relevance to the major objectives of the project first stage was identified. A narrative review by Schwaickardt and colleagues (2021) addressed the effects of technology use (or rather overuse) on public health. It was not focussed exclusively on OL, but considered a broader range of educational technology and unequivocally concluded that "…the excessive use of technologies can lead to antisocial behaviors, aggressiveness and emotional instability, causing a decrease in social interactions, fear of physical contact and difficulty in creating social bonds, with a preference for the virtual world over the real one. With the restrictions imposed by social isolation, negative and unintentional consequences such as fear, loneliness, panic, changes in eating habits and sleep, and the excess of time in front of the television and cell phones have aggravated even more the changes in human social behavior, with damage not yet calculated in children and adolescents. Remote or distance learning, necessary for the millions of students to have their rights guaranteed, has further amplified social inequality in education and in Internet access conditions…" (Schwaickardt et al., 2021, p.139). Published in Spanish (with more attention to sources from Latin America) in 2021 the review encompasses studies published in between August 2019 and December 2020 (i.e., combines some data from the pre-pandemic period and data originated at its onset, when the vast majority of educational institutions were forced to go

into the OL mode). As such, the findings of this review create the perfect link to Stage one of our project.

Findings: Stage two

A review of the collection of 27 reviews and/or meta-analyses published about Covid-19 era OL reveals a mixed result, with indications that many university students found the experience novel, adaptive, and satisfactory, but also that many experienced additional stresses due to technical/connectivity factors and that overall, their mental health was negatively impacted. Much of the research comes from the medical disciplines, where the lack of hands-on practical labs and patient interactions were particularly problematic.

It should be noted that many of the reviews relied on small collections of studies and that they were conducted rapidly to be timely, but that additional evidence has continued to emerge and may provide a more nuanced picture. With regards to mental health outcomes, it may be impossible to isolate the impact of remote OL as an independent factor – the pandemic was a period of general heightened anxiety and stress for many. Depression, anxiety and stress were the main mental health outcomes that emerged from the reviews, with no explicit mention of asocial tendency, though lack of engagement and isolation were often mentioned as contributing factors to the main three outcomes.

Among the major challenges named in the literature was the lack of personal interactions and need for faculty time; for instance, Grafton-Clarke et al. (2022) reviewed online adaptations in medical education and identified interaction as a major theme – of the 55 articles in their review, four explicitly referred to lack of interaction as a "barrier," and another nine found that student-faculty interactions had decreased. This decline in interaction was particularly problematic in their field, as students typically must interact not only with the teacher but patients as well. In a similar vein, Islam and Alam (2021) conducted a review of literature in veterinary medical education and reported difficulty with practical classes and that the lack of face-to-face interactions can lead to boredom and lack of focus. Wilcha (2020) conducted a rapid qualitative review of medical student virtual teaching and concluded that the mental health of students was compromised by the reduction in student engagement, among other factors; though they also conclude that peer mentoring proved valuable, driving not only student-to-student teaching but also motivation and task management. Jain et al. (2022) also conclude that while OL offered accessible virtual training to neurosurgical students that was consistent with the

growing popularity and practice of telemedicine, it is vital that institutions provide mental health initiatives to help students dealing with additional stress. It is perhaps not surprising that medical education, which often relies on hands-on practical labs as part of course delivery, was particularly challenging to deliver remotely (Kelley, 2021). Kerkstra et al. (2022) and Santos et al. (2021), focusing on dental education, reviewed the literature and came to generally more positive conclusions despite the lack of hands-on training that can be difficult or impossible to replicated in an online environment. The ability to assess student competence in an adaptive way thanks to the OL environment was viewed positively. Kerkstra and colleagues do note a perceived lack of communication between instructor and student, especially when student cameras were turned off and recommend implementing interactive approaches to foster student activity and to encourage more peer interaction and learning. Problems reported by Santos and colleagues were more technical in nature (i.e., faculty members struggling to work with the technology).

Chang et al. (2021) conducted a meta-analysis that explored college students' feelings of anxiety and depression during the Covid-19 pandemic, and concluded that students could not help but spend considerable time staring at screens and had to avoid crowded social situations, both of which have been linked by research with feelings of depression/anxiety, though they varied by gender, with men more likely to experience anxiety and women more likely to experience depression. Other mental health issues that were the focus of reviews include stress, aggression, and sleep habits (Ebrahim et al., 2022; Elharake et al., 2022; Mulyadi et al., 2021), with populations of low socioeconomic status and/or those living in rural areas being particularly at risk. Mulyadi et al. (2021) reviewed the nursing literature and an analysis of their included studies found approximately one-third of the student nurses reported feelings of anxiety, half of students experienced depression, and a quarter developed sleep disturbances; however, it should be noted that these mental health issues did not necessarily derive exclusively from their experiences in OL. Li et al. (2021) synthesized a collection of literature on the mental health of college students and found that the prevalence of both depression and anxiety increased significantly during pandemic. For depression, 18 studies were included in their MA, representing a total of 63,317 students, and prevalence of depression was recorded at 36%; for anxiety, 20 studies were included representing 73,912 students and prevalence was recorded at 36%.

A systematic review of pedagogical and assessment changes wrought by the pandemic performed by Ibna Seraj et al. (2022) identified 18 themes among the "challenges of online learning," with lack of interaction ranking fourth after several technical complaints (e.g., course integration with the technology, Internet connectivity, lack of infrastructure). The authors point out that these challenges were faced by both students and teachers, who reported a lack of professional development and organizational preparedness and infrastructure. Mohtar and Yunus (2022) explored factors related to engagement in their review and found a split, with 6 out 11 articles reporting increased engagement, and 5 out of 11 reporting disengagement. Reasons for the latter include the perception of online tasks as ineffective compared to more familiar face-to-face variants, and the shift to more independent learning being perceived as a burden. On the other hand, novelty of approaches is reported as leading to increased engagement as was overall satisfaction with the course. Camilleri (2021), focusing on service quality for both students and teachers, systematically reviewed the literature on opportunities and challenges faced by higher education institutions when making the rapid changeover to OL. Camilleri notes that the shift entailed both reliance on asynchronous learning management systems and synchronous communications (largely via video conferencing). This required teachers to quickly develop new service models, with tests and other evaluation mechanisms needing to be designed to fit the new model. Camilleri also noted that student isolation can lead to a lack of self-regulation, students feeling unsettled, and other mental health concerns; and that teachers were often pressed to monitor, or at least be aware of, their students' feelings of loneliness and emotional health, adding to their sense of responsibility.

Teachers were the exclusive focus of some reviews; for instance, Li and Yu (2022) looked at teachers' satisfaction and changes to their expected roles. One of the themes that emerged from their review was what they describe as "healing-informed teaching practice" or "monitoring students' learning effects, and their psychological or technical problems" (p. 8). This in turn led to a drop in satisfaction level and emotional exhaustion. Similarly, Susilaningsih et al. (2021) found a decline in teachers' quality of work and life due to a blurring of their work/life balance and additional stresses from their expanded role. Ozamiz-Etxebarria et al. (2021) reviewed teachers' response to their experiences during the pandemic and found notable levels of anxiety (17%), depression (19%), and stress (30%), with stress being particularly acute for university

professors as compared to schoolteachers, though there was significant heterogeneity between studies.

Salas-Pilco et al. (2022) conducted a systematic review of student engagement in OL during the pandemic, focusing specifically on Latin American higher education. Three types of engagement were investigated: behavioural engagement (active participation), cognitive engagement (motivation and self-regulation), and emotional engagement (positive attitudes). Although some challenges were reported, overall Salas-Pilco with colleagues, conclude that behavioural engagement was largely successful, with higher drop-out rates and connectivity issues being two of the negative effects reported in some studies. With regards to cognitive engagement, students in the included studies were reported motivated to participate in their OL, though some students were said to have had difficulty self-regulating their learning. Finally, regarding their emotional or affective engagement, students reportedly valued their OL experiences and generally expressed positive attitudes. However, in several studies students reported feelings of increased stress and anxiety. Pires (2022) conducted a review limited to Pharmacy education students' satisfaction with OL during the pandemic and found a similarly mixed result, with a nearly 50/50 split between positive and negative reactions. Positive aspects included working from the comfort of home, less travel time, and "feeling valued and helpful during the pandemic," while negative included prolonged screen time, less communication, and anxiety.

To summarize, the studies conducted during the pandemic indicate that the forced reliance on OL forms of instruction in postsecondary education may exacerbate the potential problem of social isolation and associated negative consequences, but also present evidence on how to address these challenges. Specifically:

- Among major challenges of OL research names lack of personal interactions and need for faculty time (Grafton-Clarke et al., 2022), adverse effects of inability to access on-site facilities, especially for medical and veterinary students (Islam & Alam, 2021), additional strains imposed on teachers, schools, and families of learners (Ibna Seraj et al., 2022), inadequate infrastructure, lack of professional training and increase in workload for instructors (Mohtar & Yunus, 2022), increase in drop-out and challenges for self-regulation (Salas-Pilco, 2022), prolonged screen time and anxiety (Pires, 2022).

- Properly modified (to account for the above challenges) OL courses may reduce the prevalence of health problems associated with the increased OL experiences (Mulyadi et al., 2021). Investing in teachers' professional development and instructional design of courses, designing more effective collaborative activities and combining synchronous and asynchronous technologies are among the means to ameliorate OL instruction (Bond, 2020), provision of specialized mental health training to help students deal with additional stress Jain et al. (2022).

In general with regard to Stage two findings, it worth noting that they were: 1) in large part, derived from the reviews of medical/health education (probably, as most sensitive to pandemic-induced changes); 2) rather ambiguous, when the same sources observed positive developments in and negative effects (e.g., disengagement) of OL; and 3) impossible to directly attribute just to the increase in OL, as manifestations of stress, anxiety, and depression, for example, were on the rise during the pandemic anyway.

Findings: Stage three

The search for and description of the relevant case studies is currently underway. We hope to catalogue the instructional practices in OL characterized by the elevated potential of increasing interactions and counteracting negative societal and psychological outcomes of OL in postsecondary education.

At this point in time, our searches yielded 56 studies that are topically related. However, only a handful produced evidence that was drawn from the period of the pandemic (March 2020 – August 2022). Publication lag times and the challenges researchers faced due to COVID restrictions undoubtedly further reduced evidence-based research that uniquely combined OL with social isolation. As such, the proposed juxta-position of the pre-pandemic literature on social isolation issues and pandemic-specific studies was extremely limited.

That said, we can offer some preliminary, promising examples. Laurie et al., (2020) addressed a key component that was interrupted during this period (i.e., faculty-student interaction and peer tutoring). They discussed the use of technology as a suitable replacement for face-to-face engagement as a promising preventive strategy in OL. However, what our analyses find as essential is that such strategies are purposely designed, implemented, and monitored. Simply creating online chat groups without clear objectives or accountability have a far less, and sometimes little or no impact on meaningful engagement in content or collaboration (Borokhovski et al., 2016).

This principle was further contextualized by the following recent studies found in our search. Synchronous communications were found to be far more effective than asynchronous (Caprara & Caprara, 2022; Fehrman & Watson, 2021; Hehir et al., 2020). Again, synchronous communications by necessity require a pedagogical structure. Interestingly, a study using Cochrane's methodology found no evidence for online resilience training. Being knowledgeable of how to engage in OL is a starting point. Only by being guided by sound instructional design does one obtain real impact (Díaz-García et al., 2021). This same study suggested that factors such as contextual barriers (e.g., culture, socio-economic) must be taken into account when OL/BL is used (also see Salas-Pilco et al., 2022). Finally, a fascinating and heuristically rich study by Martin, et al. (2022), described above, identified and helped define the construct of "presences" (teacher, cognitive, social). All three were found to be critical in DE course design, with each being equally important. Historically, academic institutions attend to the first two, and address "social" only within the immediate course environment. Their research, like that of Díaz-García, demands greater attention to the primary "clients" of the system, especially faculty and students, and their ability to realize the full potential of OL/BL while considering the contextual constraints.

A century+ of classroom-based instruction has been accepted as the gold standard. Research demonstrates that technology can make a good thing better, if properly utilized. This does not suggest that OL and its variants in post-secondary education are always appropriate or effective. Our systematic review yielded, as is usually the case with educational research, a high degree of heterogeneity in study outcomes. Sometimes it works; sometimes it doesn't. Furthermore, and perhaps self-evident, the literature demonstrates repeatedly that pedagogy and systemic context are the principle factors for positive or negative outcomes. Implicating these aspects are hard work, and must be research-based. More research on the intersection between mental health and technology-amplified instruction is critical.

Practitioner Recommendations

We now cite a few, important policy implications. Each is relatively generic as stated. However, institutional goals and procedures that support them are both complex, and likely require fundamental changes at many levels of the system to respond to a 21st century post-secondary service to society.

Based on the findings of this systematic review, the following practical recommendations can be offered:

- With respect to achievement outcomes, it has been repeatedly demonstrated that BL is superior to OL. According to recently released second-order MA its average weighted effect size is $g^{++} = 0.385$, $k = 12$ (Borokhovski et al., 2022). Whenever possible employing BL should be considered as a viable alternative to either OL or in-class instruction. Data suggest that it is the "best of both worlds."

- Interactions/collaboration and engagement in OL and BL have a strong potential on positively impacting learning and satisfaction, (Bernard et al., 2009; Borokhovski et al., 2012; Tschetter, 2015; Harper, 2018). Technology has the capacity to extend and transform links across the participants of any learning environment. Students and faculty are at the core, but engaging, collaborative instructional domains, extended communities' direct impact (e.g., local NGOs or webinars on myriad topics), and true applications of problem-based learning (PBL) all represent activities that expand the boundaries of the "classroom" to the worldroom.

- Expanding on the previous point, there are various means to enable and promote interactions in OL/BL, including: webinars, video-assets, on-line discussion boards, discussion forums, Wikis and blogs, 3D virtual environments & gaming, group projects, on-campus orientation sessions, one-on-one synchronous sessions with instructors and peers, etc. (Colak, 2018; Farrel et al., 2018). All constitute direct forms of communication across teachers and students/peers, thus simulating face-to-face interactions. Importantly, minority and disadvantaged/disabled students who disproportionately utilize OL are particularly well served by these approaches (Beschorner et al., 2021; Chen et al., 2010; Dziuban et al., 2018, Reimer & Schleicher, 2020).

- Systematic reviews also focus on identifying best evidence-based practices for enhancing students' self-efficacy, engagement with learning and for elevating social presence (Lockman & Schirmer, 2020; Malik, 2020). Among recommended solutions, research names immersive technologies (Ryan et al., 2022) and those digital resources whose design focuses on usability, immediacy, enabling teacher-student interactions, and building sense of community (Hehir et al., 2021), as well as pedagogical frameworks that provide timely and good-quality feedback, support and promote peer-to-peer facilitation and mentoring, develop sensitivity to cultural and applied issues, especially in medical education (Deshpande, 2017).

Conclusion

The primary outcomes of this project will be both scholarly and social in nature. Our evidence-based approach identified and examined the occurrence and potential mitigation of asocial consequences resulting from distance-based instructional delivery, with potentially heuristic implications. The social benefit is derived from advice for improvement of teaching approaches used by arguably society's principle formal institution in enhancing our economic, intellectual, environmental and personal/collective wellbeing – i.e., education. While higher education is our main target, the use of technology-supported instruction is increasingly utilized at the vocational and high school levels. Instructional design principles will likely transfer.

We have provided specific recommendations for addressing the needs of vulnerable populations who are disproportionately impacted by negative the consequences of DE and the opportunity gap. Better curriculum planning and pedagogy can ameliorate social isolation and related problems that can lead to asocial behavior. Technology, a likely part of the problem, can also be a key ingredient in the solution as it serves learning and attitude. What really matters is how educators design social presence and productive interaction into supportive learning environments. As education is a fundamental institution for societal development, our objectives attend to the goal of avoiding asocial drivers in favor of pro-social enhancement.

Finally, during the period of this investigation, we found few empirical studies providing data gathered *during* the pandemic. We expect significant output in the coming few years. There is thus an urgent need for timely follow-up research, especially as it relates to qualitative studies examining mental health issues that occurred during COVID. Lessons learned during emergency teaching solutions should prove extremely valuable. Also needed is concrete information on if, and if so, how post-secondary institutions have transformed their instructional delivery methods post-pandemic utilizing OL/BL.

Knowledge mobilization activities

A Knowledge Mobilization Plan for research of this sort must consider the needs of a wide array of interested parties: post-secondary students, teachers, administrators, and institutional support services related to both course design and delivery, and general mental health (e.g., university student services). The following touches upon all of these audiences. Deliverables will be prepared in paper-based and electronic formats (e.g., websites), including our Brief, and the present Report. We plan to summarizing the review findings in a clear, accessible form, where

applicable; and Web-based "*Knowledge Links*" that are produced by the Centre for the Study of Learning and Performance (CSLP) (https://www.concordia.ca/research/learning-performance.html.) These are **plain language summaries** of the research findings geared to educators, policy and decision makers, summarizing the key findings with implications for policy and practice. In addition to featuring these on our website, Concordia's Centre for Teaching and Learning (CTL), http://www.concordia.ca/offices/ctl.html, will also integrate the research results into its digital **learning modules on online course design** hosted on its digital learning platform for professors. These learning modules will be openly accessible on the web.

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Appendix 1
Online Learning Collection (Funnel Plot)

Below we tried to understand what made the meta-analysis by Roberts (2011) such a special case from the conceptual and methodological standpoint and if there is a justification (except for statistical estimates) for its exclusion from the Online Learning collection of meta-analyses. First it was noted that the meta-analysis focused exclusively on adult learning which sets it apart from the other Online Learning meta-analyses as it is understood that adults differ from K-12 and early university level students with regards to their self-regulation skills, and their motivation to participate and commit to and adequately manage online courses or training programs. In addition, the meta-analysis made use of an atypical literature search and inclusion process where the author completed a new search and review process while also making use of two previously completed meta-analyses, namely Bernard et al. (2009) and Means et al. (2009). The author assumed that all studies published prior to 2005 were already included in Means et al. or Bernard

et al, and hence only made use of the articles included in them, and then ran a new search from 2005 up to 2010. Such a literature search and review process presents rather an unorthodox approach that brings the systematicity of the meta-analysis into question. As such, and while not caught in the original review process, the Roberts' meta-analysis constitutes a case that does not fully fit the criteria of systematicity. Hence, it is more appropriate to remove it from the Online Learning collection of meta-analyses.
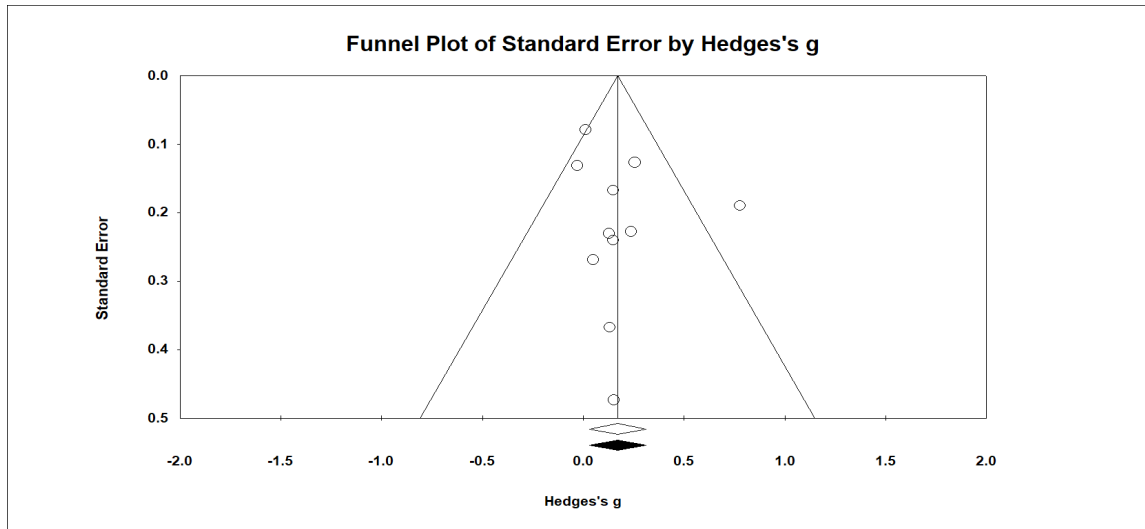

Figure 2. Funnel Plot of achievement effects sizes for the 'Online Learning' collection of meta-analyses.