Designing Coherent Support Ecosystem in K to 12 Digital Learning: Research Recommendations

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Abstract: Research on student support in K–12 digital learning has identified a range of proximal and auxiliary actors who contribute to engagement and persistence. This paper reviews and synthesizes research on proximal and auxiliary supports and identifies recurring patterns of role ambiguity, inconsistent preparation of support actors, and limited coordination across roles and institutions. We propose a support ecosystem perspective to guide future research on proximal and auxiliary supports in K–12 digital learning.

Introduction

Digital learning continues to expand across U.S. K-12 education. While program enrollment surged during the pandemic and then declined as in-person schooling resumed, recent national data indicate that participation in digital programs has stabilized at levels above those observed prior to 2020, with continued gradual growth across many states (Digital Learning Collaborative, 2024). The number of states offering full-time virtual school options has also increased, reflecting sustained policy support and more consistent availability of online learning pathways.

As digital learning becomes a more established component of K–12 education, understanding how to support students in these environments has become increasingly important. Research suggests that online learners often require structured academic guidance, behavioral monitoring, and socioemotional support to persist in online coursework. These needs are shaped by developmental factors and by the structural features of digital learning, including physical separation from teachers and reduced opportunities for informal interaction (Barbour & Reeves, 2009; Cavanaugh et al., 2009). Digital learning models vary substantially in structure and governance, which shapes how responsibility for student support is defined and enacted. While early research frequently centered on student readiness for online learning, more recent literature shifts attention from student readiness toward the design of institutional supports once students enter digital environments. (Walter et al., 2024).

Engagement frameworks have provided an important foundation for understanding how multiple actors influence student success in online learning. The Adolescent Community of Engagement framework identifies teachers, parents, and peers as central actors shaping affective, behavioral, and cognitive engagement (Borup et al., 2014). Subsequent adaptations, including the Proximate Community of Engagement and Academic Communities of Engagement frameworks, further emphasize the relational and distributed nature of support in digital environments (Borup et al., 2020; Oviatt et al., 2018). Importantly, these frameworks position student support within a broader community of influence.

Although prior research has identified key actors influencing engagement, research on how these actors and supports are coordinated across institutional contexts remains comparatively limited. Studies of parents (Guo et al., 2024; Maimaiti et al., 2025), on-site facilitators (Borup, 2018; Freidhoff et al., 2015; Viano & Borup, 2025), tutoring programs (Dameron, 2022; Gortazar et al., 2024), academic coaches (Bell, 2024; Letchworth et al., 2025; Moore, 2020), counselors (Greenridge et al., 2023; Roberts et al., 2023), peer networks (Barbour, 2022; Kohli et al., 2022;

Mercier et al., 2024), and community-based organizations (Ocak & Karakus, 2022), have largely proceeded in parallel strands. Practitioner accounts reveal persistent role confusion and systemic fragmentation, particularly in supplemental models that span multiple institutions (Archambault et al., 2016; Beck, 2015; Harms et al., 2006; Sandberg et al., 2025). This indicates that supports that may show promise in isolation are not always aligned, sustained, or equitably accessible.

To address this gap, we propose reframing student support in K–12 digital learning as a *coordinated support ecosystem*. Rather than focusing on isolated roles, this perspective examines how multiple actors and services are structured and aligned within varied digital learning models. This paper synthesizes existing research on student support and advances research recommendations focused on the design, coordination, and sustainability of digital learning support ecosystems.

Conceptual Foundation: Proximal and Auxiliary Supports in a Layered Ecosystem

Building on engagement frameworks that identify teachers, parents, and peers as central actors in students' affective, behavioral, and cognitive engagement (Borup et al., 2014; Borup et al., 2020; Oviatt et al., 2018), we distinguish between two analytically important layers of support: proximal supports and auxiliary supports. Proximal supports refer to individuals who are physically or situationally co-present with the learner and immediately accessible during engagement with digital coursework. Their defining characteristic is relational and spatial proximity rather than formal title. In K–12 digital learning contexts, proximal supports commonly include parents or guardians and on-site facilitators who provide structure, monitoring, encouragement, and accountability in day-to-day learning routines (Borup & Stimson, 2017; Borup et al., 2019; Freidhoff et al., 2015). Given the developmental characteristics of many K–12 learners, including evolving self-regulatory and executive functioning skills, these locally situated supports often play a critical role in sustaining persistence and engagement (Barbour & Reeves, 2009; Cavanaugh et al., 2009).

Auxiliary supports operate outside students' immediate physical learning contexts but contribute to academic, behavioral, or socioemotional engagement through remote or community-based services. These supports may include online tutoring, academic coaching, virtual counseling and psychological services, digitally mediated peer mentoring, and community-based support services (Moore, 2020; Ready et al., 2024; Mercier et al., 2024; Tysinger et al., 2018). Auxiliary supports frequently provide specialized expertise or scalable interventions, but they are typically delivered outside the student's core instructional setting, either virtually or through community-based services that function beyond the school's immediate learning environment.

Distinguishing between proximal and auxiliary supports clarifies where support is situated and how it is structurally positioned within digital learning environments. However, this distinction alone does not resolve a central problem in the literature. Although research has identified multiple support actors across both layers, far less attention has been given to how supports are coordinated within each layer or aligned across layers, particularly in digital learning models that span institutional boundaries (Archambault et al., 2016). Studies have tended to examine individual roles or discrete interventions rather than the structures that integrate them (Barbour, 2022). As a result, we lack a clear understanding of how layered supports function collectively as part of a coherent system.

Conceptualizing support as a layered ecosystem extends this distinction by centering coordination across roles and structures. An ecosystem perspective shifts the analytic focus from identifying individual support roles to examining how proximal and auxiliary actors are structured, aligned, and sustained within varied digital learning models. This perspective focuses analysis on role architecture, communication pathways, accountability structures, and equity across layers. The following section synthesizes existing research to identify patterns, tensions, and gaps that inform a research agenda centered on the design and coherence of digital learning support ecosystems.

What We Know: Patterns Across Proximal and Auxiliary Supports

Existing research provides important insights into how specific actors contribute to student engagement and persistence in K–12 digital learning. When examined collectively, the literature reveals recurring patterns that illuminate both the strengths and limitations of current support structures.

Role Ambiguity and Shared Responsibility

A consistent theme across studies of proximal supports is ambiguity in role definition. Research on parental involvement demonstrates that parents play a central role in sustaining behavioral engagement, monitoring progress, and providing encouragement, yet expectations for cognitive and instructional support are often unclear or inconsistently communicated (Guo et al., 2024; Sandberg et al., 2025). Parents frequently report navigating technology, managing communication with schools, and assisting with coursework without formal preparation (Guo et al., 2024; Maimaiti et al., 2025).

On-site facilitators face similar ambiguity. Although their physical presence enables behavioral monitoring, accountability routines, and relational support, their instructional authority and boundaries relative to online teachers are often loosely defined (Borup & Stimson, 2017; Borup et al., 2019; Freidhoff et al., 2015; Viano & Borup, 2025). In supplemental models that involve both online providers and brick-and-mortar schools, responsibility for student outcomes may be distributed across institutions, further complicating accountability and communication (Archambault et al., 2016). Across both parent and facilitator roles, unclear delineation of responsibility contributes to overlap, gaps, and inconsistent implementation.

Preparation, Capacity, and Implementation Variability

A second cross-cutting pattern concerns preparation and capacity. Parents are frequently expected to function as learning coaches without structured training, despite documented challenges related to technology use, communication, and personalization (Guo et al., 2024; Maimaiti et al., 2025). Although some programs provide orientation materials or guidance, systematic preparation models remain uneven (Sandberg et al., 2025).

On-site facilitators similarly report limited formal training, even though evidence suggests that structured preparation and learner-centered facilitation practices can improve retention and accountability outcomes (Borup & Stimson, 2017; Hannum et al., 2008). Facilitator background and workload vary substantially across settings, contributing to inconsistent implementation (Borup et al., 2019; Freidhoff et al., 2015).

Auxiliary supports also exhibit variability in implementation. Studies of online tutoring demonstrate positive academic effects under structured conditions (Ready et al., 2024; Gortazar et al., 2024), and research on academic coaching highlights the role of relational strategies in promoting persistence (Moore, 2020; Letchworth et al., 2025). However, these studies typically focus on specific interventions rather than broader integration within school systems.

Patterns of Promise, Limited Generalizability

Research across proximal and auxiliary supports identifies context specific associations between targeted interventions and improvements in engagement and selected student outcomes. Trained on site facilitators have been linked to higher retention in certain virtual schooling contexts (Hannum et al., 2008). Randomized and quasi experimental studies of online tutoring report measurable gains in student performance under defined implementation conditions (Ready et al., 2024; Gortazar et al., 2024). Peer mentoring and digitally mediated support structures have been associated with increased motivation, sense of belonging, and self-regulation in particular program models (Mercier et al., 2024; Kohli et al., 2022).

Despite these promising findings, the evidentiary base is uneven in scope and design. Most studies focus on single roles or discrete interventions rather than examining coordinated networks of support. Empirical attention to how tutoring interacts with parental monitoring, how coaching complements facilitation, or how counseling services align with instructional and home-based supports remains limited (Tysinger et al., 2018). Consequently, the cumulative effects of layered supports remain underexamined.

Systemic Fragmentation and Model Variation

Finally, the literature points to structural fragmentation across digital learning models. Supplemental programs often require coordination between online providers and local schools, creating accountability tensions and communication challenges (Archambault et al., 2016; Barbour, 2022). Even within full-time virtual schools, scaling support services such as mental health counseling or mentoring may strain institutional capacity (Walter et al., 2024). Support structures also vary across full-time virtual, blended, and supplemental models, shaping expectations for parental involvement, facilitator presence, and access to auxiliary services (Watson & Gemin, 2008). However, comparative research examining how ecosystem architecture differs across models remains limited.

Existing research demonstrates that both proximal and auxiliary supports can contribute meaningfully to student engagement and persistence. At the same time, it reveals persistent ambiguity in role delineation, uneven preparation, limited coordination, and insufficient attention to how supports function collectively. These patterns suggest the need for research that examines support ecosystems rather than isolated actors.

Reframing the Problem: Researching Support as an Ecosystem

The existing literature on student support in K–12 digital learning is uneven and fragmented. Parents and on-site facilitators have received sustained attention, while tutors, academic coaches, counselors, peer mentors, and community-based supports are examined less consistently and often within narrow programmatic contexts. Across these strands, roles are typically studied in isolation, with limited attention to how responsibilities are distributed across actors or how supports function in relation to one another within specific digital learning models.

We define a support ecosystem as the coordinated network of proximal and auxiliary actors, services, and institutional structures that collectively sustain students' academic, behavioral, and socioemotional engagement in digital learning environments. This framing builds on engagement scholarship that identifies multiple actors influencing engagement (Borup et al., 2014; Borup et al., 2020) but shifts analytic attention toward alignment, coordination, and system design. Adopting an ecosystem lens surfaces several interrelated research priorities.

Role Architecture and Delineation

Research has documented ambiguity in parental and facilitator responsibilities (Borup et al., 2019; Guo et al., 2024; Sandberg et al., 2025), yet few studies systematically examine how roles are formally defined or negotiated across stakeholders. Future research should map how responsibility for affective, behavioral, and cognitive support is distributed across actors within different program models. Comparative studies could examine how role clarity varies between full-time virtual, supplemental, and blended settings (Watson & Gemin, 2008), and whether clearer delineation is associated with improved persistence or engagement.

Coordination and Communication Structures

Institutional fragmentation, particularly in supplemental programs spanning multiple organizations, creates accountability tensions and communication gaps (Archambault et al., 2016). However, empirical studies rarely investigate the coordination mechanisms that connect proximal and auxiliary supports. Research is needed to examine how communication routines, shared data systems, referral processes, and decision protocols shape alignment across actors. Multi-level and network-based methodologies may be especially valuable in examining how information and responsibility flow within digital learning ecosystems.

Model Variation and Structural Design

Support ecosystems are shaped by program design. Full-time virtual schools, supplemental providers, and blended partnerships allocate responsibility differently and vary in their internal capacity to provide auxiliary services (Watson & Gemin, 2008; Walter et al., 2024). Yet comparative research across models remains limited. Future studies should examine how ecosystem architecture differs by model type and how structural design influences coordination, scalability, and sustainability.

Equity and Access

Access to both proximal and auxiliary supports is uneven. Families vary in their capacity to provide monitoring and academic support (Guo et al., 2024; Maimaiti et al., 2025), and students enrolled in online programs often include disproportionate numbers of at-risk learners (Beck et al., 2021; Tysinger et al., 2018). An ecosystem perspective requires explicit attention to how socioeconomic, geographic, and institutional factors shape access to layered supports and whether certain configurations mitigate or exacerbate inequities.

Conclusion: Advancing a Research Agenda on Support Ecosystems

Digital learning is an institutionalized and expanding component of K–12 public schooling. As participation stabilizes above pre-pandemic levels and program models diversify, the question is not simply whether individual supports are effective, but how layered supports are structured and coordinated within complex systems. Existing research has illuminated the roles of parents, facilitators, tutors, coaches, and counselors, yet these roles are too often examined in isolation. An ecosystem perspective reframes student support as a problem of alignment, integration, and sustainability across proximal and auxiliary layers.

Advancing this research agenda requires moving beyond single-role studies toward multi-level investigations of role architecture, coordination mechanisms, model variation, and equity. By examining how supports function collectively rather than discretely, the field can better understand how to design digital learning environments that are coherent, responsive, and sustainable. As digital learning continues to expand, developing and empirically testing models of coordinated support ecosystems will be necessary to align program growth with systemic clarity and student-centered design.

References

Archambault, L., Kennedy, K., & Freidhoff, J. (2016). Accountability for students in K-12 online learning: Perspectives from Michigan stakeholders and beyond. *Online Learning*, *20*(3). https://doi.org/10.24059/olj.v20i3.975

Barbour, M. K. (2022) Where do they go? An investigation of K-12 online learners' process for obtaining support. *TechTrends, 66*, 351-365. https://doi.org/10.1007/s11528-022-00698-w

Barbour, M. K., & Reeves, T. C. (2009). The reality of virtual schools: A review of the literature. *Computers & Education, 52*(2), 402-416. https://doi.org/10.1016/j.compedu.2008.09.009

Beck, D., Tran, B., Maranto, R., & Clark, T. (2021). Why they come and go: comparing special education and general education students in cyber schools. *Journal of Online Learning Research, 7*(3), 233-248. https://www.learntechlib.org/p/219618/

Bell, K. (2024). Affordances, constraints and collaborative potential of e-mentoring platforms and their features for K–12 educators: A systematic literature review. *International Journal of Mentoring and Coaching in Education, 13*(3), 346-360. https://doi.org/10.1108/IJMCE-07-2023-0056

Borup, J., Chambers, C. B., & Stimson, R. (2019). Student perceptions of online teacher and on-site facilitator support in supplemental online courses. *Online Learning, 23*(4). https://doi.org/10.24059/olj.v23i4.1565

Borup, J., Graham, C. R., West, R. E., Archambault, L., & Spring, K. J. (2020). Academic communities of engagement: An expansive lens for examining support structures in blended and online learning. *Educational Technology Research and Development, 68*, 807-832. https://doi.org/10.1007/s11423-020-09744-x

Borup, J., & Stimson, R. (2017). *Helping online students be successful: Mentor responsibilities*. Michigan Virtual Learning Research Institute. https://michiganvirtual.org/research/publications/helping-online-students-be-successful-mentor-responsibilities/

Borup, J., West, R. E., Graham, C. R. & Davies, R. S. (2014). The adolescent community of engagement framework: A lens for research on K-12 online learning. *Journal of Technology and Teacher Education, 22*(1), 107-129. https://www.learntechlib.org/primary/p/112371/

Cavanaugh, C. S., Barbour, M. K., & Clark, T. (2009). Research and practice in K-12 online learning: A review of open access literature. *The International Review of Research in Open and Distributed Learning*, *10*(1). https://doi.org/10.19173/irrodl.v10i1.607

Dameron, E. (2022, March 2). *Online tutoring study shows cause for optimism*. Rady School of Management, University of California San Diego. https://today.ucsd.edu/story/online-tutoring-study-shows-cause-for-optimism

Digital Learning Collaborative. (2024). *Snapshot 2024: The post-pandemic landscape emerges*. Evergreen Education Group. https://www.deelac.com/wp-content/uploads/2025/02/Snapshot-2024.pdf

Freidhoff, J. R., Borup, J., Stimson, R. J., & Debruler, K. (2015). Documenting and sharing the work of successful on-site mentors. *Journal of Online Learning Research*, *1*(1), 107-128. https://www.learntechlib.org/p/149918/

Gortazar, L., Hupkau, C., & Roldán-Monés, A. (2024). Online tutoring works: Experimental evidence from a program with vulnerable children. *Journal of Public Economics, 232*, 105082. https://doi.org/10.1016/j.jpubeco.2024.105082.

Greenidge T, Smith-Adcock S, Cakmakci H, & Su, Y. W. (2023). A transcendental phenomenology of school counselors' lived experiences transforming remote counseling services during the COVID-19 pandemic. *Professional School Counseling 27*(1). https://doi.org/10.1177/2156759X231161524

Guo, Q., Graham, C. R., Borup, J., Sandberg, B., & West, R. E. (2024). Parental support challenges for K-12 student online engagement. *Distance Education, 45*(4), 579-605. https://doi.org/10.1080/01587919.2024.2397481

Hannum, W. H., Irvin, M. J., Lei, P., & Farmer, T. W. (2008). Effectiveness of using learner-centered principles on student retention in distance education courses in rural schools. *Distance Education*, *29*(3), 211–229. https://doi.org/10.1080/01587910802395763

Kohli, S., Ramachandran, N., Tudor, A., Tumushabe, G., Hsu, O., & Ranade, G. (2022). Inclusive study group formation at scale. *arXiv.* https://doi.org/10.48550/arXiv.2202.07439

Letchworth, N., Koltonski, S., & Kennon, L. (2025). Strategies used by academic coaches in the online classroom to foster connection and success for students. *Advances in Online Education: A Peer-Reviewed Journal, 3*(4), 345. https://doi.org/10.69554/MJNJ9265

Maimaiti, G., Hew, K. F., & Xiao, Y. (2025). Challenges to parental engagement in K-12 online learning during the pandemic: Lessons learned and a tripartite model for future involvement. *Future in Educational Research, 3*(3), 482-504. https://doi.org/10.1002/fer3.70007

Mercier, A., Paquette, B., Hoeft, F., & Richter, C. (2024). Online peer mentoring for youth with learning differences. *Research Square*. https://doi.org/10.21203/rs.3.rs-5189431/v1

Moore, A. B. (2020). *Increasing learning coach involvement to support cultivating student engagement in K-12 online classrooms* (Doctoral dissertation). Johns Hopkins University. http://jhir.library.jhu.edu/handle/1774.2/63507

Oviatt, D. R., Graham, C. R., Borup, J., & Davies, R. S. (2018). Online student use of a proximate community of engagement at an independent study program. *Online Learning*, *22*(1). https://doi.org/10.24059/olj.v22i1.1153

Ready, Douglas D., McCormick, S. G., & Shmoys, R. J. (2024). *The effects of in-school virtual tutoring on student reading development: Evidence from a short-cycle randomized controlled trial*. Annenberg Institute at Brown University. https://doi.org/10.26300/569p-wz78

Roberts, A., Goodman-Scott, E., & Edirmanasinghe, N. (2023). The experiences of school counselors providing virtual services during COVID-19: A phenomenological investigation. *Professional School Counseling, 27*(1). https://doi.org/10.1177/2156759X231199738

Sandberg, B. T., Graham, C. R., Borup, J., West, R. E., & Velasquez, R. Q. (2025). Behind the screen: Exploring parental roles in K-12 online education. *Journal of Research on Technology in Education*, https://doi.org/10.1080/15391523.2024.2447729

Tysinger, P. D., Tysinger, J. A., Diamanduros, T. D. (2018). The role of the school psychologist in K-12 online & blended learning. In K. Kennedy & R. Ferdig (eds.), *Handbook of research on K-12 online and blended learning* (2nd ed., 453-454). ETC Press. https://kilthub.cmu.edu/articles/journal_contribution/Handbook_of_Research_on_K-12_Online_and_Blended_Learning_Second_Edition_/6686813

Viano, S., & Borup, J. (2025, February). *In the room where it happens: What we learned by developing and implementing an observation tool for in-school online credit recovery programs* [paper]. Digital Learning Annual Conference, Atlanta, GA.

Walter, A., Martin, F., Hageman-Mays, K., & Wiggs, B. (2024). Trends and issues in K-12 virtual academies: Perspectives of virtual academy leaders. *Journal of Online Learning Research, 10*(2), 153-189. https://www.learntechlib.org/p/222801/

Watson, J., & Gemin, B. (2008). Using online learning for at-risk students and credit recovery: Promising practices in online learning. iNACOL https://aurora-institute.org/resource/promising-practices-in-online-learning-using-online-learning-for-at-risk-students-and-credit-recovery/