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A Systems Approach to Technology Integration: The SETI Framework

Un enfoque sistémico de la integración de tecnología: el marco SETI

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Abstract:

The Socio-Ecological Technology Integration (SETI) framework offers a systems-oriented perspective on effective technology integration in education. Unlike earlier models that primarily focus on teacher practice, such as TPACK and SAMR, the SETI framework situates the educator within a complex set of socio-ecological systems, including the microsystem of school environments, the exosystem of district-level support structures, and the macrosystem of national policies and cultural norms. This paper builds upon prior conceptualizations of SETI by unpacking it further in terms of how educators and educational leaders can utilize SETI, and also presents a set of newly developed practical resources that support its implementation. These resources include reflection tools, integration checklists, and strategic planning guides that help educators and educational leaders examine the multiple interdependent factors necessary for successful technology integration. The SETI framework offers a significant contribution to the educational technology literature by repositioning effective integration as a systemic responsibility rather than an individual task. In doing so, it enables educators and leaders to identify barriers, coordinate strategic responses, and promote sustainable, equitable technology use aligned with institutional and policy contexts.

Keywords: SETI, socio-ecological technology integration, socio-ecological, technology integration, education, frameworks, TPACK, SAMR

Resumen:

El marco de Integración Socioecológica de la Tecnología (SETI, por sus siglas en inglés) ofrece una perspectiva sistémica de la integración eficaz de la tecnología en educación. A diferencia de otros modelos anteriores que se centran en la práctica docente —como TPACK y SAMR—, el marco SETI sitúa al educador en un conjunto complejo de sistemas socioecológicos, incluido el microsistema de los entornos escolares, el exosistema de las estructuras de apoyo a nivel de distrito y el macrosistema de las políticas nacionales y las

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normas culturales. Este artículo parte de conceptualizaciones previas de SETI y desarrolla el marco para mostrar cómo pueden utilizarlo tanto los educadores como los responsables educativos, además de presentar una serie de recursos prácticos de reciente desarrollo que respaldan la implementación. Estos recursos incluyen herramientas de reflexión, listas de control de la integración y guías de planificación estratégica que ayudan a los educadores y los responsables educativos a examinar los múltiples factores interdependientes necesarios para la integración exitosa de la tecnología. El marco SETI contribuye a la literatura sobre tecnología educativa al reposicionar la integración eficaz como una responsabilidad sistémica, en lugar de una tarea individual. De este modo, permite a educadores y responsables identificar posibles obstáculos, coordinar respuestas estratégicas y promover un uso sostenible y equitativo de la tecnología en sintonía con los contextos institucionales y políticos.

Palabras clave: SETI, integración socioecológica de la tecnología, socioecológico, integración de tecnología, educación, marcos, TPACK, SAMR

"No one can whistle a symphony. It takes a whole orchestra to play it."

H. E. Luccock

1. Introduction

Digital technologies are now a central feature of contemporary education systems. Their integration into instructional practice has been linked to a range of cognitive and affective outcomes, including increased knowledge acquisition (Saltan & Arslan, 2017), improved academic performance (Yilmaz, 2018), and heightened learner attention and motivation (Ibáñez et al., 2020). In online and blended learning environments, the use of technology is often embedded by necessity; however, the nature and quality of integration vary considerably, ranging from transmissive content delivery to interactive and collaborative engagement formats (Ivone et al., 2020).

Policy frameworks and professional standards have consistently emphasized the importance of integrating technology in ways that are pedagogically purposeful and contextually appropriate (ISTE, 2016). Nevertheless, empirical research indicates that technology is not always implemented in ways that align with these aims. Studies have documented a prevalence of low-level usage, such as repetitive skill drills or unstructured free-time applications, particularly in K–12 settings (Chen et al., 2014; Kurt et al., 2013; Tondeur et al., 2012).

In recent years, the lack of preparation for using technology has been highlighted during the transition to online learning during the COVID-19 pandemic (Crompton et al., 2023) and the recent acceleration in the use and development of generative artificial intelligence in education (Crompton & Burke, 2024; Xiao et al., 2025). Several frameworks have been developed to support educators in conceptualizing and improving technology integration. Among the most widely cited are the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) and the Substitution, Augmentation, Modification, Redefinition (SAMR) model (Puentedura, 2009). These models provide structured approaches to aligning technology with pedagogy and content. However, their focus is predominantly on what the educator is doing with technology within the classroom, with less attention to the broader ecological factors influencing integration processes.

This paper highlights the Socio-Ecological Technology Integration (SETI) framework, which extends beyond the educator to offer a systems-level perspective on the use of technology in education. SETI is informed by socio-ecological theory (viz., Bronfenbrenner, 1979), and emphasizes the dynamic interrelations among individual, institutional, and societal influences. The study outlines the conceptual foundations of the framework, situates it in relation to established models, and introduces a set of applied resources and illustrative use cases. The intent is to contribute to the research literature on technology integration by offering a model that accounts for multi-level contextual variables and supports a more comprehensive analysis of integration practices.

2. Literature review

The integration of digital technologies into teaching and learning has been a persistent area of focus in both K–12 and higher education. As technological tools continue to evolve and expand in capability, the question of how to integrate them effectively remains a central concern in instructional technology research and practice (Bakir, 2016). Despite increased attention to technology integration, many educators across sectors continue to report uncertainty or lack of readiness when it comes to implementing technology in the classroom, even those who identify as technologically literate (Bakir, 2016; Dinçer, 2018). These findings suggest that the gap is not only about access or awareness, but also about the availability of clear, actionable frameworks to guide integration efforts in diverse educational settings. The next sections examine existing models that have been widely adopted to support this work and consider how they conceptualize the role of the educator in the technology integration process.

2.1. Extant frameworks

Numerous frameworks have been developed to support the integration of digital technologies into educational settings. Their underlying conceptual structures continue to inform broader understandings of technology-enhanced education. Some early efforts focused on technologies, such as the MIT Mobile Framework (Yu, 2009) and the Moodbile framework (Casany et al., 2012), and were designed to guide the incorporation of mobile applications within institutional technology infrastructures, particularly in higher education. These models offered valuable guidance for aligning mobile tools with learning management systems and institutional platforms, but were not primarily intended to support curriculum-level instructional design.

Other frameworks adopted a pedagogical orientation. For instance, Park (2011) proposed a framework that categorized learning activities based on their capacity to support distance education, focusing on the spatial and communicative distance between instructors and learners. While insightful, the framework's emphasis remained on mobility and learner distribution rather than curriculum integration.

Several scholars have also drawn upon activity theory to develop models that address socio-cultural and cognitive dimensions of technology use. Koole's (2009) Framework for the Rational Analysis of Mobile Education (FRAME) explicitly incorporates constructs from Vygotsky's theory of mediated learning and the zone of proximal development, offering a lens through which to consider how learners interact with content, technology, and context. Similarly, Uden (2007) and Zurita and Nussbaum (2007) developed frameworks to analyze learning activities, design requirements, and developmental processes, emphasizing the social and situational influences that shape educational practice.

Despite their contributions to research, these frameworks provide limited direct guidance for classroom educators seeking to integrate digital technologies into subject-specific instruction. In contrast, two models have gained prominence for their explicit focus on technology integration in curriculum design: the Technological Pedagogical Content

Knowledge (TPACK) framework and the Substitution, Augmentation, Modification, Redefinition (SAMR) model.

2.1.1. TPACK

The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) extends Shulman's (1986) concept of pedagogical content knowledge by introducing a third essential domain, technological knowledge. The framework consists of three core knowledge areas: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). The model emphasizes that effective technology integration arises when these domains intersect meaningfully. For instance, an educator designing a lesson must consider the most appropriate content, the instructional strategies that best facilitate learning that content, and the technological tools that align with both. The intersection of all three, TPACK, represents a dynamic knowledge space where technology is used in coordination with pedagogy and disciplinary understanding rather than in isolation. Rather than prescribing specific tools or techniques, the framework highlights the contextual decision-making required of educators as they adapt their practice across different learning environments. TPACK has been widely used in teacher education and professional development as a conceptual tool for designing, evaluating, and refining the integration of digital technologies into instructional practice.

2.1.2. SAMR

The Substitution, Augmentation, Modification, Redefinition (SAMR) model (Puentedura, 2009) offers a taxonomy for categorizing how digital technologies are employed to support or transform learning activities. It is organized into four hierarchical categories. At the base is substitution, where technology replaces a traditional tool without functional improvement, for example, using a digital device instead of a pen and paper. The second level, augmentation, includes minor functional improvements, such as using word processing features like spell check or voice typing. These two levels are collectively referred to as enhancement, as the technology supports but does not fundamentally alter the task.

The third level, modification, involves a significant redesign of the learning activity made possible through technology. An example is students using collaborative platforms to co-author documents in real-time, enabling feedback and iterative development. The highest level, redefinition, describes tasks that were previously inconceivable without the technology. For example, students might create a multimedia documentary and publish it online for global peer review. This level of integration facilitates learning experiences that extend beyond traditional classroom boundaries, often involving authentic audiences and complex, student-driven inquiry. The upper two categories are classified as transformation, indicating the degree to which technology enables novel pedagogical opportunities. The SAMR model is frequently used in professional development to support educators in critically reflecting on their use of technology. It offers a structured approach to analyzing instructional choices, although it does not explicitly address content alignment or pedagogical theory. As such, it is often employed in conjunction with other frameworks, such as TPACK, to provide a more comprehensive understanding of effective technology integration.

While earlier frameworks have contributed foundational insights, particularly in relation to design, activity, and learner context, TPACK and SAMR remain the most widely applied models for guiding educators in integrating digital tools into curriculum and pedagogy. Nonetheless, TPACK and SAMR operate by placing the educator as the only person responsible for technology integration. Such a perspective places an undue burden on individual educators, failing to acknowledge the essential roles of other stakeholders, including instructional designers, school leaders, IT professionals, and policymakers, whose expertise and decisions significantly shape the conditions under which integration occurs. By overlooking these

collaborative and systemic dimensions, the frameworks present an incomplete account of how technology is adopted and sustained in educational environments. A more accurate and equitable model must recognize that effective integration is not the product of individual effort alone, but the outcome of coordinated support across multiple levels of the educational system.

2.1.3. Purpose

The purpose of this paper is to review the more recent SETI framework, which reconceptualizes technology integration as a systems-level process shaped by multiple, interacting influences. This paper demonstrates its practical relevance in K-12 and higher education through the presentation of utilize cases for educators and educational leaders, resources to use with SETI, and applied examples. In doing so, it aims to provide a more comprehensive and context-responsive approach to supporting effective and sustainable technology integration in educational practice.

3. Socio-Ecological Technology Integration Framework

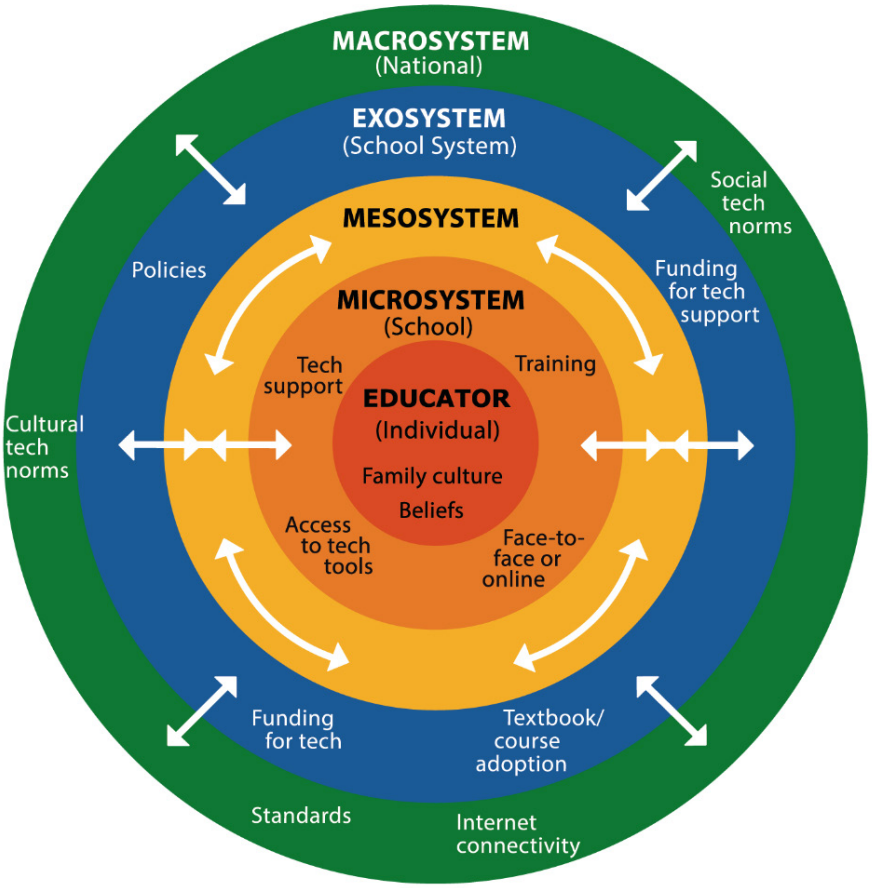
The Socio-Ecological Technology Integration (SETI) framework (Crompton et al., 2024) is a systems-level approach to understanding how technology is integrated in educational contexts. Unlike earlier models such as TPACK and SAMR, which center the educator as the only person involved in technology integration, SETI situates the educator within a network of interacting ecological systems. The framework emphasizes that technology integration is influenced not only by an educator's beliefs and practices, but also by the structures, relationships, and norms that exist at the school, district, and national levels. The socio-cultural impact has been well-documented by scholars in the use and development of technologies (e.g., Gorlacheva et al., 2019). In SETI, elements such as institutional support, policy environments, cultural expectations, family dynamics, and infrastructure are incorporated, factors that are typically underrepresented in educator-focused models of integration.

SETI builds upon an earlier model developed from a thematic systematic review of the literature on mobile learning integration (Crompton, 2017). That review identified four interrelated domains—beliefs, resources, methods, and pedagogical purpose—that are necessary for effective integration. These elements formed the initial socio-ecological framework, which has since been expanded through empirical research, including a comparative study of teacher resilience during COVID-19 in the United States and South Africa (Crompton et al., 2023). Insights from this work led to refinements of the framework, such as the explicit inclusion of families, school systems, district leadership, and national-level actors as integral to the technology integration process.

Structurally, the SETI framework is organized into concentric circles that radiate outward from the educator (see Figure 1). The innermost circle includes the educator's beliefs and family context. Surrounding this is the microsystem of the school environment, which encompasses leadership, students, and immediate technological supports. The exosystem encompasses the district-level influences, including funding, training, and local policies. The macrosystem refers to national and cultural influences, including government ICT policies and societal attitudes toward digital learning. Interconnections between these levels are acknowledged through the mesosystem, which highlights the overlapping and dynamic interactions among systems.

At its core, SETI shifts responsibility from the individual to the collective, emphasizing that effective and equitable technology integration is the result of a coordinated effort across the entire educational ecosystem.

FIGURE 1. Socio-Ecological Technology Integration.



Source: Crompton et al., 2023.

4. SETI for educators

Educators in K-12 and higher education can use the SETI (Socio-Ecological Technology Integration) framework as a strategic tool to contextualize their experiences and advocate for the systemic support necessary for effective technology integration.

4.1. K-12 Educators

This framework allows educators to articulate technology integration challenges as issues embedded in a complex network of influences, including infrastructure, policy, professional development, and sociocultural norms. Such a shift in perspective is instrumental in transforming individual frustrations into well-structured requests for institutional change. SETI can be used to empower educators to identify and communicate the limitations of their technological ecosystem in a structured, evidence-informed manner. For example, when educators experience inconsistent access to professional development in digital pedagogies, the SETI framework enables them to demonstrate how this shortfall is not merely a matter of personal preparedness but a systemic gap at the school or district level. By mapping such needs within the framework's concentric layers, from classroom to national policy, educators

can frame their professional needs in ways that compel attention from school leaders, district authorities, and policy-makers. Teachers can encounter obstacles such as a lack of support and limited knowledge about advocacy; yet, overcoming these obstacles is crucial for fostering teacher autonomy, relatedness, and competence (Raymond, 2024). SETI helps by functioning as a diagnostic and advocacy tool, aligning educators' experiences with the structural dimensions to support their advocacy to help them gain what is needed to effectively integrate technology.

SETI enables reflection on individual belief systems, as well as community and national norms. In the research that led to the development of the first version of SETI, when the factors influencing technology integration were examined, one factor stood out above all others: the educator's personal beliefs about the use of technology in education (Crompton, 2017). The educator may have all the resources and support, but if that educator believed that technology was not an effective tool to use, they would not use it, or use it in an ineffective way. SETI provides a reminder to educators to begin in the center of the framework and reflect on their thoughts and beliefs. Educators can also use the framework to examine how cultural attitudes toward digital learning, such as parental skepticism about screen time or assumptions about student autonomy, intersect with institutional mandates and digital initiatives. For instance, if educators notice that parental resistance to online learning platforms limits home engagement, they can use SETI to identify the underlying issue, such as cultural norms or communication policies, which may prompt responses like parent workshops or translated guides. This application of SETI situates the educator as both agent and advocate within an ecosystem that must function collectively to support student learning outcomes.

4.2. Higher education faculty

Higher education faculty can again utilize the SETI framework as a reflective and strategic tool to guide their technology integration practices within the complex university ecosystems. By mapping their own experiences onto the layers of the framework, faculty can identify which barriers stem from personal beliefs or teaching strategies and which are rooted in systemic constraints such as limited access to instructional design support, inflexible curriculum structures, or insufficient policy guidance on digital ethics.

The SETI framework equips faculty to advocate for necessary supports by repositioning challenges as collective, institutional concerns rather than individual shortcomings. For instance, if a faculty member struggles to implement online learning due to outdated classroom technologies or inconsistent technical assistance, SETI offers a structured rationale to bring these issues to the attention of department chairs, teaching and learning centres, or governance committees. This can lead to more informed conversations about resource allocation, workload planning, and long-term infrastructure development, all of which are crucial for sustaining effective digital pedagogy.

Additionally, faculty can utilize SETI to engage more intentionally with the broader academic and cultural environment that influences teaching and learning. This includes recognizing how student access, institutional policies, disciplinary norms, and even family expectations influence the uptake and effectiveness of technology in the classroom. By situating their work within the socio-ecological systems of the institution, faculty are better positioned to contribute to collective initiatives, shape departmental conversations about innovation, and ensure that their pedagogical choices align with both institutional goals and student needs. SETI thus supports faculty not only as educators but as active participants in shaping the university's digital learning ecosystem.

5. SETI for educational leaders

Educational leaders can use the SETI framework to strategically support educators by identifying and addressing the multi-layered conditions necessary for effective technology integration.

5.1. K-12 Education leaders

In K-12 education, rather than focusing solely on classroom-level interventions, leaders can utilize SETI to examine the structural and cultural elements within the school environment that either enable or constrain the use of technology. For example, if educators are hesitant to experiment with digital tools due to a lack of just-in-time technical support, leaders can interpret this through the SETI lens as a systemic issue within the school's microsystem, requiring structural solutions such as staffing adjustments or reallocating professional learning time.

SETI also provides a mechanism for K-12 leaders to advocate upwards, to district administrators, policy-makers, and funding agencies, by demonstrating how technology integration is contingent on coordinated support across all levels of the educational system. School leaders may be limited in their authority to influence funding models, infrastructure upgrades, or policy development, yet they can use SETI to construct evidence-based arguments that link these macro-level decisions to observable outcomes in teaching and learning. For instance, a principal could use SETI to highlight how inadequate national broadband infrastructure is directly affecting student engagement and assessment in digital environments, thereby justifying requests for targeted investment.

SETI encourages educational leaders to recognize the dynamic interactions across systems and act as connectors within and beyond their institutions. This includes coordinating with families, community organizations, and regional stakeholders to build a coherent ecosystem that supports learning. Leaders can utilize the framework to guide reflective dialogue across departments or institutions, fostering a shared responsibility and promoting forward planning. By using SETI, leaders can position themselves not only as managers of immediate school needs but as system-level thinkers who anticipate barriers, broker cross-sector relationships, and pursue long-term solutions for sustainable technology integration.

5.2. Higher education leaders

SETI also enables higher education leaders to advocate within and beyond their institutions. Deans, provosts, and directors often negotiate with governing boards, accreditation bodies, funding agencies, and national ministries. The framework equips them with a structured rationale to articulate how local challenges—such as inequitable access to devices, inconsistent pedagogical support, or a lack of recognition for digital scholarship—stem from broader systemic issues. For example, a vice-provost for teaching and learning might use SETI to present evidence to a ministry of education on how rigid assessment regulations hinder the adoption of digital and hybrid teaching models, thereby justifying requests for regulatory reform or funding for pedagogical experimentation.

At the same time, SETI encourages leaders in higher education to foster coordinated efforts across interdependent systems. These may include partnerships between instructional technology units, academic departments, IT services, and student affairs, as well as engagement with external stakeholders, such as industry or community organizations. The framework underscores the importance of aligning institutional strategy with the beliefs and practices of faculty, the digital competencies of students, and the sociocultural context in which the university operates.

6. SETI resources

A set of practical resources has been developed to complement the use of the SETI framework. While educators and leaders can engage meaningfully with the framework on its own as an analytical and reflective tool, these additional resources are intended to support deeper and more sustained implementation across various contexts. The materials provide structured guidance for applying SETI principles in everyday practice, including planning, evaluation, professional reflection, and institutional advocacy.

6.1. SETI Systems Reflection Tool

The first resource is a systems reflection tool for educators and educational leaders in K-12 and higher education.

SETI Systems Reflection Tool: A Guide for K–12 Educators Supporting Technology Integration

A guide for educators in using the Socio-Ecological Technology Integration (SETI) framework to assess what support and resources you need to successfully integrate technology.

Educator Level (Individual Beliefs and Practices)

- ☐ Have you reflected on your personal beliefs about technology and how they influence your teaching?
- ☐ Are you aware of how family culture, traditions, and biases (your own and your students') may shape perceptions of technology in education?
- ☐ Are you integrating technology in ways that align with effective pedagogical strategies and curriculum goals?

School Level (Microsystem)

- ☐ Does your school provide adequate access to technology (devices, software, and internet connectivity) for both educators and students?
- ☐ Are you actively participating in professional development opportunities related to technology integration?
- ☐ Is there technical support readily available to help you troubleshoot and resolve challenges?
- ☐ Are you working with colleagues and school leadership to build a culture of effective technology use?
- ☐ Are there clear school policies guiding the safe, ethical, and effective use of technology, and are you following them?

School District Level (Exosystem)

- ☐ Are you provided with district-wide policies and guidelines to support technology integration?
- ☐ Does your district allocate funding and resources to ensure technology access, support, and training?
- ☐ Are you advocating for needed improvements by sharing challenges and successes with district leaders?
- ☐ Do you engage in professional learning communities or district-led technology initiatives to stay informed?

National Level (Macrosystem)

- ☐ Are you aware of national policies, political priorities, and education standards, and do they support effective and equitable technology integration?

- ☐ Are you aware of how cultural, social, and political factors influence how technology is valued and adopted in education, and are you considering these influences in your practice?
- ☐ Is the government ensuring equitable access to technology, internet connectivity, and digital resources, and are you advocating for these needs in your school or district?
- ☐ Are you engaging in national conversations and professional networks to stay informed, share insights, and contribute to policy discussions on technology integration?

Cross-Cutting Elements (Mesosystem)

- ☐ Are policies and support structures aligned across school, district, and national levels to ensure consistency?
- ☐ Are all stakeholders, educators, administrators, and policymakers actively working together to create a well-supported, technology-integrated learning environment?

SETI Systems Reflection Tool: For School and District Leaders Enabling Effective Technology Integration

A guide for educational leaders in using the Socio-Ecological Technology Integration (SETI) framework to assess whether the necessary policies, resources, and support structures are in place to facilitate effective technology integration.

Leadership in Supporting Educators (Educator Level)

- ☐ Are you ensuring that educators have access to training and professional development to integrate technology effectively?
- ☐ Are you fostering a culture where educators feel supported in exploring and reflecting on their beliefs about technology in learning?
- ☐ Are you providing opportunities for educators to collaborate, share best practices, and learn from one another?

Leadership at the School Level (Microsystem)

- ☐ Are you ensuring that educators and students have equitable access to technology, including devices, software, and reliable internet connectivity?
- ☐ Are school policies in place to guide the safe, ethical, and effective use of technology in learning?
- ☐ Is there a system for providing timely and effective technical support to educators and students?

Leadership at the School District Level (Exosystem)

- ☐ Are district-wide policies and guidelines in place to support and standardize technology integration across schools?
- ☐ Are there mechanisms for educators to provide feedback on technology-related challenges and successes?
- ☐ Are you staying current and ensuring sufficient funding and resource allocation for technology access, training, and support?

Leadership at the National Level (Macrosystem)

- ☐ Are you staying informed about national policies, political priorities, and education standards related to technology integration?
- ☐ Are you advocating for government policies and funding that ensure equitable access to technology and digital learning resources?
- ☐ Are you addressing how cultural, social, and political factors influence technology adoption and integration in education?

Cross-Cutting Responsibilities (Mesosystem)

- ☐ Are you aligning policies and support structures across school, district, and national levels to create a consistent and effective technology integration strategy?
- ☐ Are you facilitating collaboration among educators, administrators, and policymakers to build a well-supported technology ecosystem?

SETI Systems Reflection Tool: A Guide for Higher Education Faculty Advancing Digital Teaching

A systems guide for educators in higher education using the Socio-Ecological Technology Integration (SETI) framework to assess what support and resources you need to successfully integrate technology.

SETI Checklist for Higher Education Faculty

A guide for university faculty using the Socio-Ecological Technology Integration (SETI) framework to evaluate and strengthen supports for effective technology integration in teaching and research.

Faculty Level (Individual Beliefs and Practices)

- ☐ Have you reflected on your personal beliefs about digital technology and its pedagogical value in higher education?
- ☐ Are you aware of how your cultural background, academic discipline, and student diversity influence your approach to technology integration?
- ☐ Are you aligning technology use with course learning outcomes, evidence-based pedagogical practices, and institutional teaching goals?

Institutional Level (Microsystem)

- ☐ Does your institution provide equitable access to necessary technology resources for faculty and students (e.g., hardware, software, bandwidth, digital library tools)?
- ☐ Are there professional development opportunities available to support pedagogical uses of technology in teaching and supervision?
- ☐ Is there dedicated technical and instructional design support for integrating technology into courses and research dissemination?
- ☐ Are academic departments and leadership fostering a culture that values and supports innovative and responsible technology use?
- ☐ Are institutional policies in place to ensure the ethical, accessible, and secure use of educational technologies?

University System and Regional Context (Exosystem)

- ☐ Are there coordinated efforts across faculties, campuses, or university systems to support scalable and consistent technology integration?
- ☐ Are you aware of system-wide investments in infrastructure and faculty development for digital teaching and learning?
- ☐ Are you contributing to or benefitting from faculty networks, cross-institutional initiatives, or regional consortia focused on educational technologies?
- ☐ Are you communicating needs or barriers to appropriate administrative leaders or committees to influence improvements?

National and Global Policy Context (Macrosystem)

- ☐ Are you familiar with national or international policies, funding streams, and quality frameworks that guide technology-enhanced higher education?

- ☐ Are you considering how national culture, higher education policy, and public attitudes influence institutional decision-making around technology?
- ☐ Are issues of digital equity and inclusion addressed in national initiatives, and are you advocating for these in your institution where needed?
- ☐ Are you participating in national or international communities of practice, policy consultations, or scholarly debates about the future of technology in higher education?

Cross-Cutting Considerations (Mesosystem)

- ☐ Are institutional strategies, policies, and supports aligned with system-wide and national policies to ensure coherent implementation?
- ☐ Are academic leaders, IT services, faculty governance bodies, and policy makers collaborating effectively to support meaningful and sustainable technology integration?

SETI Systems Reflection Tool: For Academic Leaders Building Institutional Support for Digital Learning

A guide for academic leaders (e.g., deans, provosts, vice chancellors) to evaluate and enhance the institutional systems and policies needed to support effective technology integration using the Socio-Ecological Technology Integration (SETI) framework.

Leadership in Supporting Faculty (Faculty Level)

- ☐ Are you supporting faculty in reflecting on their educational beliefs and how these influence technology use?
- ☐ Are you providing mechanisms for inclusive decision-making that consider diverse faculty perspectives on technology integration?
- ☐ Are professional development programs available that align digital tools with pedagogical innovation and disciplinary expectations?

Leadership at the Institutional Level (Microsystem)

- ☐ Is your institution ensuring equitable access to robust technology infrastructure and digital learning environments for both faculty and students?
- ☐ Are institutional policies in place that address digital equity, accessibility, ethical use, and data security in educational technologies?
- ☐ Are units such as centers for teaching and learning, IT services, and digital pedagogy teams adequately resourced and aligned in their support of faculty?
- ☐ Are you fostering a culture of innovation and continuous improvement in technology-enhanced teaching, learning, and research?

Leadership Across University Systems and Partnerships (Exosystem)

- ☐ Are you engaged in cross-institutional or system-wide strategic initiatives for digital transformation in teaching and learning?

- ☐ Are you gathering and responding to data and feedback from faculty and students on technology integration challenges and opportunities?
- ☐ Are you investing in shared platforms, cloud services, or open educational resources that extend institutional capacity?
- ☐ Are you supporting collaborative research or community-engaged scholarship initiatives that integrate educational technologies?

Leadership in National and Global Contexts (Macrosystem)

- ☐ Are you staying informed about national digital education policies, international quality frameworks, and regulatory standards affecting technology use?
- ☐ Are you advocating for policy reform or funding that supports inclusive, innovative, and sustainable educational technology initiatives?
- ☐ Are you representing your institution in national or global digital education networks, alliances, or policy forums?
- ☐ Are cultural, social, and economic factors in your national and international context considered in strategic decisions about digital transformation?

Cross-Cutting Leadership Responsibilities (Mesosystem)

- ☐ Are institutional strategies aligned with broader system-level and national policies to ensure coherence in technology adoption?
- ☐ Are you facilitating cross-role collaboration (faculty, IT, instructional design, student services) to support an integrated digital learning ecosystem?
- ☐ Are monitoring and evaluation processes in place to assess the impact of technology integration on student success, equity, and teaching quality?

6.2. Advocacy planning guide

Advocacy is greatly supported by the SETI framework, helping educators and leaders pinpoint where barriers exist within the broader educational system. This Advocacy Planning Guide provides a structured approach for translating those insights into concrete, system-level action (see Table 1).

Table 1: Advocacy Planning Guide

Section	Guiding Prompts	Example Response
1. Define the Challenge	What barrier are you experiencing in integrating technology?	Inconsistent access to functioning Wi-Fi in hybrid classrooms.
2. Identify the Systemic Level	Which level(s) of the SETI framework does this issue belong to? (Micro, Meso, Exo, Macro)	Inconsistent access to functioning Wi-Fi in hybrid classrooms.
3. Describe the Impact	How does this barrier affect teaching, learning, or equitable access for students?	Limits real-time collaboration, causes student disengagement, and disrupts instructional flow.
4. Evidence to Support the Case	What data, examples, or observations can you share to illustrate the problem?	Logs of outages across 4 weeks; 3 faculty members reporting disruption in hybrid instruction.
5. Stakeholders Involved	Who needs to be informed or involved in addressing this issue?	Department chair, IT services, academic technology office, associate dean.
6. Proposed Solution or Request	What are you asking for? Be specific and feasible.	Request a dedicated technology support person for the building and prioritization of Wi-Fi upgrades.
7. Alignment with Institutional Goals	How does your request align with broader institutional priorities (e.g., digital equity, retention, innovation)?	Enhances student success in hybrid delivery and supports inclusive digital learning environments.
8. Communication Plan	How and when will you raise this issue? What format will you use (e.g., memo, meeting, email)?	Prepare a short brief and request time on the agenda at the upcoming faculty tech steering committee.

6.3. Case studies

The case studies and vignettes included in this section illustrate how the SETI framework can be applied in real-world educational contexts to surface systemic barriers and opportunities for effective technology integration. Each scenario highlights a different layer of the socio-ecological system, allowing educators and leaders to analyze challenges not as

isolated incidents but as outcomes shaped by broader institutional, cultural, or infrastructural dynamics. These cases can be used in faculty development sessions, leadership retreats, or collaborative planning meetings to prompt reflection, guide discussion, and support collective problem-solving grounded in systems thinking.

Case Study A: Uneven Access and Equity in the Classroom

Scenario:

Professor Ndlovu teaches in a regional institution where many students rely on limited mobile data and shared devices. During the pandemic, she moved to asynchronous teaching but found engagement dropped significantly. Although she redesigned her courses using low-bandwidth tools, she remains concerned about the digital divide and feels unsupported in her efforts to address it institutionally.

Relevant SETI Layers:

Macrosystem (national infrastructure), Exosystem (institutional policy), Student experience (equity)

Reflective Question:

How can faculty surface digital equity issues as institutional priorities rather than isolated instructional problems?

Case Study B: Faculty Frustration with Support Gaps

Scenario:

Dr. Allen, a senior lecturer in a large urban university, has adopted a blended model for his introductory sociology course. Despite his interest in using video feedback and discussion tools, he finds himself repeatedly delayed by unresolved technical issues. The university's IT helpdesk is understaffed, and faculty training is only offered at the start of the academic year. As a result, he has reverted to more basic tools, compromising his original pedagogical goals.

Relevant SETI Layers:

Microsystem (access to support), Exosystem (institutional investment), Educator beliefs (adaptive practice)

Reflective Question:

What structural changes within the institution could be proposed to prevent skilled educators from scaling back innovation due to inconsistent support?

Case Study C: Cultural Perceptions and Parental Influence

Scenario:

Dr. Wang is a faculty member in a teacher education program that includes practicum partnerships with local schools. She noticed that student teachers report resistance from parents when using online tools in early childhood settings. Parents believe screen time is inappropriate for young learners, regardless of pedagogical intent. This resistance has led some schools to limit student teachers' use of digital platforms entirely.

Relevant SETI Layers:

Macrosystem (cultural norms), Mesosystem (school-university partnership), Family (external perceptions)

Reflective Question:

In what ways can faculty work with institutional and community stakeholders to address sociocultural beliefs that shape attitudes toward educational technology?

6.4. SETI integration tracker

The SETI Integration Tracker is a practical tool designed to help educators and leaders monitor the conditions that support or hinder effective technology integration across the layers of the socio-ecological system. By regularly recording observations, identifying areas of strength or concern, and tracking actions taken, users can build a clear picture of how systemic factors influence digital teaching and learning over time.

TABLE 1. SETI integration tracker

SETI Domain	Indicator of Integration	Current Status(Red / Amber / Green)	Evidence or Notes	Action Taken / Planned	Date Reviewed
Educator (Core)	Educator beliefs and confidence in using digital tools		e.g., survey responses, reflection notes, observed practices		
Microsystem	Availability of reliable devices and infrastructure in immediate teaching context		e.g., classroom audits, reported incidents, access logs		
Microsystem	Access to real-time technical and pedagogical support		e.g., IT response time, staff feedback		
Microsystem	Alignment of tools with course-level teaching objectives		e.g., LMS usage reports, curriculum mapping		
Mesosystem	Coordination of tools, policies, and practices across departments or programs		e.g., use of shared platforms, consistent guidelines		

Exosystem	Institutional support (e.g., PD opportunities, help desk, funding)		e.g., availability of workshops, budget allocations		
Macrosystem	National or institutional culture and policy alignment		e.g., curriculum flexibility, policy mandates, cultural attitudes		
Student Impact	Evidence of student access, participation, and engagement in technology-supported learning		e.g., LMS analytics, feedback surveys, attendance		
Advocacy Action	Has this domain required systemic advocacy or escalation?		e.g., memos, leadership briefings, departmental resolutions		

These tools offer practical mechanisms to support the implementation of the SETI framework across various educational settings. They facilitate structured reflection, enable the identification of systemic factors affecting technology integration, and support evidence-informed planning and advocacy aligned with institutional and policy contexts.

7. Conclusion

In this paper, the Socio-Ecological Technology Integration (SETI) framework is highlighted as a systems-level model for understanding and supporting effective digital integration in education. By situating the educator within a broader ecological structure, comprising classroom realities, institutional infrastructure, community expectations, and national policy, SETI expands the analytical lens beyond the individual practitioner. It addresses a longstanding limitation of earlier models by emphasizing that meaningful technology integration is not the sole responsibility of educators but a collective endeavor requiring systemic coordination. To support implementation, a set of SETI-aligned tools has been introduced, including the SETI systems reflection tool, advocacy planning guide, case studies, and integration tracker. These resources offer practical entry points for educators and educational leaders to identify systemic barriers, reflect on practice, advocate for necessary change, and align technology use with broader institutional goals. In doing so, they operationalize the theoretical dimensions of the SETI framework and promote its application in both K–12 and higher education contexts.

As educational systems worldwide continue to evolve in response to technological advancements, the SETI framework provides a timely and necessary perspective, one that acknowledges the complexity of technology integration and foregrounds the interdependence of actors and structures. Its application enables stakeholders at all levels to make informed, strategic decisions that support sustainable, contextually grounded, and pedagogically meaningful integration of digital technologies in education.

Author's contributions

Helen CROMPTON: Conceptualization, visualization, investigation, data processing, writing – original draft, review & editing.

Artificial intelligence (AI) policy

The author declares that no artificial intelligence (AI) tools have been used in the preparation process of this manuscript.

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