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Educational technology and the everyday information practices that shape student thinking and learning

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Abstract

Introduction. As technology becomes increasingly embedded in K–12 classrooms worldwide, it is essential to understand teachers’ and students’ everyday information practices—especially in light of declining student engagement and the urgent calls to foster critical thinking. This study draws on the expanded everyday information practices model (Savolainen & Thomson, 2022) and the substitution, augmentation, modification, redefinition (SAMR) model (Puentedura, 2009) to examine how teachers and their students seek, create, use, and share information in technology-rich classrooms, and how these practices relate to beliefs and cognitive outcomes.

Method. Using survey data from 9,627 teachers in 245 schools across 28 countries voluntarily participating in the Apple Distinguished Schools program, this study uses descriptive statistics and correlations to analyse 15 classroom information practices and eight pedagogical beliefs.

Results. Findings reveal three key patterns: (1) average frequency of information practices do not necessarily align with teachers’ perceptions of students’ critical thinking or complex problem-solving; (2) expanded everyday information practices categories alone do not predict cognitive outcomes. Information practices aligned with SAMR’s upper levels—are more strongly associated with those outcomes; and (3) teacher beliefs tend to mirror use frequency.

Conclusion. This study bridges educational technology and information science by offering new insights into how everyday classroom information practices shape teaching and learning.

Introduction

In today's Kindergarten-Grade 12 (K-12) classrooms, where technology is increasingly embedded in everyday information practices, it is important to understand how teachers interact with information. Classroom information practices—the routines through which educators and students seek, create, use, and share information—play a central role in shaping students' learning experiences and the development of higher-order skills such as critical thinking and complex problem-solving. This may include sending and receiving emails, streaming videos, and viewing and uploading assignments to learning management systems. While access to digital tools has expanded globally over the past several decades through initiatives like one-to-one (1:1) computing programs (Watters, 2015), it is not simply the presence of or access to technology, but how it is used as part of pedagogical routines that determines its impact.

There remains limited knowledge about how K-12 students and educators engage in everyday information practices in technology-rich classrooms—particularly how those practices relate to pedagogical beliefs and to student learning outcomes such as critical thinking and complex problem-solving. Recent studies have explored the information practices of teachers in specific national contexts (e.g., Hanif & Warraich, 2023) and of higher education academics and researchers (Alon, 2025; Willson et al., 2024a; Willson et al., 2024b), but to our knowledge, no large-scale, cross-national dataset exists that captures everyday information practices in K-12 classrooms.

This gap limits our understanding of how technology is meaningfully (or superficially) integrated into classrooms and how it impacts students and teachers in various contexts. Without this knowledge, information science research may overlook the complex social and cognitive dynamics of classroom information practices, while educational technology research may continue to focus on access and infrastructure rather than the nuanced ways in which information practices shape learning. Addressing this gap allows for a more robust account of digital integration in schools—one that links what teachers do with what they believe, and how those beliefs may (or may not) support higher-order student outcomes.

This study builds on the work of Bebell and Burt (2025), which examined teacher practices and beliefs in relation to student engagement. Expanding that foundation, the present study adopts an information science lens to investigate everyday information practices in K-12 classrooms globally. Specifically, it explores how these practices reflect—or diverge from—teachers' beliefs and how they relate to perceptions of students' critical thinking and complex problem-solving. In doing so, this paper aims to highlight the socio-technical dynamics shaping contemporary classrooms and extend the conversation from engagement to the deeper cognitive dimensions of learning.

The research is guided by the following questions:

- RQ1: What are the most and least frequently reported classroom information practices among teachers in this study?
- RQ2: Which information practices are most strongly associated with teachers' perceptions of students' critical thinking and complex problem-solving?
- RQ3: How do teachers' information practices relate to their beliefs about technology and learning?

This study draws on Savolainen's work on everyday life information seeking (1995), everyday information practices (EIP) (2008), and the expanded model for everyday information practices developed by Savolainen and Thomson (2022), which frames information practices as socially situated and often habitual. The expanded everyday information practices model provides a structure for classifying practices into two broad domains: 'acquiring' (e.g., information seeking and information use) and 'expressing' (e.g., information creating, information use, and information sharing). This classification structure supports a more nuanced analysis of how teachers' routine

engagements with information may influence the learning environments they shape. The study also draws on influential educational technology models such as SAMR (Substitution, Augmentation, Modification, and Redefinition) to analyse the pedagogical depth of technology use and provide a more well-rounded lens on everyday information practices in K-12 classrooms.

Literature review

Conceptual foundations

This section synthesizes research on two core constructs in information science: information behaviour and information practices. Although often used interchangeably, these terms describe distinct dimensions of how individuals interact with information (Savolainen, 2007). Information behaviour describes goal-directed, individual actions, while information practices describe the socially embedded, routine activities shaped by cultural, institutional, and technological contexts. By clarifying these definitions and their points of convergence, this review aims to distinguish information practices from general classroom routines and emphasize their informational and socio-technical dimensions within educational settings.

Savolainen's ELIS framework (1995) first foregrounded how individuals navigate information needs within the routines of daily life, capturing the interplay of context, tasks, and situational constraints. Savolainen expanded this model to EIP (2008), emphasizing not only information seeking, but also its use, sharing, and contextual embedding (McKenzie, 2003; Talja, 2005). The more recent expanded everyday information practices model (Savolainen & Thomson, 2022) further enriches this perspective by integrating information creating and distinguishing between information use for 'acquiring' and 'expressing'. In digitally mediated settings—such as K-12 classrooms—expanded everyday information practices is especially apt for exploring how teachers' and students' everyday information practices with and without technology are shaped by access to institutional tools, policies, and pedagogical beliefs.

While ELIS and EIP have been applied in various professional and cultural settings, their use in classroom studies remains limited. Large-scale, comparative studies of information practices across educational systems are rare. This gap limits the field's ability to understand how classroom information practices vary across contexts of policy, resource constraints, or pedagogical cultures.

Teacher beliefs

In both educational research and information behaviour research, beliefs—including attitudes, values, and self-efficacy—are frequently conceptualized as moderators of practice (Ajzen, 1991). Teachers who believe that technology can support inquiry, autonomy, or higher-order thinking may be more likely to adopt complex, expressive information practices. In contrast, those who view technology primarily as a delivery tool may restrict its use to more basic or procedural tasks. A substantial body of research documents persistent gaps between pedagogical beliefs and classroom practice: while educators often express support for student-centred or constructivist learning, they may default to teacher-directed instruction due to structural constraints such as limited time, accountability demands, or prescriptive curricula.

Technology, information practices, and higher-order thinking skills

Higher-order thinking skills, like critical thinking and complex problem-solving, are widely regarded as central aims of education (Bailin, 2002; Radulović & Stančić, 2017; Rezaei et al., 2011). Rather than simply recalling facts, these skills involve analysing information, evaluating evidence, and generating reasoned judgments. Critical thinking, for instance, has been described as the ability to apply logic, inference, and evaluation to assess whether claims are supported by sound reasoning (O'Reilly et al., 2022). Complex problem-solving builds on these processes, requiring learners to navigate open-ended, often ill-defined challenges that demand strategic decision-making and adaptability. In this study, these cognitive capacities are treated not as abstract outcomes but as embedded in everyday information practices—raising questions about how

classroom information practices may support or constrain students' development of these essential skills.

As 1:1 computing and other forms of classroom technology become more pervasive, both the affordances and limitations have been documented in educational technology research.

Technology can foster collaboration, access to global knowledge, scaffolding, differentiated instruction, and student agency. But persistent critique and caution accompany these claims. For example, Longcamp et al. (2005) show that handwriting engages motor and memory circuits differently than typing, which may have developmental implications in early education. Yanguas (2020) draws attention to cognitive load and distraction when students juggle device interfaces. More recent observers (e.g., Korbey, 2023; Jargon, 2024) raise concerns that increased screen time may erode capacity for deep reading, reflection, or face-to-face interaction. Ihara et al. (2021) warn that technology-heavy instruction may constrain emotional or social development, while recent neuroscience-informed critiques (Froud et al., 2024) suggest early learners may be particularly vulnerable to overstimulation.

These risks are compounded by a persistent challenge in educational technology: not access itself, but implementation. When untested tools or methods are adopted without sufficient research, training, or pedagogical fit, even well-resourced classrooms can fall short. A historical example lies in early efforts to teach students how to evaluate online sources using checklists like the Currency, Relevance, Authority, Accuracy, Purpose test (Blakeslee, 2004), which, while widely adopted, were ultimately found to be less effective than anticipated when compared to lateral reading strategies (Fielding, 2019; Wineburg & McGrew, 2019).

This cautionary tale is particularly salient today, as schools, especially in the global north, confront the rapid influx of generative artificial intelligence (AI). Educators face mounting pressure to adopt emerging tools, often without adequate support, training, or clarity on pedagogical value. Generative AI is an 'arrival technology' (Reich & Dukes, 2024)—it sometimes enters schools uninvited and immediately demands attention, often outpacing the researcher training needed to understand its impact. Without rigorous evaluation, there is a risk that today's digital innovations will follow the same path as past missteps—adopted widely, yet pedagogically shallow.

Educational technology frameworks

Educational technology frameworks like the SAMR model are widely used in both research and classroom practice. The SAMR model (Substitution, Augmentation, Modification, Redefinition), shown in Table 1, offers a scaffolded view of how technology can transform teaching and learning—from simple substitution of analog tools to the fundamental redefinition of learning tasks (Puentedura, 2009). The model was first introduced by Ruben Puentedura, as a framework to intentionally evaluate and integrate educational technology based on its pedagogical intention and impact.

Since its introduction, the SAMR model has been widely applied in various educational contexts such as professional development, technology integration planning, and instructional design. Some of its benefits include its accessibility, intuitive visual structure, and appeal for guiding teacher reflection. However, SAMR has been criticized for its rigid hierarchical structure and emphasis on product over process, often neglecting the socio-pedagogical contexts in which technology use occurs (Hamilton et al., 2016). While models like SAMR are valuable for considering the depth of technology integration, they are not expressly designed to explain the routines, motivations, and contextual factors that shape how digital practices actually unfold in classrooms.

SAMR Level	Definition	
Substitution	Technology is a direct substitution for an existing tool without functional improvements.	Enhancement
Augmentation	Technology replaces a tool and improves its functionality.	
Modification	Technology significantly redesigns how a task is performed.	Transformation
Redefinition	Technology enables new tasks that were not previously possible.	

Table 1. Puentedura's (2009) Substitution, Augmentation, Modification, and Redefinition (SAMR) Model

This study therefore adopts Savolainen and Thomsons' (2022) expanded everyday information practices framework as its primary analytical lens, given its alignment with the study's focus on everyday classroom information practices. expanded everyday information practices allows for the classification of these practices into 'acquiring' and 'expressing' categories and emphasizes their socio-technical, habitual, and context-dependent nature. SAMR is used, in this study, in a complementary capacity to consider the potential cognitive depth of each information practice. Rather than evaluating whether a teacher is working at the 'Redefinition' level, this study investigates how their recurring information practices align (or misalign) with teachers' beliefs and students' educational outcomes such as critical thinking and complex problem-solving.

Gaps and the case for this study

Although substantial literature addresses technology access, teacher beliefs, and classroom interventions, three gaps remain:

1. Scale and context diversity: Few studies examine classroom information practices in K-12 across multiple countries or contexts, limiting generalizability and theory-building.
2. Belief-practice-cognitive linkages: Scholars seldom model how beliefs influence information practices and, in turn, relate to teacher perceptions of student higher-order thinking skills.
3. Informational science framing: Many educational technology studies focus on tools or tasks; few analyse the information flows and patterns that underlie those tasks. Expanded everyday information practices provides an analytical vocabulary to do so.

This study advances theory in information science (engaging expanded everyday information practices in educational contexts) and adds contextual factors to educational technology scholarship (by re-centring practice over novelty).

Methodology

The survey instrument was developed by the research team based on prior large-scale educational technology studies (Bebell et al., 2010; LEGO, 2024). All data were collected voluntarily and anonymously by K-12 classroom teachers who provided active consent to have their results analysed and shared in a non-personally identifying manner.

All teacher participants were part of the Apple Distinguished Schools program, and approval for the study was granted by Apple Inc.'s legal team. The Apple Distinguished Schools program includes over 1,000 K–12 public and private schools in over 40 countries and is voluntary. While each school varies in mission, leadership, and pedagogy, they are all alike in adopting technology to encourage collaboration, innovation, and student engagement (Apple Distinguished Schools, 2025). The current criteria for program inclusion includes:

- Schools must participate in a one-to-one device program for at least two academic years.
- Educators integrate technology creatively and meaningfully into their curriculum (Apple Distinguished Educators, 2025).
- In regions where it is available, at least 75% of teachers hold Apple Teacher distinction.
- Each school demonstrates continuous improvement and positive student outcomes.

The 15-minute Qualtrics-hosted questionnaire was distributed via email invitation to Apple Distinguished Schools school leadership. Schools that responded received further information and a link to the online teacher survey. Survey items covered a range of topics, including teacher demographics, access to technology, frequency and types of classroom technology use, and beliefs. All questions were optional, resulting in variable response rates across items. The survey featured a mix of closed-ended Likert scale and frequency-based items, along with two open-ended questions designed to capture insights on technology limitations and innovative practices.

The initial dataset contained 18,243 individual classroom teacher responses from November 2021 through June 2024, but 1,165 entries were excluded during data cleaning, including responses with less than 40% survey completion. Of the remaining 17,078 responses, 94% of respondents completed the entire survey and 6% completed it partially, with at least a 41% completion rate. Only classroom teachers were included in the final sample; non-instructional staff were excluded unless they noted that they are actively teaching in some part of their role within the schools.

Although the survey was administered over three years, the items related to information practices were most stable and comparable in the 2023 and 2024 versions. As such, this study draws exclusively on data from those two years ($n = 9,627$). While the full survey included a wide range of items and two open-ended questions, this analysis focuses on a targeted subset: 15 items related to information practices, two questions about higher-order thinking (critical thinking and complex problem-solving), and eight items assessing beliefs. Information practices and higher-order questions were rated on a 7-point frequency scale ranging from Never (0) to Everyday (6), while belief items used a 5-point Likert scale ranging from No Impact (0) to Major Impact (4).

The information practices questions were first categorized using the expanded everyday information practices framework. The survey questions were divided into two overarching types: eight 'acquiring' questions and seven 'expressing' questions. These were further broken down into subcategories: information seeking and information use (for 'acquiring'), and information creating, information use, and information sharing (for 'expressing').

This exploratory study primarily relies on descriptive statistics and correlation analysis. Descriptive statistics were computed for all key variables, and Spearman's rho correlations were used to assess relationships between information practices, critical thinking, and complex problem-solving.

Participants

All respondents taught in schools enrolled in the Apple Distinguished Schools program. While the sample is large and represents a number of teachers, schools, countries, and experiences, this study is not intended to represent the generalized population of any community. Instead, it is a snapshot of the ADS schools who volunteered to participate. There is currently no shared curriculum, intervention, or other characteristics among these schools beyond their 1:1 device

programs and Apple Distinguished Schools affiliation. As such, this analysis is meant to be exploratory and descriptive.

In total, n = 9,627 responses were analysed across 245 schools in 28 countries, including fourteen schools that participated in 2023 and 2024. Table 2 provides a breakdown of responses by country. The greatest number of responses were from the United States (33.9% of responses), Mexico (22.98% of responses), and the United Kingdom (6.5% of responses).

Country	Number of Responses	% of Responses
United States	3264	33.90%
Mexico	2212	22.98%
United Kingdom	626	6.50%
Malaysia	409	4.25%
United Arab Emirates	365	3.79%
Brazil	357	3.71%
Australia	286	2.97%
India	286	2.97%
South Africa	279	2.90%
Japan	245	2.54%
Thailand	186	1.93%
Singapore	156	1.62%
Philippines	149	1.55%
Chile	138	1.43%
New Zealand	138	1.43%
Italy	129	1.34%
Hong Kong	90	0.93%
Portugal	82	0.85%
Canada	51	0.53%
Germany	39	0.41%
Sweden	39	0.41%
Taiwan	37	0.38%
Turkey	31	0.32%
South Korea	23	0.24%
Switzerland	5	0.05%
China	3	0.03%
Austria	1	0.01%
Finland	1	0.01%

Table 2. Number of responses by country (2023-2024).

Respondents represented a wide range of grade levels (as shown in Table 3), including early years, elementary, middle, and high school educators. The greatest number of responses came from high school teachers (n = 3934), and the lowest came from those teaching early years (n = 1553) Because some teachers reported teaching across multiple grade levels, the total number of grade-level responses exceeds the number of individual participants.

Grade Level	Number of Responses
Early Years (Early Years, Pre-K, Kindergarten)	1553
Elementary (Grades 1-5)	3611
Middle (Grades 6-8)	3496
High (Grades 9-12)	3934

Table 3. Number of responses by grade level (2023-2024)

As shown in Table 4, teachers reported primary subject areas taught, with options reflecting core academic and specialty areas. Note that totals exceed the total study population because many respondents reported teaching multiple grade levels. The largest number of survey responses were ‘Language arts, literature, writing, ELA’ teachers (n = 2486) and ‘mathematics’ teachers (n = 2146) while the fewest number of responses came from those who teach ‘Computer Science / Digital Technologies / Digital Solutions’ (n = 243) and ‘PE, health, athletics’ (n = 511).

Subject Area	Number of Responses
Language arts, literature, writing, ELA	2486
Mathematics	2146
Self-contained classroom (multiple subjects)	1679
Humanities: History, social studies, geography	1614
Sciences: Biology, chemistry, physics	1573
Languages: Foreign, world, non-native language	1201
Other	1138
Art, music, drama	769
Special education, learning support	652
PE, health, athletics	511
Computer Science / Digital Technologies / Digital Solutions	243

Table 4. Number of responses by subject area (2023–2024). Totals exceed n because respondents could select more than one subject area.

Responses also reflected broad participation across early- to late-career educators, with a slight increase in representation among those in their early years of teaching, followed by a gradual decline as years of experience increased.

Results

Table 5 presents the mean frequency of each information practice included in this study, along with its classification under the expanded everyday information practices model. Mean scores ranged from 0.84 to 5.02 on a 0–6 scale. The most frequently reported information practice was ‘using technology to communicate with students’ families’ (mean = 5.02, SD = 1.611), followed by ‘using iPad/MacBook to deliver or share feedback with students’ (mean = 4.10, SD = 1.895). Both of these fall under the ‘expressing’ category—specifically, information sharing.

Other practices in the top five included ‘researching a topic using the internet’ (‘acquiring’, information seeking; mean = 3.92, SD = 1.961), and ‘creating or capturing digital images for use/sharing’ (‘expressing’, information creating; mean = 3.82, SD = 1.919).

The least surveyed practices included ‘using robotics, a maker space, or a 3D printer’ (‘expressing’, information use; mean = 0.84, SD = 1.587), ‘connecting with industry experts’ (‘acquiring’, information seeking; mean = 1.08, SD = 1.587), ‘analyzing digital content for bias or validity’ (‘acquiring’, information use; mean = 2.55, SD = 2.144), and ‘creating audio or video using iPad/MacBook’ (‘expressing’, information creating; mean = 2.96, SD = 2.144).

Of the top four most frequent practices, three were ‘expressing’ and one was ‘acquiring.’ Among the four least frequent practices, two were ‘expressing’ and one was ‘acquiring.’ This distribution suggests that there is no clear pattern in terms of overall frequency between ‘expressing’ and ‘acquiring’ practices. However, a notable trend is that more complex or demanding information practices—those that require specific skills, technological expertise, or access to specialized resources—tend to occur less frequently than practices that primarily require access alone.

E-EIP Component	E-EIP Subcomponent	During this past school year, how often did you perform the following:	n	Mean	Std. Deviation
Acquiring	Information Seeking	Ask your students to research a topic using the Internet.	6,478	3.92	1.961
Acquiring	Information Use (A)	Assess/test/quiz students using iPad/MacBook.	6,515	3.81	1.875
Acquiring	Information Use (A)	Ask your students to practice self-directed learning.	6,444	3.80	1.900
Acquiring	Information Use (A)	Ask your students to take notes using iPad/MacBook in class.	6,485	3.70	2.281
Acquiring	Information Use (A)	Ask your students to play digital games related to their learning/curriculum.	6,458	3.32	2.037
Acquiring	Information Use (A)	Ask your students to maintain a digital organizer/calendar.	6,454	3.07	2.510
Acquiring	Information Use (A)	Ask your students to analyse digital content for bias/validity.	6,436	2.55	2.144
Acquiring	Information Seeking	Ask your students to connect with industry experts. (2024 ONLY).	2,866	1.08	1.587
Expressing	Information Sharing	Use technology to communicate (emails, texts, website, social media, etc.) with my students' families.	6,521	5.02	1.611
Expressing	Information Sharing	Use iPad/MacBook to deliver/share feedback with your students.	6,499	4.10	1.895
Expressing	Information Creating	Ask your students to create or capture digital images for use/sharing.	6,450	3.82	1.919
Expressing	Information Creating	Ask your students to showcase their creativity using technology. (2024 ONLY)	2,877	3.08	2.004
Expressing	Information Sharing	Ask your students to peer teach (give presentations to the class).	6,477	3.02	2.026
Expressing	Information Creating	Ask your students to create audio or video using iPad/MacBook.	6,475	2.96	1.933
Expressing	Information Use (E)	Ask your students to use robotics, a maker space, or a 3D printer.	6,444	0.84	1.587
Expressing	Information Sharing	Use technology to communicate (emails, texts, website, social media, etc.) with my students' families.	6,521	5.02	1.611
Expressing	Information Sharing	Use iPad/MacBook to deliver/share feedback with your students.	6,499	4.10	1.895

Table 5. Mean frequency of classroom practices by expanded everyday information practices component

E-EIP Subcomponent	During this past school year, how often did you perform the following	Mean	Correlation to Critical Thinking	Correlation to Complex Problem-Solving
Information Seeking	Ask your students to research a topic using the Internet.	3.92	$\rho = .39$	$\rho = .37$
Information Use (A)	Assess/test/quiz students using iPad/MacBook.	3.81	$\rho = .31$	$\rho = .34$
information Use (A)	Ask your students to practice self-directed learning.	3.80	$\rho = .48$	$\rho = .47$
Information Use (A)	Ask your students to take notes using iPad/MacBook in class.	3.70	$\rho = .35$	$\rho = .36$
Information Use (A)	Ask your students to play digital games related to their learning/curriculum.	3.32	$\rho = .28$	$\rho = .30$
information Use (A)	Ask your students to maintain a digital organizer/calendar.	3.07	$\rho = .32$	$\rho = .33$
information Use (A)	Ask your students to analyse digital content for bias/validity.	2.55	$\rho = .45$	$\rho = .44$
information Seeking	Ask your students to connect with industry experts. (2024 ONLY).	1.08	$\rho = .35$	$\rho = .41$

Table 6. Spearman's correlations showing the relationship between 'acquiring' information practices, critical thinking, and complex problem-solving

E-EIP Subcomponent	During this past school year, how often did you perform the following	Mean	Correlation to Critical Thinking	Correlation to Complex Problem-Solving
Information Sharing	Use technology to communicate (emails, texts, website, social media, etc.) with my students' families.	5.02	$\rho = .23$	$\rho = .23$
Information Sharing	Use iPad/MacBook to deliver/share feedback with your students.	4.10	$\rho = .35$	$\rho = .36$
Information Creating	Ask your students to create or capture digital images for use/sharing.	3.82	$\rho = .39$	$\rho = .40$
Information Creating	Ask your students to showcase their creativity using technology. (2024 ONLY)	3.08	$\rho = .51$	$\rho = .50$
Information Sharing	Ask your students to peer teach (give presentations to the class).	3.02	$\rho = .38$	$\rho = .40$
Information Creating	Ask your students to create audio or video using iPad/MacBook.	2.96	$\rho = .32$	$\rho = .34$
Information Use (E)	Ask your students to use robotics, a maker space, or a 3D printer.	0.84	$\rho = .24$	$\rho = .28$

Table 7. Spearman's correlations showing the relationship between 'expressing' information practices, critical thinking, and complex problem-solving

To explore how information practices might support deeper learning, this study examined the relationships between the frequency of specific classroom practices and two teacher-reported

outcomes: students' critical thinking and complex problem-solving. Using the expanded everyday information practices model as an analytical framework, each practice was initially categorized as either 'acquiring' (information seeking or information use) or 'expressing' (information creating, information use, or information sharing). These were then correlated with critical thinking and complex problem-solving scores using Spearman's rho to identify patterns.

The research team hypothesized that expressive practices, especially those involving information creation or sharing, would correlate more strongly with higher-order thinking outcomes. This held true in part: the practice of 'Showcasing creativity using technology'—an expressive, information-creating activity—was most strongly associated with both critical thinking ($\rho = .51$) and complex problem-solving ($\rho = .50$). However, several 'acquiring' practices not typically associated with expression—such as 'Practicing self-directed learning' and 'Analyzing digital content for bias'—also showed strong correlations to critical thinking and complex problem-solving.

These findings suggest that the 'expressing'/'acquiring' distinction within expanded everyday information practices may not sufficiently capture the complexity of these tasks. What appears more significant is the nature of the activity itself—specifically, whether it demands analysis, synthesis, autonomy, or creativity. In this way, tasks traditionally labelled as 'acquiring' may still be cognitively rich and supportive of critical thinking when they involve student-driven learning or evaluative reasoning.

Furthermore, task frequency did not necessarily predict higher-order thinking outcomes. For example, 'Using technology to communicate with families' had the highest mean frequency ($M = 5.02$) but showed the weakest associations with critical thinking and problem-solving ($\rho = .23$). In contrast, less frequent practices such as 'Connecting with industry experts' or 'Creating audio or video using iPad/MacBook' demonstrated stronger relationships with these outcomes.

Because the expanded everyday information practices classification alone did not yield consistent explanatory power, this study also draws on the SAMR model (Puentedura, 2009) to further interpret the findings. SAMR outlines four levels of technology integration—Substitution, Augmentation, Modification, and Redefinition.

In the next section, the SAMR model will be used to map the 15 information practices examined here in greater detail. While expanded everyday information practices offers a valuable lens for understanding how information flows in everyday classroom contexts, SAMR may better account for the instructional design and cognitive demands of these practices in technology-rich classrooms.

SAMR Model

An analysis of the frequency of classroom information practices (Table 8) reveals several clear patterns in how digital tools are integrated into instruction. Practices situated at the lower end of the SAMR model, particularly those classified as Substitution or Augmentation, occurred more frequently than those requiring Modification or Redefinition. For instance, using technology to communicate with students' families ($M = 5.02$, $SD = 1.611$) and using an iPad/MacBook to deliver feedback ($M = 4.10$, $SD = 1.895$) were among the most common practices, and both fell within the Substitution and Augmentation tiers of SAMR.

SAMR	During this past school year, how often did you perform the following	n	Mean	Std. Deviation
Substitution & Augmentation	Use technology to communicate (emails, texts, website, social media, etc.) with my students' families.	6,521	5.02	1.611
Augmentation	Use iPad/MacBook to deliver/share feedback with your students.	6,499	4.10	1.895
Augmentation	Ask your students to research a topic using the Internet.	6,478	3.92	1.961
Augmentation & Modification	Ask your students to create or capture digital images for use/sharing.	6,450	3.82	1.919
Substitution & Augmentation	Assess/test/quiz students using iPad/MacBook.	6,515	3.81	1.875
Modification	Ask your students to practice self-directed learning.	6,444	3.80	1.900
Substitution	Ask your students to take notes using iPad/MacBook in class.	6,485	3.70	2.281
Augmentation & Modification	Ask your students to play digital games related to their learning/curriculum.	6,458	3.32	2.037
Redefinition	Ask your students to showcase their creativity using technology. (2024 ONLY)	2,877	3.08	2.004
Augmentation	Ask your students to maintain a digital organizer/calendar.	6,454	3.07	2.510
Modification	Ask your students to peer teach (give presentations to the class).	6,477	3.02	2.026
Modification & Redefinition	Ask your students to create audio or video using iPad/MacBook.	6,475	2.96	1.933
Modification & Redefinition	Ask your students to analyse digital content for bias/validity.	6,436	2.55	2.144
Redefinition	Ask your students to connect with industry experts. (2024 ONLY)	2,866	1.08	1.587
Redefinition	Ask your students to use robotics, a maker space, or a 3D printer.	6,444	0.84	1.587

Table 8. Mean frequency of classroom practices by SAMR categorization

Conversely, higher-order uses of technology—such as connecting with industry experts ($M = 1.08$, $SD = 1.587$) or using robotics and makerspaces ($M = 0.84$, $SD = 1.587$)—were among the least frequent, despite their placement in the Redefinition tier. While basic technology integration is now routine, these findings suggest more transformative, cognitively demanding applications remain underutilized.

SAMR	During this past school year, how often did you perform the following	Mean	Correlation to Critical Thinking	Correlation to Complex Problem-Solving
Substitution & Augmentation	Use technology to communicate (emails, texts, website, social media, etc.) with my students' families.	5.02	$\rho = .23$	$\rho = .23$
Augmentation	Use iPad/MacBook to deliver/share feedback with your students.	4.10	$\rho = .35$	$\rho = .36$
Augmentation	Ask your students to research a topic using the Internet.	3.92	$\rho = .39$	$\rho = .37$
Augmentation & Modification	Ask your students to create or capture digital images for use/sharing.	3.82	$\rho = .39$	$\rho = .40$
Substitution & Augmentation	Assess/test/quiz students using iPad/MacBook.	3.81	$\rho = .31$	$\rho = .34$
Modification	Ask your students to practice self-directed learning.	3.80	$\rho = .45$	$\rho = .47$
Substitution	Ask your students to take notes using iPad/MacBook in class.	3.70	$\rho = .35$	$\rho = .36$
Augmentation & Modification	Ask your students to play digital games related to their learning/curriculum.	3.32	$\rho = .28$	$\rho = .3$
Redefinition	Ask your students to showcase their creativity using technology. (2024 ONLY)	3.08	$\rho = .51$	$\rho = .50$
Augmentation	Ask your students to maintain a digital organizer/calendar.	3.07	$\rho = .32$	$\rho = .33$
Modification	Ask your students to peer teach (give presentations to the class).	3.02	$\rho = .38$	$\rho = .40$
Modification & Redefinition	Ask your students to create audio or video using iPad/MacBook.	2.96	$\rho = .32$	$\rho = .34$
Modification & Redefinition	Ask your students to analyse digital content for bias/validity.	2.55	$\rho = .45$	$\rho = .44$
Redefinition	Ask your students to connect with industry experts. (2024 ONLY)	1.08	$\rho = .35$	$\rho = .41$
Redefinition	Ask your students to use robotics, a maker space, or a 3D printer.	0.84	$\rho = .24$	$\rho = .28$

Table 9. Spearman's correlations showing the relationship between information practices, critical thinking, and complex problem-solving categorized by SAMR model types

Further, when examining how these practices correlate with higher-order thinking (Table 9), a value-use gap becomes apparent. Several practices with strong associations to critical thinking and complex problem-solving—such as showcasing creativity using technology ($\rho = .51/.50$), analysing digital content for bias ($\rho = .45/.44$), and connecting with industry experts ($\rho = .35/.41$)—ranked lower in terms of frequency. Meanwhile, more routine tasks like taking notes or communicating with families, though frequently practiced, showed weaker correlations with these cognitive outcomes.

Beliefs

Teacher respondents were also asked about their values and beliefs. In particular, the survey asked them to rate, on a 5-point Likert scale, the extent to which they felt a number of classroom practices and tools would impact them and their students. On this scale, 'No Impact' was coded as 0, and 'Major Impact' was coded as 4.

Belief	n	Mean	Std. Deviation	Variance
Social and emotional learning	6376	3.27	.955	.912
Personalized learning	6369	3.26	.916	.839
Learner autonomy	6363	3.11	.960	.922
Online learning	6376	2.84	1.086	1.180
Artificial intelligence (AI)	6373	2.76	1.222	1.494
Virtual reality/augmented reality (VR/AR)	6346	2.54	1.178	1.387

Table 10. Teacher beliefs about the impact of technology and learning experiences

As shown in Table 10, these belief data appear to mirror the frequency patterns seen in teachers' reported information practices (see Tables 5 and 8). Practices that align with more relational aspects of teaching, such as social-emotional learning ($M = 3.27$, $SD = .955$), personalized learning ($M = 3.26$, $SD = .916$), and learner autonomy ($M = 3.11$, $SD = .960$), were rated as having the highest impact. In contrast, beliefs about the impact of more advanced digital skills or technologies, such as spatial computing ($M = 2.35$, $SD = 1.242$), coding ($M = 2.41$, $SD = 1.262$), AR/VR ($M = 2.54$, $SD = 1.178$), and artificial intelligence (AI) ($M = 2.76$, $SD = 1.222$) were notably lower—and these correspond to the least frequently reported classroom practices, such as using robotics, maker spaces or 3D printers. This pattern suggests a relationship between what teacher beliefs and practices, especially in technology-rich environments where access is high but confidence or perceived relevance may vary by task complexity.

Discussion

The results of this study reveal connected patterns in how classroom information practices, teacher beliefs, and perceived student higher-order thinking are configured in technology-rich environments. First, the most frequently reported classroom information practices centred on simple communication, feedback, and research tasks, yet, as shown in Table 9, these same classroom information practices produced some of the weaker correlations with teachers' perceptions of students' critical thinking and complex problem-solving. In contrast, less frequent but more cognitively demanding practices—such as showcasing creativity, analysing digital content for bias, and self-directed learning—demonstrated stronger positive associations with those outcomes. This divergence suggests that frequency of use in classrooms does not necessarily align with cognitive impact.

Second, the standard deviations across most classroom information practices were high (ranging from 1.587 to over 2.510 on a 6-point scale), suggesting significant variability in how teachers interpret and implement these practices. This variability may reflect contextual differences across schools, subjects, regions, or access to technology.

Third, the 'expressing' and 'acquiring' distinctions (per expanded everyday information practices) did not readily map to frequency or impact on thinking outcomes. While expressive practices like showcasing creativity yielded high correlations ($\rho = .51 / .50$), certain acquiring practices—namely analysing bias or facilitating self-directed learning—also showed moderate to strong relationships ($\rho = .44-.47$). This implies that what matters most is not simply whether a practice is 'expressing' or 'acquiring,' but how much autonomy, critical judgment, or cognitive demand it affords. When we overlay these practices onto the SAMR framework, we see that high-impact practices (often with lower frequency) tend to align with Modification and Redefinition levels—those tasks that transform learning, according to Puentedura (2009)—whereas high-frequency, lower impact practices often fall into Substitution / Augmentation, offering convenience without deep reinvention.

Finally, teacher beliefs about instructional impact and emerging technologies appear to mirror frequency patterns for classroom information practices, yet they diverge from actual critical

thinking and complex problem-solving correlations. Teachers generally perceived social-emotional learning, learner autonomy, and personalized learning as more impactful—practices not inherently dependent on complex digital integration. Conversely, advanced digital practices like coding, AR/VR, and spatial computing were deemed lower in perceived impact and used infrequently. However, some of these latter practices (e.g., showcasing creativity with technology and analysing digital content for bias) often showed stronger positive relationships to critical thinking and complex problem-solving than many of the frequently adopted ones (e.g., communicating with families, offering feedback to students, and researching using the internet). This belief-practice-impact gap suggests that teachers may undervalue the potential of cognitively demanding digital practices because they lack exposure, confidence, training, or institutional support.

These findings contribute to both theory and practice. They show which classroom information practices are most and least frequent, clarify how these relate (or fail to relate) to higher-order thinking, and reveal how beliefs may constrain practice choices even when those practices have greater payoff for students' critical thinking and complex problem-solving skills. However, while these findings highlight meaningful associations between certain classroom information practices and perceived student outcomes, the cross-sectional design limits causal inference. It is equally plausible that teachers who perceive their students as already capable of critical thinking may be more inclined to assign cognitively demanding tasks such as showcasing creativity or analysing bias, rather than these tasks directly enhancing such skills.

The data supports some conclusions: the descriptive and correlation analyses intersect meaningfully with literature on the implementation gap, belief-behaviour gaps, and technology integration models (Howard & Mojeiko, 2015; Ertmer & Ottenbreit-Leftwich, 2010). This study corroborates previous findings about underuse of transformative technology but diverges by providing large-scale empirical links between specific information practices and student outcomes. It answers the research questions by showing which classroom information practices are most common (RQ1), which classroom information practices align most strongly with perceptions of critical thinking and complex problem-solving (RQ2), and how beliefs and classroom information practices relate (RQ3). Because this study spans multiple countries and leverages the expanded everyday information practices and SAMR frameworks, it offers a nuanced perspective on how to move beyond superficial technology adoption toward practices with real cognitive impact.

Conclusion

Thirty years after Savolainen's foundational work on everyday life information seeking, this study revisits the classroom to examine how teachers and students engage with information practices in a technology-saturated era. Drawing on a large international dataset, the findings reveal a misalignment: in technology-rich settings, high-frequency classroom information practices tend to be lower in cognitive demand, while less common classroom information practices show stronger associations with critical thinking and complex problem-solving. Beliefs also play a role: teachers were more confident in the impact of general pedagogical strategies than in digitally intensive ones.

These findings contribute to both educational technology and information science by empirically linking classroom information practices, especially technology-mediated information practices, to higher-order thinking—an area often theorized but rarely measured at scale. While this study benefits from a large dataset with teacher voices from many different backgrounds, it is not without limitations. The data are self-reported and cross-sectional, meaning they reflect perceptions at a single point in time rather than observed behaviour over time. Moreover, many of the classroom information practices were reported by teachers about their students, which introduces an additional layer of interpretation. Finally, the sample consists of schools

participating in a technology-forward, innovative initiative, which may reflect environments with greater access, infrastructure, or leadership support than average—though not necessarily universal teacher buy-in.

These factors should temper generalizations while highlighting the need for continued research into the lived realities of technology integration in classrooms, specifically from an information science and information behaviour perspective. To reverse declines in student engagement over time and as students age, (Bălătescu & Cernea-Radu, 2024; Gallup, 2024; von Davier et al., 2024), schools must move beyond infrastructure and prioritize the informational layer of teaching and learning. Future research may investigate how institutional support, exposure, and teacher preparation shape the adoption of cognitively rich practices. Additionally, future research may look into differences in information practices by various demographics, contexts, and settings.

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