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Toward a whole-of-virtual school framework for promoting student physical activity: a scoping review protocol

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Abstract

Background The advent of full-time virtual schooling presents unique challenges and opportunities for the promotion of physical activity (PA) among children and adolescents. Despite the recognized benefits of PA as an essential component for combating non-communicable diseases and ensuring holistic development, there is a notable gap in understanding how to effectively integrate PA within the digital learning environments of full-time virtual schools. Current efforts to promote student PA are targeted for implementation exclusively in contexts characterized by physical school campuses that are bound to their surrounding local communities. This is problematic given the digital, widely distributed, and contextually unmoored nature of virtual schooling. Our aim in this scoping review is to advance research on whole-of-school physical activity promotion within full-time virtual schools by examining the published literature on whole-of-school PA promotion within full-time virtual schools. Specifically, this review will map the literature, consolidate knowledge claims and practical implications, and identify evidence gaps that merit further investigation.

Methods/design This review will be conducted using evidence-informed scoping review methodology and reporting guidelines. Articles will be included if they are peer-reviewed English-language research, commentary, practical, or grey literature and relate to the participation, support, design, development, and/or provision of remote online PA interventions delivered through primary/elementary and/or secondary/middle school/high schools. Searches will be conducted in PsycInfo, ERIC, SportDiscus, and Web of Science. Additional hand-searching, reference scans, and grey literature searches will also be performed. Two trained research assistants will independently complete study screening and selection and data charting with guidance from a senior author. Charted data will be displayed in table form, and depending on the results, data will also be synthesized through qualitative content analysis using the Active Schools guiding framework as an analytical and interpretive lens.

Discussion This scoping review will serve as a guidepost for the application and advancement of research on whole-of-school PA promotion through full-time virtual schools. The results will address the increased importance of equitable online learning and PA promotion due to the expanding virtual education landscape, with implications for public health and education policy.

Systematic review registration Open Science Framework: <https://osf.io/f6wau/>.

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Keywords Digital learning, Online learning, Distance education, Whole-school, CSPAP, Multicomponent, Physical education, Health promotion, Children, Adolescents

Background

Physical activity is widely recognized as a key determinant of health [1, 2]. Despite the known benefits of regular participation in physical activity (PA) in the prevention of non-communicable diseases, such as cardiovascular disease, type 2 diabetes, and certain types of cancer, there is a global deficit in physically active behavior [3]. Physical inactivity was identified as the fourth leading cause of death worldwide, prompting public health experts to pronounce it a pandemic [4, 5]. Inactive living is not limited to adults. Currently, 81% of children and adolescents do not engage in the recommended minimum of 60-min of PA every day [6]. This suggests many school-age youth may not be fully reaping the benefits of increased PA engagement, which include healthy physical, mental, social, and emotional development, as well as possible academic advantages [7, 8]. Additionally, some tracking studies demonstrate that a persistent pattern of PA behavior marks the transition to adulthood; thus, inactive youth may grow up to become inactive adults [9]. Early intervention through schools to promote increased PA engagement is therefore critical and requires the shared attention of education and public health professionals.

Approaching schools with the aim of increasing youth PA and promoting sustained PA engagement into adulthood requires careful consideration of many factors [10]. Social-ecological models, also known as systems perspectives, have been used to suggest how schools operate as part of a multi-tiered system in which factors influencing children's PA expands outward from a child's intrapersonal characteristics (e.g., beliefs, abilities) to the surrounding interpersonal (e.g., interactions with teachers, relationships with peers), institutional (e.g., school facilities, administrative support), community (e.g., school-university partnerships, facility joint-use agreements between schools and community partners), and policy environments (e.g., state policies related to school-based PA, national courses of study and content standards for school physical education [PE]) [8–10].

Systems perspectives underpin multi-component frameworks designed to guide efforts to increase youth PA [10]. For example, the comprehensive school physical activity program (CSPAP) framework includes five components: (a) physical education, (b) PA during school, (c) PA before and after school, (d) staff involvement, and (e) family and community engagement [11]. This framework, and others such as the Creating Active

Schools (CAS) framework in the United Kingdom [12], represent “whole-of-school” approaches to youth PA promotion, which the International Society for Physical Activity and Health (ISPAH) identified as one of eight investments that work to increase PA [13]. Most recently, the concept of an *active school culture* was developed in the USA to build upon the CSPAP framework by reinforcing the essential role of whole-school buy-in [14]. Active school cultures “[consist] of deliberate, systematic, and sustained efforts among teachers, administrators, school staff, parents, community members, and students to fully integrate physical activity into the essential fabric of a school community [14] (p. 7). The expanded framework encompasses nine essential elements for sustained PA integration across the school ecology (see Fig. 1).

While whole-of-school approaches continue to gain interest as a promising route for moving the needle on youth PA, the current empirical basis for such approaches is largely limited to school systems that revolve around and function through, brick-and-mortar school campuses. Physical activity promotion in such contexts relies heavily on creating opportunities for PA that are based on established schedules and routines, as well as in-person engagement with people, facilities, equipment, and materials at the school and in the local community.

Less is known about the effectiveness of such approaches in wholly virtual schools, which are becoming increasingly popular worldwide. Today, there are more than 700 full-time virtual schools in operation across the USA with nearly 600,000 students enrolled, or over 1% of the nation's K-12 public school population [15]. Further, a significant proportion of schools allow students to receive PE credits through online courses delivered through virtual schools [16]. While the USA has been at the forefront of developing virtual education systems, especially in the wake of the COVID-19 pandemic, the expansion of full-time virtual schooling is a global phenomenon. The European Commission's Digital Education Action Plan [17] highlights efforts to reset education for the digital age across Europe. Similar initiatives have also been enacted in other regions, including Asia and Latin America, where organizations like UNICEF have recognized virtual education as a key focus for improving access to quality education globally [18].

Full-time virtual schools provide all learning experiences online (often asynchronously, on-demand) via the

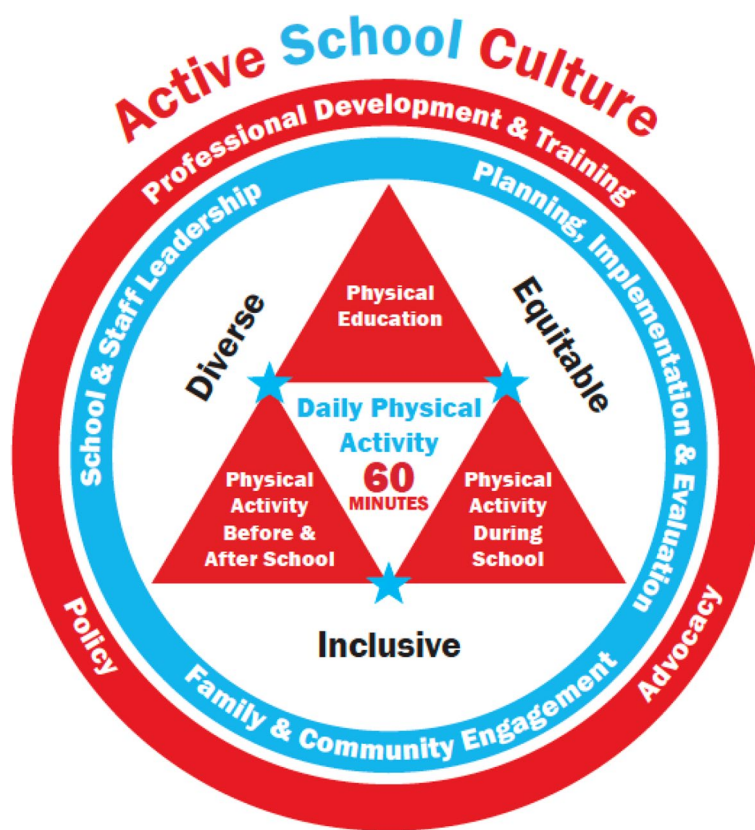


Fig. 1 Active Schools Guiding Framework [14]

Internet, with students engaging exclusively through digital devices (usually at home) and teachers working remotely [15]. The online learning within virtual schools allows students to operate outside historical time boundaries for learning (i.e., the standard school day). Remote delivery of online learning obsoletes consolidated school buildings, while the expansive reach of the Internet decentralizes virtual school communities across disparate contexts. Thus, expanding full-time virtual educational options in the USA and global initiatives for scaling digital learning [17, 18] represents a paradigm shift within existing educational systems. Virtual schools operate within new, digitally infused school and social ecologies [19] that require reconsideration of standard educational and student health promotion models to ensure equitability across school contexts and that the learning and well-being needs of virtual school students are met.

Virtual schooling presents unique challenges and affordances for whole-of-school PA promotion. For example, children and adolescents engage in more PA when there are more opportunities [20]. Thus, the structured, routinized, and compulsory nature of traditional school days plays a significant role in youth PA behavior [21].

Wholesale full-time, online, and at-home learning during the COVID-19 pandemic demonstrated the negative impacts virtually-delivered school programming could have on student PA levels without physical school attendance [22]. Studies conducted during this time indicated the transition to virtual learning was associated with declines in PA for some students due to the absence of structured, in-person activities such as recess, PE, and extracurricular sports [23]. This indicates full-time virtual school students may be at considerably higher risk for sustained inactivity and sedentary behavior [24]. The absence of a shared “local” community may further limit structured PA opportunities for virtual learners.

Research suggests physical school environments like playgrounds and gymnasiums offer opportunities for movement, however, actual student PA levels in traditional schools can vary significantly depending on school culture, policies, and access to resources and quality opportunities [20, 25]. Therefore, the promotion of PA, whether in virtual or physical schools, is contingent upon intentional efforts to create active environments, supported by both structured programs and a culture that values PA. To that end, virtual schools provide possible advantages, including enhanced capacity

to deliver tailored PE lessons and encourage student PA engagement using new and various digital strategies [26–28]. Embedded digital technologies present the ability to efficiently communicate with household members in support of student PA [29, 30] and can promote positive behavior change through goal setting and self-monitoring [31]. Digital technology deployed to support virtual school students' well-being also enables the identification of expanded PA opportunities within students' communities and presents a capacity for encouraging personally relevant PA participation beyond what traditional school-based opportunities can offer [32, 33].

Students enrolled in full-time virtual schools deserve equitable school-supported PA opportunities. The promotion of PA is particularly critical within virtual schools, given the potential for prolonged sedentary behavior due to the absence of physical school environments and structured in-person activities. Ensuring students in virtual schools have equitable access to regular PA opportunities is therefore not only a matter of promoting active lifestyles but also a significant public health priority. To overcome challenges associated with student PA promotion within these schools and to leverage opportunities digital technology presents to support the health and well-being of full-time virtual school students, it is essential to identify and articulate strategies for developing and sustaining active virtual school cultures. To date, relevant literature reviews have focused on individual components of whole-of-school PA promotion frameworks [34–37], implementation of multi-component school PA interventions [38–40], and active school cultures [14, 41]. None of these reviews included research on applications of whole-of-school PA promotion approaches within full-time virtual schools. Recent reviews on the intersections of digital technology and youth PA have also been conducted [42–45]; however, only one included research on topics related to PA promotion within full-time virtual schools [46]. Given the paucity of consolidated evidence on the topic and to help establish clear directions for research and practice, this scoping review will answer the following questions:

1. What characterizes existing published research on whole-of-school PA in the context of full-time virtual schooling?
2. Based on the available evidence, what knowledge claims and implications for practice do authors assert about whole-of-school PA in the context of full-time virtual schooling?
3. What evidence gaps have authors identified related to whole-of-school PA in the context of full-time virtual schooling?

Methods and design

The protocol for this study is informally registered in the Open Science Framework (OSF; <https://osf.io/f6wau/>) and will be conducted using evidence-informed, best-practice scoping review methodologies [47–50]. Given the iterative nature of the scoping review process, research questions and methodologies may require further refinement as the study progresses. We will report any deviations in the final publication of the study. This protocol was developed following Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) best practices [51, 52] and in alignment with OSF guidance [53]. The completed PRISMA-P checklist is included as Supplementary material 1. We will follow the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) [54] as the reporting guideline for the final publication of this study.

Eligibility criteria

Inclusion and exclusion criteria will be defined based on the Population, Concept, Context (PCC) framework [55] to ensure the literature selection aligns with the proposed research questions. The included literature will comprise strategies and considerations relevant to developing and sustaining an “active school culture” [14] within full-time virtual schools. To ensure comprehensive perspectives are captured and considered, all included literature will relate to the participation, support, design, development, and/or provision of virtually contextualized PA interventions where engagement occurs online, is provided by primary/elementary and/or secondary/middle school/high schools, and includes relevant stakeholders (i.e., students, teachers, administrators, staff, parents, policymakers, professional development providers, evaluators, corporations, non-profit organizations, community organizations).

Although this review focuses on full-time virtual schools, literature related to virtually contextualized PA interventions offered by brick-and-mortar schools will also be included. This will ensure all relevant research and commentary on the promotion of PA in virtual learning contexts, including hybrid online face-to-face modalities, are captured to inform the study research questions. Peer-reviewed research and commentaries, as well as grey literature, will be included if they are published in English. Citation details of non-English studies that meet our inclusion criteria but are excluded due to language will be made available in a supplementary file to ensure a complete and transparent record of the studies considered in our search. Literature related to online PA interventions where engagement occurs exclusively in person (e.g., online guided movement integration break

during face-to-face class) will be excluded, as well as literature related to online PA interventions not delivered through primary/elementary or secondary schools (e.g., primary healthcare telehealth PA intervention). Conference abstracts, and literature not published in English will also be excluded.

Inclusion criteria

All literature eligible for selection must meet the following inclusion criteria:

- Comprises strategies that can apply to implementing whole-of-school PA within full-time primary/elementary and secondary/middle/high school virtual schools. This will include virtually contextualized PA interventions that are associated with brick-and-mortar school settings but designed for student engagement primarily outside of school hours.
- Relates to participating, supporting, developing, and/or providing remote online PA interventions delivered through primary/elementary and secondary/middle/high schools
- Published peer-reviewed research articles
- Peer-reviewed practical articles and commentaries
- Published grey literature such as commentaries and practical reports
- Literature written in English

Exclusion criteria

Literature will be excluded if any of the following criteria are fulfilled:

- Pertains to in-person participation, support, development, and/or provision of online PA interventions where student engagement occurs solely in-person during school hours without a virtual component that allows participation outside the school environment
- Pertains to online PA interventions disconnected from primary/elementary and/or secondary/middle/high schools
- Conference abstracts
- Literature not published in English

Information sources

Searches for relevant studies will be identified through the following electronic databases: PsycInfo (EBSCO; 1800–present), ERIC (EBSCO; 1966–present), SPORT-Discus (EBSCO; 1800–present), and Web of Science (1900–present). Additional searches for relevant literature will be conducted by hand-searching and scanning

reference lists of included articles. Grey literature searching will also be conducted through government and association websites.

Search strategy

Using a list of pre-defined keywords developed by the subject experts on the authorship team and sentinel articles, the Health and Human Services (HHS) Librarian will design, test, and refine a general search strategy consisting of keywords, subject headings, Boolean operators, and proximity operators in accordance with the Peer Review of Electronic Search Strategies Guidelines (PRESS) [56]. Search terms relate to primary/elementary and secondary school settings, remote online interventions, PA, as well as the elements of an active school culture [14].

The HHS Librarian will share the search strategy for review by the team and then finalize and translate the search strategy across all electronic databases listed above. Searches will be conducted within each database. Search strategies, dates of searches conducted, and the total number of results within each database will be documented and made available through OSF for transparency and replicability. The HHS Librarian will guide the team through the search for grey literature. All grey literature and materials found through hand-searching will also be documented and made available through OSF. All search results will be stored in Covidence, a digital systematic review tool that will automatically de-duplicate search results and facilitate study screening.

Final search

The authors will conduct a citation review of the studies selected for final inclusion in the last round of screening to identify additional relevant studies. Additionally, the HHS Librarian will conduct an updated search from the last search date to retrieve more recently published relevant studies. Any additional studies will be documented and stored in Covidence for a final round of screening.

Study selection and screening

Using the eligibility criteria defined above, two trained research assistants will independently conduct title and abstract screening in Covidence. Conflicts will be resolved by group discussion with a senior author. Two trained research assistants will independently conduct the first round of full-text screening in Covidence. Any full-text articles that are not available will be retrieved by the HHS Librarian or requested through Interlibrary Loan services. Final full-text screening and selection of articles will be conducted in Covidence by two trained research assistants. Conflicts from the final round of screening will be resolved by group discussion. Reasons

for study exclusion will be documented in Covidence. All changes and edits to the eligibility criteria will be documented and reported in the final manuscript. Covidence will design a preliminary PRISMA flow diagram outlining the process of searching for and selecting results for the scoping review. The HHS Librarian, in consultation with the research team, will make necessary edits and generate a final flow diagram.

Data charting

The data charting process will follow the best practices outlined by Pollack and colleagues [57] and will use the nine elements of an active school culture [14] to facilitate charting organization. A team of trained research assistants will conduct data charting using a standardized abstraction form developed for this review using Covidence and with oversight from at least one senior author. The form will be designed to identify the elements of an active school culture and capture key information from the included literature relevant to the review research questions. Information of interest from included empirical literature will include the following:

- Active school culture element(s) emphasis
- Study characteristics: year published, country of origin, journal published, study aims/research questions, outcome measures, setting, school level reflected, demographics reflected, sample size
- Participant characteristics: stakeholder role (e.g., student, parent, teacher), student grade level(s), age(s), gender(s)
- PA levels, such as daily or weekly minutes, types of PA opportunities, and contextual factors influencing PA engagement
- Modality of the virtual experience [58]
- Delivery methods of the virtual environment (e.g., synchronous or asynchronous)
- Access pathways for virtual intervention components (e.g., devices used, internet access, learning management system, mobile application)
- Intervention features and strategies, research methodology
- Knowledge claims and implications for practice asserted about whole-of-school PA in the context of full-time virtual schools

Information of interest from included peer-reviewed commentary and practical articles will include the following:

- Active school culture element(s) emphasis

- Commentary and practical article characteristics: year published, country of origin, journal published, aims/purpose
- Modality of the virtual experience [57]
- Delivery methods of the virtual environment (e.g., synchronous or asynchronous)
- Access pathways for virtual intervention components (e.g., devices used, internet access, learning management system, mobile application)
- Recommendations for practice concerning whole-of-school PA in the context of full-time virtual schools

Information of interest from included grey literature will include the following:

- Active school culture element(s) emphasis
- Commentary and practical article characteristics: year published, country of origin, journal published, aims/purpose
- Modality of the virtual experience [57]
- Delivery methods of the virtual environment (e.g., synchronous or asynchronous)
- Access pathways for virtual intervention components (e.g., devices used, internet access, learning management system, mobile application)
- Key knowledge claims and implications for practice asserted about whole-of-school PA in the context of full-time virtual schools

A guidance form that details each item will be provided to support the charting process. The forms will be piloted on at least five articles that are included to ensure functionality. Following group reflection, these forms will be finalized, and data charting will commence for the included literature. Given the iterative nature of the data charting process, we will allow the charting forms to evolve and note any deviations from this protocol in the final published review.

Synthesis and presentation of results

The findings of this review will provide an overview of research, commentary, and professional and grey literature related to strategies, facilitators, and barriers to developing and sustaining whole-of-school PA within full-time virtual schools. Charted data will be illustrated in the form of three tables and may include additional relevant visuals (i.e., graphs, figures, infographics). The first table will present data from included empirical studies, the second table will present data from included commentary and professional articles, and the third table will present data on included grey literature. The decision to include additional visuals will be informed by the data collected, ensuring only meaningful representations

that enhance our findings and insights are incorporated. Depending on the results of this review, data will also be synthesized using qualitative content analysis [54, 55, 59, 60] using the nine elements of an active school culture [14] as a guide. The outcome will be a prospective framework for developing and sustaining whole-of-school PA promotion in full-time virtual schools. A supporting narrative will also be provided to further describe the results and proposed framework [57].

Discussion

Recent shifts toward full-time virtual schooling, accelerated by the COVID-19 pandemic, have raised urgent concerns about the PA levels of students. Physical inactivity is a leading risk factor for numerous health issues, including obesity, cardiovascular disease, and mental health disorders [61]. Currently, many adolescents do not meet the recommended minimum of 60-min of daily PA, with rates of inactivity notably increasing during periods of remote virtual learning [22–24]. Given the prevalence of virtual schools is growing globally, it is critical to understand how to effectively promote PA within these unique educational settings to safeguard students' health and well-being and ensure equitable opportunities for PA for all students regardless of their educational context.

The purpose of this review will therefore be to identify and examine existing literature related to developing and sustaining whole-of-school PA promotion within the unique context of full-time virtual schools. The advent of online learning and the growing prevalence of full-time virtual school enrollment have altered traditional educational ecosystems, necessitating a re-evaluation of existing whole-of-school PA promotion frameworks. Our review will aim to explore how whole-of-school PA promotion, traditionally reliant on physical school settings and localized community contexts, can be adapted and maintained in the remote online modality of fully virtual schooling. This will include identifying effective strategies and outcomes related to implementing an active school culture in these novel educational environments. We will also propose an initial framework for developing and sustaining active school cultures in full-time virtual schools.

This scoping review is important for several reasons. First, it will address a significant gap in the literature by focusing on full-time virtual schools. The rapid expansion of online learning reinforces the need to understand how PA can be effectively integrated into these new educational systems to ensure the health and well-being of a growing segment of the student population. Second, this review will have the potential to inform policy and practice by proposing initial,

evidence-informed recommendations for developing and sustaining active virtual school cultures. These insights will be particularly pertinent, given the extent to which the COVID-19 pandemic highlighted challenges associated with maintaining student PA levels in remote online learning environments [22–24]. Finally, findings from this study could have implications for public health, education policy, and community partnerships. By identifying strategies to promote PA in full-time virtual school settings, this research will contribute to broader efforts to combat physical inactivity and sedentary behavior among children and adolescents, thereby addressing a critical aspect of student health and well-being in the digital age.

This scoping review will make a significant contribution to the understanding of whole-of-school PA promotion in the evolving landscape of primary/elementary and secondary education. It will underscore the necessity of adapting and reimagining PA promotion strategies in an increasingly digital world, ensuring equitable access to health-enhancing PA opportunities for all students that meet their needs and align with their interests and contexts.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13643-024-02689-9>.

Supplementary Material 1.

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Authors' contributions

CK and EO conceptualized the study and prepared the draft protocol and manuscript. CW, TH, JK, and BD contributed to the refinement and finalization of the protocol and manuscript. All authors read and approved the final manuscript.

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Data availability

Data sharing is not applicable to this article because no datasets were generated or analyzed for this study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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