The past and future technology in classroom management and school discipline: A systematic review

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Abstract:

Schools have marched into the digital age–but have classroom management and school discipline followed suit? Analyzing the content and methodologies of over two decades of empirical research in ERIC, this systematic literature review describes how the field has conceived of technology's roles in classroom management and school discipline. These roles include training teachers, supporting educators' day-to-day practices, and promoting self-discipline or self-regulation among students. A variety of tools were applied, including but not limited to videos, 3D simulations, and web-based apps. Strengths and limitations of this body of scholarship are discussed, including suggestions for keeping pace with emerging practices.

Keywords: classroom management | school discipline | teaching | classroom technologies

Article:

1. Introduction

Classroom management is essential to the work of teaching and learning. The costs of disruptive classroom behavior may be tallied in terms of negative effects on student learning, school climate, and teacher well-being (Aldrup, Klusmann, Lüdtke, Gö;llner, & Trautwein, 2018; Dinkes; Cataldi, & Lin-Kelly, 2007). Yet despite the importance of classroom management, some individual teachers or schools may find it difficult to maintain orderly and productive learning classroom environments. Adding complexity and urgency to the issue, recent scholarship has raised concerns that compliance-based or exclusionary school discipline approaches (e.g., suspensions) may be ineffective or applied disproportionately toward students of color, male students, and students identified for special education services (Irby, 2018, Lustick, 2018, Mansfield, Fowler, & Rainbolt, 2018, Mansfield, Rainbolt, & Fowler, 2018)

In considering the state of the field, two additional observations come to the forefront. First, there are various schools of thought when it comes to classroom management (e.g., ecological, behavioral, social-emotional) (Bear, 2015; Korpershoek, Harms, de Boer, van Kuijk, &

Doolaard, 2016; Osher, Bear, Sprague, & Doyle, 2010). For example, ecological approaches might address classroom environment (e.g., organizing classroom spaces and routines such that misbehavior is preempted). Behavioral approaches might emphasize tiered systems of support and intervention or other approaches to analysis and response. Yet others might emphasize students' social-emotional competencies and development. Yet, despite the popularity of such approaches, it is not necessarily clear how advancements in digital technologies might support them. After all, digital technologies have become ubiquitous in everyday life and interwoven into notions about educational improvement (Halverson & Smith, 2009; Hamilton, Rosenberg, & Akcaoglu, 2016).

Second, we observe that many practitioners have been quick to embrace technologies for classroom management. For example, the app known as ClassDojo© was launched by British entrepreneurs in 2011, but is now used in at least 90% of U.S. K-8 schools as well as by over 35 million students in over 180 countries (ClassDojo, 2017; Williamson, 2017). This app digitizes the implementation of token economies, such as those found in multi-tiered behavioral approaches. Less widespread, but no less novel, teachers can now practice classroom management in computer-simulated classrooms (e.g., Judge, Bobzien; Maydosz, Gear, & Katsioloudis, 2013) or connect with classroom management coaches online (Rock et al., 2013). In light of these and other changes, there is a pressing need for scholars and practitioners to view the landscape of possibilities when it comes to classroom management and technological advancement. This is especially so when considering that not every technological change is necessarily a panacea (e.g., Cuban, 2001; Hamilton et al., 2016). A more complete map of prior research would inform the field about the potential uses and contributions of technologies to classroom management.

Accordingly, the aim of this systematic literature review is to describe research at the intersection of technology and classroom management. Our examination of over two decades of scholarship was guided by two basic questions. First, what has been the role of technology in supporting classroom management and school discipline? Addressing this question involved examining not only the kinds of technologies used, but also the theory of change underlying their usage. Second, what methodologies have researchers employed toward exploring this intersection? Addressing this question yielded insight into the relative strengths and weaknesses within this body of research. Ultimately, we map the terrain of prior research, provide implications of new technological trends relating to school discipline, frame future research, and provide direction for the future development of technological innovations.

2. Methods

2.1. The literature search

Using the ERIC database, we focused our search on peer-reviewed scholarship published 1996–2017, a period documenting unprecedented advancements in digital technologies such as personal computers, email, digital cameras, smartphones, and Web 2.0. Therefore, scholarship from this period provided reasonable parameters to study classroom management and school discipline as it entered the digital age. Our approach to searching the literature spanned various bases. First, we employed the following terms: "discipline referrals", "behavior referrals,"

"behavior management," "classroom management," "discipline policy," and "school discipline." We also focused on scholars known to be conducting work involving discipline (e.g., Horner, Skiba, Sugai).

2.2. Selection of abstracts

After duplicates were removed, this initial search surfaced 2425 articles. Technology search terms were then applied in order to further refine our search (i.e. technology, computer, tools, online, video, software, web, system). This trimmed our results to 315 articles. Subsequently, abstracts and bibliographic information (and in many cases, full-length manuscripts) were then reviewed and additional criteria for inclusion were applied. For example, because this review focused on the content and methodologies involved in prior research, only empirical articles were included. That is, conceptual papers or papers advocating for a new technology without data collection or analysis were excluded. Further, we focused on digital or electronic technologies. Although filter terms such as "tool" and "technology" were helpful to an extent, articles employing the terms in general ways (e.g., survey instruments as a form of "tool; " everyday schooling as a form of social "technology") were omitted.

In a similar way, we excluded instances in which classroom management or discipline were given only nominal treatment. For example, some studies focused on the instructional uses for technologies (e.g., iPads; laptops), but mentioned classroom management skills vaguely (e.g., as a prerequisite to technology integration). Likewise, studies that simply mentioned researchers as the main users of technology (e.g., downloading datasets or conducting analyses about classroom management) were excluded. Thus, the final subset for this review included only pieces that empirically examined the potential roles of technology in classroom management and school discipline, with a total of 22 pieces meeting these criteria.

2.3. Analysis of the articles

After identifying these studies, we performed a content analysis of the full articles. In order to better understand the roles that have been envisioned for technologies in classroom management, we were informed by two theoretical paradigms. First, in line with sociotechnical perspectives (Latour, 2004; Leonardi, 2013; Orlikowski, 2000), we recognized that how people enact or implement particular technologies says something about how they see the world. For the analyst, this means seeing artifacts not only in terms of their material, but also in terms of agents' aims, practices, and theories of change. Examining the body of literature in this way resulted in three main categories: (A) tools for supporting teacher training or professional learning; (B) tools that might be integrated into the everyday work of teachers or administrators; and (C) tools for helping students with self-discipline and self-regulation. Given the large number of studies falling into the first category, we also sub-categorized studies about training or professional learning according to technology type (i.e., videos, interactive simulations, databases).

Second, our analysis was informed by current schools of thought about effective classroom management (Bear, 2015; Osher et al., 2010). Although not every technology study articulated a classroom management paradigm, when evidenced, these schools of thought helped us to additionally frame the practices or changes envisioned by researchers. *Ecological* perspectives

emphasize (re)designing classroom spaces and routines, such that opportunities for misbehavior are diminished. In employing ecological strategies, teachers orchestrate a sense of order, pacing, and cooperativeness, while also maintaining a strong sense of situational awareness or "withitness" (Doyle, 2006). *Social and emotional* (SEL) perspectives emphasize the promotion of prosocial behavior and self-discipline, often by fostering more positive relationships among community members (e.g., teacher-student, student-student, teacher-parent) (Bear, 2015). In this way, SEL models have been associated with a variety of outcomes, including but not limited to improved school climate, improved behavioral adjustment, and positive self-image (e.g., Sklad; Diekstra, Ritter, Ben, & Gravesteijn, 2012). Finally, *behavioral* perspectives encourage teachers to analyze misbehavior, subsequently applying various behavior modification techniques (e.g., positive reinforcement, punishment, token economies). Included in this perspective are tiered intervention models, such as Positive Behavioral Interventions and Supports (PBIS) (e.g., Sugai, O'Keeffe, & Fallon, 2012). The models encourage the use of data to help analyze the antecedents to behavioral problems, as well as to support the application and monitoring of rewards, consequences, and instruction about desired behaviors.

Finally, we examined the research methodologies employed within this body of research, analyzing the scholarship in terms of overall design type (e.g., qualitative, quantitative, mixed methods) and instrumentation (e.g., interviews; questionnaires), as well as issues potentially affecting the generalizability of the studies (e.g., sampling). Because the methodology sections for some studies were not explicit or detailed, we also examined the studies' findings more closely to better understand the research methodologies employed.

3. Results

The results of our analyses are conveyed in two major sections according to citation content and methodologies. The content analysis is further delineated thematically into three subsections: 1) supporting teacher training and professional development; 2) tools that educators might use in their daily work, and; 3) technology that is designed for helping students with self-discipline and self-regulation. The methodologies section summarizes the overall research design and instrumentation used in the studies we examined.

3.1. Content analysis

Content analysis revealed ways researchers have conceptualized the potential role technologies can play in classroom management and student discipline. In particular, we were interested in what kinds of technologies were attended to, how they were used, and by whom. In general, scholars have examined these technologies in terms of three broad categories: platforms that can be used for teacher training and/or professional development; instruments teachers and/or administrators can use for day-to-day operations; and tools students can use as a part of self-discipline and self-regulation. Analysis within each category also revealed a different model of logic regarding how and why technologies might benefit students' classroom behavior.

Supporting teacher training and professional learning with technology. The bulk of studies reviewed involved technologies intended to support teachers' acquisition of classroom management knowledge or skills. Specifically, nearly three-quarters (73%, n = 16) of the 22

articles included in this review focused on teacher training and professional development platforms (see Table 1). In many cases, the intent was to examine if such technologies might improve the delivery of classroom management curricula. In addition to a lack of discussion about specific content areas, the studies did not further indicate a specific approach; for example, whether ecological, behavioral, or social-emotional in nature. A variety of technology types were featured in these studies, including videos, interactive simulations, and databases, which are described next.

Table 1. Content and methodology of studies on supporting teacher training and professional learning.

Reference	Technology type	Methodology	Role of Technology	Key Outcomes
1. Video-based professional learning				
Baker et al. (2016)	Videos, with discussion board	Qualitative: 86 discussion posts from 13 first- or second-year teachers[a]	Videos and online discussion boards were used to supplement a one-day face-to-face classroom management training workshop	Participants, with support from their peers, learned classroom management techniques which decreased behavioral problems and improved relationships between teachers and students
Gazi and Aksal (2011)	Video	Qualitative: Open-ended written responses from 38 pre-service teachers	Video vignettes were used to spark reflection about participants' classroom management practices	Participants felt that video supported their learning about classroom management
Hicks-Hoste et al. (2015)	Video	Quantitative: Pre- and post-treatment survey of 18 after-school care providers	Using the *Incredible Years Teacher Classroom Management Program (IYTCM)*, video vignettes portrayed positive teacher interactions with students displaying problematic behaviors.	Positive effect on participants' attitudes about and applications of positive classroom management strategies
Marquez et al. (2016)	Videos, with online tools and resources	Quantitative: Pre- and post-treatment survey of 37 teachers Quantitative: Randomized control trial (pre-, post-, and follow-up test) of 101 teachers	The *Classroom Management in Action (CMA)* online PD program was used to train teachers on classroom management skills The *CMA* online PD program was used to train teachers on classroom management skills	Positive effects on teacher self-efficacy, classroom management practices, and satisfaction with the technology. Positive effects on classroom management knowledge, teacher self-efficacy, and satisfaction with the technology, but inconclusive effects on student behavior.
Sariscsany and Pettigrew (1997)	Video	Quantitative: Pre- and post-test of classroom knowledge of 77 pre-service teachers	Four treatments were compared: The *Interactive Video Classroom Management Training Program (IVCMTP)* containing video vignettes with interactive, computerized quizzes; teacher-directed use of video vignettes with worksheets; traditional face-to-face instruction; and a control group (no instruction).	Although all instructional had positive effects on classroom management knowledge, interactive video vignettes with quizzes were most effective. No significant differences were found between face-to-face

Reference	Technology type	Methodology	Role of Technology	Key Outcomes
				instruction and teacher-directed video.
Shernoff and Kratochwill (2007)	Video	Mixed-methods: Survey and interviews assessing 8 teachers' classroom management strategies and attitudes about the intervention, plus tallies of 13 students' problematic behaviors	Video vignettes were used to model classroom management strategies as a part of the *Incredible Years Classroom Management Program*	Positive effects on student behavior. Teachers who received professional consultation in conjunction with the videos reported higher rates of confidence and uses of strategies than those who only viewed videos.
Smith et al. (2012)	Video (3D animation and live action)	Quantitative: Survey assessing 55 pre-service teachers' identification of classroom management issues	Two approaches (live action and 3D animation) to delivering video vignettes from the *Decision Points* classroom management curricula were compared	Viewers of 3D and live action videos identified student behaviors with similar degrees of accuracy
Snoeyink (2010)	Video	Qualitative: Open-ended written responses from 8 pre-service teachers, plus a focus group interview with all participants	Participants viewed videos of themselves and their students' behaviors during a lesson in order to reflect upon their own "withitness" as teachers	Participants became more reflective about their instructional and classroom management practices, as well as more attuned to students' instructional and behavioral needs.
Youngblom and Filter (2013)	Video	Quantitative: Questionnaire assessed 37 pre-service teachers' identification of classroom management issues	Video vignettes of adults acting as if they were children were used to portray common classroom scenarios	Participants had difficulty accurately identifying student behaviors and the appropriate teacher responses
2. Interactive simulations				
Hummel et al. (2015)	Online card game	Quantitative: Questionnaires from 19 pre-service teachers	An online *Mastership* game was used to structure participants' conversations involving classroom management dilemmas	The online game resulted in similar learning outcomes as the face-to-face game, but with a lower rate of participant satisfaction
Judge et al. (2013)	Video and virtual environment	Quantitative: Frequency of 6 pre-service teachers' application of techniques	A video provided participants with direct instruction in behaviorist techniques; these were then applied in a computerized simulation of a classroom using *TLE TeachLive™ (Teaching Learning Environment, Teaching in a Virtual Environment)* technology	Although participants improved their uses of the techniques, they also critiqued the virtual environment's lack of realism
Lowdermilk, Martinez, Pecina, Beccera, and Lowdermilk (2012)	Virtual Environment	Mixed-Methods: Survey including open-ended responses from 89 pre-service teachers	A 3D game, *Behavior Breakthroughs™*, with computer simulated student requiring students to practice Applied Behavior Analysis	Positive effects on students' comfort with and appropriate application of ABA
Muir et al. (2013)	Virtual environment	Qualitative: Video footage and reflections	Participants simulated classroom interactions by role-playing student avatars in *Second Life (SL)™*, with the	Participants found the platform difficult to use, but were optimistic about

Reference	Technology type	Methodology	Role of Technology	Key Outcomes
		(oral and written) from 8 pre-service teachers	instructor and researcher playing the role of classroom teacher	its potential to support the modeling and practice of classroom management
Pas et al. (2016)	Virtual environment	Quantitative: Observations of and survey responses from (pre-, post-, and follow-up) 19 teachers (with 9 years teaching experience, on average)[b]	The *TeachLivE*[TM] mixed-reality virtual classroom environment allowed teachers to practice classroom management strategies, while instructional coaches worked one-on-one with teachers to develop performance improvement plans targeting specific classroom management behaviors	Teachers' classroom management strategies and students' classroom behaviors improved; teachers reported feeling comfortable using the virtual classroom environment
3. Databases				
Kurz and Batarelo (2010)	Video case library	Qualitative: Open-ended written responses from 27 pre-service teachers	Videos from the *Best Practices* database showcased various classroom instructional practices, including classroom management	Participants enjoyed observing real-life classrooms, but felt the videos did not adequately focus on practices for handling disruptive student behavior
Lee and Choi (2008)	Audio case library	Qualitative: Open-ended class essays from 23 preservice teachers; one focus group interview with 3 participants.	A case study library provided participants with various audio files relating to classroom management dilemmas	Participants enjoyed exploring multiple perspectives and approaches to problem solving

[a] Seven of the 13 teachers discontinued their participation before the 8-week training ended, so the sample size varied across the analysis.

[b] A complete data set for all three time periods was only available for 15 teachers: 19 had data at the baseline; 18 had data at the post study; and 15 had data at the follow-up.

Video-based professional learning. In total, nine studies focused on using video, making video the most prevalent teacher training platform in our review. Some studies examined using video to deliver instructional content. For example, Sariscsany and Pettigrew (1997) compared the effects of three approaches to delivering declarative knowledge to preservice teachers: face-to-face lectures, traditional video lectures, and interactive video vignettes (short clips with quiz questions). When compared to a control group, the interactive video vignettes were found to be most beneficial, whereas no significant differences were found between either mode of lecture. In a later study, Smith, McLaughlin, and Brown (2012) compared the use of 3-D animated vignettes with live-action visual examples, finding that users were able to identify student behavioral issues with similar degrees of accuracy in both cases. Also employing video vignettes, Youngblom and Filter (2013) tested the extent to which pre-service teachers could effectively label examples of "students" (adult actors) engaging in problematic behaviors (e.g., avoidance; attention seeking) and teachers' behavioristic responses (i.e., positive reinforcement, negative reinforcement, punishment). Findings from this study, however, were inconclusive. In general, the pre-service teachers were lackluster in their abilities to correctly identify "student" behaviors and teacher responses. Further, factors such as hours of coursework and other educative and professional experiences failed to predict participants' accuracy, and the authors acknowledged other limitations to this study, including those relating to their sampling and approach to video vignettes.

In other instances, videos were designed to spark self-reflection among teachers. For example, two studies involved video-taping pre-service teachers' classroom interactions for later viewing (Gazi & Aksal, 2011; Snoeyink, 2010). Thereafter, pre-service teachers were asked to reflect on and analyze their classroom management practices based on what they observed in the videos. In line with ecological perspectives on classroom management, both sets of participants found these videos useful for thinking about the routines and atmosphere of their classrooms, including the extent to which teachers monitored or exhibited "withithness" with students' needs. Consequently, pre-service teachers reported increased levels of self-awareness about their teaching and classroom management practices. Indeed, general conclusions of the video studies were that video platforms benefitted teachers' attitudes and analytical abilities and strengthened their application of classroom management techniques.

Notably, several of the studies in this review incorporated video as only one part of an overall package for supporting teacher learning. For example, two studies focused on a specific classroom management curriculum known as *The Incredible Years*® (Hicks-Hoste, Carlson, & Tiret, 2015; Shernoff; Kratochwill, 2007). In these studies, DVDs of video vignettes were used to model classroom management practices. However, mastery of this curriculum was also supported by other components, such as role-playing, reflection, and practice. In a similar way, the professional development program, *Classroom Management in Action*©, consisted of several components. The first component consisted of vignettes, how-to videos, and templates for planning ways to apply strategies. The other components included progress monitoring tools for assessing classrooms and individual students, as well as tip sheets for supporting teacher decision making (Marquez et al., 2016). Altogether, these studies suggest that video may help deliver content or provide viewers with a sense of realism when coupled with comprehensive learning aides.

Interactive simulations. Whereas the interactions with videos described above were largely limited to quiz questions or self-reflection, simulations may offer participants more interactive or richer situations in which to learn and practice classroom management skills. Perhaps the least interactive example involved a card game for facilitating peer discussions about classroom management dilemmas (Hummel, Geerts; Slootmaker; Kuipers, & Westera, 2015). In essence, this study compared outcomes from using the online version of the card game and the face-to-face version. Although learning outcomes where similar, online participants found this version less enjoyable.

Analysis showed other studies were more interactive, using computerization to simulate dynamic, virtual situations where participants could practice various approaches to classroom management. For example, J. Lowerdermilk, Martinez, Pecina, Beccera, and C. Lowdermilk (2012) describe how a computerized game, *Behavior Breakthroughs*™, was able to simulate the behaviors of a child with autism, thus providing preservice teachers opportunities to make decisions about how to address challenging behaviors and practice applied behavior analysis techniques.

Additionally, three studies examined the use of mixed-reality environments, where live adults play student avatars in computer-simulated classroom spaces. In concept, mixed-reality

environments could provide preservice teachers with low-cost and low-risk environments in which to develop or practice classroom management skills. Focusing on this potential, Muir, Allen, Rayner, and Cleland (2013) reported how preservice teachers were able to take turns playing student and teacher roles using the platform, *Second Life®*. This study focused especially on establishing whether the simulated environment encouraged realistic interactions and self-reflection. Two different studies described the use of the *TeachLive™* platform, which uses trained actors to puppeteer the student avatars, improvising their speech and actions according to the avatar's designated personality. In addition, both studies intentionally integrated classroom management curricula that was explicitly behaviorist. Specifically, Judge, Bobzien, Maydosz, Gear, and Katsioloudis (2013) describe how *TeachLive™* provided participants with opportunities to learn and practice differential reinforcement of incompatible behavior (DRI). In this instance, the virtual environment was presented via Skype video calling. Additionally, pre-service teachers' learning of DRI was supported via three intervention conditions, ranging from training videos alone to videos plus email to videos plus focus group feedback. Similarly, Pas et al. (2016) describe using *TeachLive™* to support teachers of students identified as moderate to severe on the Autism Spectrum. The goal was to improve teachers' use of proactive, positive behavior management strategies. In this instance, the virtual environment was presented via a webcam and Xbox Kinect© console, thus allowing the perspective of the classroom to change as the teacher walked around the room or approached a student virtually. Teachers were supported by expert coaches using a data-informed coaching model, *The Classroom Check-Up©*.

On the whole, these studies suggest that computerized and mixed-reality simulations, supported by other interventions, are potentially useful tools to support the development of classroom management skills. Particular benefits include the increasing realism of available platforms and the reduction of costs and risks to students. In essence, teachers were free to make and improve upon their mistakes, drawing upon classroom management curricula in order to improve their outcomes.

Databases. Electronic databases were the final category of technologies geared toward training and professional learning. Specifically, two studies expanded upon the use of vignettes and case scenarios in pre-service environments. Kurz and Batarelo (2010) used video cases from Arizona State University's PT3 *Best Practices* database as a part of a course for preservice teachers. This database was intended to serve as a free online resource for viewing curriculum and teaching cases from assorted subject areas and classroom contexts. Unlike the previously discussed examples of video, the content of these resources was broader and did not focus solely on classroom management. A main finding of this study was that pre-service teachers who used this database enjoyed seeing instructional practices modeled for them. Secondary to this, participants also appreciated gaining exposure to various ecologies of classroom routines and student behaviors. However, participants also critiqued the database because it did not focus adequately on classroom management or dealing with disruptive student behavior. In this light, the database may have helped spark some reflection about classroom management, but did not necessarily impart particular skills or increase knowledge relating to actual practices.

Similarly, Lee and Choi (2008) examined the use of an online audio library to deliver classroom management case scenarios. According to the authors, the intent was to provide preservice teachers with dilemmas without straightforward answers, perhaps then provoking deeper

reflection and discussion. As such, the library did not necessarily espouse any particular school of thought or set of approaches to classroom management. Study participants enjoyed the complexities and ambiguities presented by this library, suggesting that it could be a useful tool for helping preservice teachers to unpack or problem-solve about their practices.

Tools for teachers or administrators. In contrast with platforms geared at teacher professional learning, the second category of studies examined technologies intended to facilitate or reshape teachers' or administrators' everyday work. Four studies (18%) fell into this category, each employing a different type of technology (i.e. classroom behavior management apps, closed-circuit television, electronic database. See Table 2).

Table 2. Content and methodology of studies on tools for teachers or administrators.

Reference	Technology type	Methodology	Role of Technology	Key Outcomes
Chiarelli et al. (2015)	Classroom management app	Quantitative: Sums of positive and negative behaviors over 2 months in a single classroom	*ClassDojo* app used to mark students' positive and negative behaviors using cues (i.e. ring or buzz) and to display individual students' tallies via smart board	Increased positive behaviors and decreased negative behaviors among students
Hope (2010)	Closed circuit TV (CCTV)	Qualitative: Interviews with 8 school staff and 2 local technical consultants[a]	CCTV cameras were used to monitor and record student behavior	Although fear of surveillance may have deterred some misbehavior, students also found ways to resist or work around the threat
Irvin et al. (2006)	Discipline referral schoolwide information system	Quantitative: Survey of 56 educators about the use and utility of the information system	The *Schoolwide Information System* was used to record and analyze office discipline referral data	System reports supported the identification of problem behaviors and development of interventions
Sanchez et al. (2017)	Classroom management app	Qualitative: ethnography of 2 teachers' practices, plus an open-ended written survey of 227 teachers	Teachers used the *Classcraft* app to gamify classroom participation and behavior	Positive effects on student motivation and engagement

[a] This paper reported two studies and their data, however, the second was about students' general misuse of the Internet and not germane to the present review.

Of these, three studies advanced behavioristic conceptualizations of classroom management technologies. For example, recent times have seen the development of web-based classroom management apps and platforms geared at facilitating token economies, such as those commonly found in PBIS models. In this vein, Chiarelli, Szabo, and Williams (2015) describe how a *ClassDojo*© was used to reward students on-the-fly for positive behaviors, as well as to penalize students for negative ones. Whereas conventional practices might involve providing students with tickets or notes, requiring additional work to track and tally, *ClassDojo*© automated this work. It also went a few steps further by playing audible "dings" and "buzzes" for merits and demerits respectively. The program also allowed students to design their own avatars and encouraged the public display of students' avatars and points earned (such as via computer projector, posters, and certificates). Although this account focused on only one classroom over a short period of time, it does provide an overall sense for how new technological tools facilitate conventional practices and shift what it might feel like to be a student in the classroom.

A similar platform, *ClassCraft©*, is geared toward secondary and post-secondary classrooms. Sanchez, Young, and Jouneau-Sion (2017) describe how *ClassCraft©* gamified student participation and token economies. Specifically, the platform is designed to mimic role-playing games (e.g., *World of Warcraft©*) by allowing students to select avatars with unique characteristics and powers (i.e. Mages, Warriors, and Healers). In using *ClassCraft©*, the line between classroom and fantasy world events blurred. For example, students' activities and behaviors in the class earned points or achieved new levels, and in turn, students could apply newly accumulated powers within the game to "heal" or "protect" team members or to augment their avatar. In *ClassCraft©*, formative assessments are known as "boss battles" and "random events" might be intended to make gameplay or classroom dynamics more interesting (e.g. "Everyone loses 10 health points" or "Everyone must speak like a pirate for the day") (p. 501).

Although it could be said that classroom management apps and platforms like *ClassDojo© or ClassCraft©* offer new layers of interactivity, feedback, and efficiency to classroom behavioral approaches, some might also argue that these platforms encourage students to function in a state of constant surveillance. Such tools are based in the premise that a teacher could at any time be watching, and that students ought to be attending to one another's point levels. Indeed, Hope (2010) explicitly draws upon notions from Foucault to argue that schools may be enacting a surveillance curriculum when adopting closed-circuit television security systems, thus reinforcing dynamics involving self-surveillance and social control. Although this study acknowledged the potential of surveillance systems to affect student behavior in positive ways, it focused on exploring what students' resistance to surveillance and social controls might look like.

Finally, the fourth study in this category focused on the use of the electronic database known as the *School Wide Information System©* (SWIS) (Irvin et al., 2006). Although some studies excluded from this review described SWIS as a tool used by researchers to generate data detailing schools' discipline referrals (e.g., Flannery, Fenning, McGrath Kato, & Bohanon, 2013; Skiba et al., 2011), Irvin et al.'s (2006) study was unique in that it described how elementary and middle school educators might leverage data about those discipline referrals to improve practices (e.g., to identify patterns problematic behaviors; to develop or monitor interventions). Although middle school users were somewhat less positive than those in elementary schools, the overall picture of SWIS was that it contributed to efficiency, as well as to educators' data-informed decision making about behavior. As such, it offers a point of contrast from the more behaviorist platforms in this category (i.e., ClassDojo©; ClassCraft©), which are not described as tools for data-informed inquiry or continuous improvement.

Tools for helping students with self-discipline and self-regulation. Whereas the preceding passages focused on situations where teachers or administrators were the main technology users, the final category, consisting of two studies (9%), focused on arrangements where students were the end users (see Table 3). These two studies presented behaviorist views about the potential of technology, describing tools intended to support students' self-regulation or self-discipline, such as by helping them to monitor and to reflect about their own behaviors.

Table 3. Content and methodology of studies on tools for helping students with self-discipline and self-regulation.

Reference	Technology type	Methodology	Role of Technology	Key Outcomes
Jull (2006)	Behavior record system	Qualitative: Interviews and observations of 2 teachers and their classrooms, plus focus groups with 12 students	Students documented their own disruptive behaviors using *Auto-Graph,* computerized log, then reflected about the graphs summarizing their behavior	Positive effect on students' classroom behavior and self-discipline
Lang et al. (2009)	Video	Quantitative: Tallies of 2 students' recitation of classroom rules	Students with Asperger's viewed and reflected about videos documenting their own positive and negative classroom behaviors	Positive effect on students' ability to recite classroom rules

Specifically, Jull (2006) described creating and using a system called *Auto-Graph* to help students document their own disruptive behaviors and the conditions surrounding them (i.e., where behaviors occurred and who else was involved). In practice, the teacher would request that a student log information into the computer; subsequently, *Auto-Graph* would produce longitudinal records (i.e., charts and graphs) summarizing the student's positive behavior and areas in need of improvement. The author reported that this system helped students reflect and set behavioral goals, yielding an increased sense of involvement among students and positive effects on behavior.

In addition, Lang et al. (2009) described how video self-modeling helped two kindergarteners identified with Asperger's to recall and recite classroom rules. Video self-modeling involved showing students videos of themselves following or not following classroom rules. The students were selected because their participation in schoolwide behavioral supports (i.e. token economy with a school store) had not effectively reduced problematic behaviors (e.g., leaving their assigned areas; failing to follow instructions; pushing or play fighting). Aside from viewing videos of themselves, the classroom teacher or aide would also notify these students if they were breaking a rule. It should be noted that other modifications and supports were provided to the students prior to and during this study. Moreover, because the study focused on helping the students to recall and recite classroom rules, it did not seek to evaluate actual changes in classroom behaviors. Together, these two studies suggest there is still ample room for research on the extent to which technologies might be used to help students regulate their own behavior.

3.2. Research methodologies employed

Whereas the preceding passages mapped the range of technologies drawing researchers' attention, the present section focuses on the methodological approaches employed by those researchers. We examined this body of scholarship not only in terms of overall design type (e.g., quantitative, qualitative, mixed methods) and instrumentation (e.g., interviews; questionnaires), but also issues potentially affecting the generalizability of the studies due to sampling and other design choices. Although research methods varied greatly, we found that most studies employed solely quantitative (n = 11) or qualitative methods (n = 9). Only two studies employed mixed-methods approaches.

Quantitative studies. Nearly all of the quantitative studies relied upon questionnaires or surveys for data collection. Measures used in these studies included, but were not limited to: attitudes

about discipline; satisfaction with the technology; knowledge about classroom management; and frequency of using particular strategies. In other words, the quantitative studies were often focused on phenomena self-reported at the teacher level, rather than on effects at the student or classroom levels. The quantitative studies employed multiple probe randomized design (Shernoff & Kratochwill, 2007), multiple baseline design (Lang et al., 2009), and pre-test/post-test design (Sariscsany & Pettigrew, 1997; Marquez et al., 2016; Hick-Hoste et al., 2015).

However, it is also notable that many of these quantitative studies were small-scale or statistically underpowered. For example, seven of the 11 quantitative studies drew upon samples of less than 40 participants. Of the purely quantitative studies, Marquez et al. (2016) had the largest sample size (n = 101), followed by Sariscsany and Pettigrew (1997) with 77 participants. Although six studies did incorporate some basic inferential statistics (e.g., ANOVA, multiple regression, paired t-tests), four of the studies employed only descriptive statistics, often in the form of tallies. For example, Lang et al. (2009) tallied the number of rules two students were able to recite. Chiarelli et al. (2015) tallied one month of positive and negative behaviors in the first author's classroom, comparing results to the second month. Judge et al. (2013) tallied six pre-service teachers' uses of and attitudes toward particular classroom management strategies within an online environment. Thus, although quantitative studies reported favorable results, their designs were sometimes insufficient to afford proper generalizations about technologies' benefits. Such studies might better be seen as snapshots of what is possible.

Qualitative studies. The qualitative studies provided descriptive accounts of participants' perceptions about the tools at hand, such as whether participants felt the tools helped them to acquire classroom management knowledge or skills (e.g., Lee & Choi, 2008; Muir et al., 2013; Snoeyink, 2010). Some studies also sought to examine outcomes among classrooms and students, such as by asking teachers or students about the tools' impacts on classroom behavior or student-teacher relationships (i.e., (Baker, Gentry, & Larmer, 2016); Jull, 2006; Sanchez et al., 2017). Although the studies examined drew upon various data sources such as open-ended written responses, interviews, observations or video footage, most focused on only one or two K-12 or teacher education classrooms. For example, three studies relied solely upon open-ended written responses (e.g., discussion posts, essays, survey questions) for their data with sample sizes ranging from 13 to 38 participants. Other studies relied upon written responses as the main data source, using other data to help triangulate findings. For example, Snoeyink (2010) collected written responses from eight pre-service teachers, following up via focus group. Similarly, Lee and Choi (2008) collected class essays from 23 pre-service teachers, later interviewing three participants in a focus group. Although Sanchez et al. (2017) reported the largest sample of written responses (N = 227), it was unclear what constituted the "ethnographic" procedures alluded to by the authors (p. 503). To sum, the sample sizes and methodologies employed in the qualitative studies suggest that although this body of research provides some preliminary descriptions of particular tools' potential benefits or drawbacks, further discussion of the findings is needed to determine the extent to which such insights might be translated to other contexts.

4. Discussion

This systematic literature review aimed to examine research at the intersections of technology and classroom management. Although thousands of articles have been published about classroom management and discipline in the past two decades, we found only 22 empirical studies incorporating digital technologies in the ERIC database. In framing this study, it is important to note that although ERIC indexes millions of items and over 1000 journals, it does not necessarily capture the universe of all studies. It is possible that articles indexed elsewhere (e.g., Web of Science; PsycINFO) could help rough out the edges of our results. Notwithstanding, the present review does illuminate the slow pace at which classroom management research has entered the digital age, as well as the general terrain covered by prior research, scant though it may be.

Our results described researchers' conceptualizations about technology's role in classroom management, the overall kinds of technologies that might be leveraged toward those roles, and the relative strengths and weaknesses of research to date. In what follows, we first discuss how the studies we reviewed might speak to the future of preparing teachers for classroom management. Second, we discuss the ways in which researchers might need to keep pace with new developments in tools for educators and students. Third, we offer suggestions for building this field of research.

4.1. The past and future of preparing teachers for classroom management

Nearly three-quarters of the studies reviewed (73%, n = 16) related to teacher training, especially in pre-service contexts. In essence, such studies asked, "Will these videos or databases help make teachers more knowledgeable about classroom management?" Although results in these regards were mostly positive, we suggest that some territories may also be underexplored.

For example, teacher professional learning now also occurs formally and informally online. As online courses and workshops in teacher education can be expected to proliferate, the studies reviewed paint an optimistic, but somewhat antiquated view of the potential of technology to support learning. Whereas new technologies are seen as fostering more constructivist, interactive approaches to learning (Halverson & Smith, 2009), the bulk of studies for professional learning used videos or databases to deliver information in a one-way fashion. Looking ahead, the studies involving computer-simulated environments (e.g., Judge et al., 2013; Pas et al., 2016) may serve as useful examples for how classroom management knowledge might be developed in practice-oriented and constructivist ways.

Moreover, we also observe that many of the studies about professional learning took place in formal teacher education contexts. Thus, questions about teachers' informal uses of technology for professional learning were left unaddressed. For example, many educators turn to online resources and social media (e.g., Pinterest, TeachersPayTeachers, Twitter) for answers as form of grassroots professional development (Cho, 2016, Hu et al., 2018). Such findings suggest that teachers may employ a repertoire of online strategies for accessing expertise, some of which may occur in ad hoc ways. It is yet unclear, however, if such activities adequately or appropriately inform teacher practices. Thus, social media researchers might could explore what advice, resources, or lore about classroom management is transmitted online and how it might impact practice.

In addition, another approach to thinking about the future of technologies in classroom management is to think in terms of specific classroom management paradigms (i.e. ecological, social and emotional, and behavioral perspectives) (Bear, 2015; Osher et al., 2010). For example, digital technologies have gained much traction in the support of teachers' learning of behaviorist strategies. Examples of this include but are not limited to computerized simulations to help teachers practice analyzing misbehavior and/or to apply appropriate responses (e.g., Pas et al., 2016; Smith et al., 2012; Youngblom & Filter, 2013). It is interesting to imagine how computerized simulations could also help teachers analyze, compare, or experiment with ecological or social and emotional strategies (e.g., uses of physical space; transitions; fostering empathy). Indeed, whereas a handful of studies used video to foster self-reflection about ecological issues (e.g., classroom routines and climates) (Gazi & Aksal, 2011; Kurz; Batarelo, 2010; Snoeyink, 2010), it would be similarly interesting to imagine how the employ of those videos could become more interactive and constructivist. For example, teachers could create documentary style videos intending to highlight their mastery of particular practices (e.g., uses of physical space, orderly procedures, withitness), and they could offer each other feedback or other commentary based upon those videos. Given the importance of context, improvisation, and sensemaking to classroom management (Doyle, 2006), it would be additionally fruitful for researchers to examine the extent to which such simulations and videos actually contributed to real-world practices.

Finally, it is notable that none of the studies reviewed seemed to connect to social and emotional schools of thought. Currently, SEL programs vary greatly in terms of their designs and expectations for teacher practices (Bear, 2015), and questions persist regarding effective approaches to training, the role of outside experts, and measurement of fidelity within SEL programs (Rimm-Kaufman et al., 2014; Sklad, Diekstra, Ritter, Ben, & Gravesteijn, 2012). It is conceivable that educational technologies could help foster adult learning when it comes to SEL. For example, teachers may need to develop new understandings about authority, misbehavior, and students' social and emotional development (e.g., anger, self-regulation, moral reasoning, or building positive relationships). As suggested in Lustick's (2018) study about restorative justice practices, some educators are not necessarily oriented toward the underlying values of such programs, despite having to implement them. Accordingly, videos, interactive simulations, and other digital tools could be used to help teachers reflect about and practice applying such new perspectives.

4.2. Keeping pace with current practices

In the preceding passages, we have described how research about technologies in classroom management and discipline has often centered on teacher education. The logic of those studies was that building teachers' knowledge and competencies in classroom management might eventually pay off when those teachers are in their classrooms. In contrast, the other studies reviewed presented an alternative logic – one that begins with the substance of educators' and students' everyday experiences in schools. In other words, this second group makes a paradigmatic shift away from seeing technology as a tool for learning classroom management skills, toward seeing technology as integrated within the flow of practice. In some ways, this

shift mimics expanding beliefs about the potential of technologies to augment, modify, and redefine educational practices (e.g., Hamilton et al., 2016).

Notably, this second group invites the field to ask, "What is practice?" From the perspective of the studies reviewed, practice often involved regular, if not moment-to-moment, decisions regarding what to do about students' positive or negative behaviors. For example, the studies about classroom behavior management apps (i.e., ClassDojo©; ClassCraft©) paint a picture of teachers constantly monitoring students, assigning merits and demerits to students on-the-fly (Chiarelli et al., 2015; Sanchez et al., 2017). Similarly, Irvin et al.'s (2006) study about SWIS described how educators might regularly use data systems to identify patterns in problematic behaviors, develop interventions, and monitor progress. In fact, although Jull (2006) focused on a how students themselves could use a data tracking system to monitor and reflect about their own behavior, these system uses occurred within the normal flow of class time.

Piecing these studies together, a picture of tomorrow's classroom management practices and technologies emerges. At present, apps like ClassDojo© and ClassCraft© are adopted on a teacher-by-teacher basis, making it difficult to aggregate or analyze patterns across a school, grade level, or other subgroup of interest. This constraint is lamentable, but perhaps not permanent. Recognizing that regular and systematic data analysis helps to provide a safety net around students and support program improvement (Sugai et al., 2000; Wayman; Conoly; Gasko, & Stringfield, 2008), other tools are already emerging that are designed to be implemented on a schoolwide basis (e.g., Kickboard, LiveSchool, Schoolrunner). Given the ways in which appropriate data can help educators rethink school discipline practices, including issues involving race and racial disparities (Irby, 2018), such platforms could serve as tools for reflection. This may be especially so as it becomes possible to integrate data from various systems (e.g., demographic subgroups; student achievement; discipline referrals; qualitative notes). Without additional research, however, it is yet unknown how classroom behavior management apps might be impacting collaboration, school improvement, and students. After all, it is possible that data might be ignored or used without proper reflection (Coburn, Honig, & Stein, 2009) or that system use might impact students' senses of competition, community, or motivation.

Finally, we note that the tools for educators and students did not envision practice in terms of alternative classroom management paradigms, such as those relating to social and emotional learning. This area may also be an important opportunity for growth, both in the marketplace and in research. For example, platforms like Panorama Education track dimensions such as students' sense of well-being and social-emotional learning, with the idea of helping schools develop programmatic changes or individualized supports. Such platforms and practices, however, have yet to be thoroughly researched.

It would also be interesting to explore whether and how some of the tools explained in this literature review might be used to strengthen newer discipline strategies such as restorative practices. For example, Rainbolt, Fowler, & Mansfield (2019) research showed that while teachers were committed to dismantling the racial discipline gaps in their high school, they felt uncomfortable practicing some of the RP strategies due to lack of practice. In fact, some teachers specifically stated that while their professional development was helpful, it did not go far enough

in offering "real-life examples" or cases they could practice and receive feedback from peers. It would be interesting to explore how tools such as databases and digital resource libraries (e.g., Kurz; Batarelo, 2010) might be adapted to address these teachers' concerns.

4.3. Future research: moving beyond "existence proofs"

Although much research has been conducted about classroom management and school discipline, we found relatively few studies directly addressing the potential roles played by technology. Further, many of the studies reviewed evaluated or described a particular use case or program – what Borko (2004) might characterize as "existence proofs" (p. 5). As described in our results, many of the quantitative studies reviewed drew upon relatively small samples or were statistically underpowered. Together with the qualitative and mixed-methods studies, the field thus has examples of phenomena that might exist, but it is yet too soon to generalize about the benefits or drawbacks of any particular tools or types of tool. In other words, it is possible to see some features in the current terrain, but more rigorous investigations across contexts, conditions, and foci are needed.

Thus, we see ample room to generate additional knowledge and research. One way to build the field would be to replicate, extend, or compare results across cases and contexts. For example, more international studies could highlight the unique roles of context or other conditions in producing particular results. Although over one-quarter of the studies (n = 6) drew upon data gathered in other countries (e.g., Turkey, the Netherlands, Tasmania, France, the United Kingdom) (Gazi & Aksal, 2011; Hope, 2010; Hummel, Geerts, Slootmaker, Kuipers, & Westera, 2015; Jull, 2006; Muir et al., 2013; Sanchez et al., 2017), and although many of the U.S. studies mentioned representing various regions, ethnicities, and socio-economic backgrounds, there has not yet been sufficient on any particular tool or application to afford such meta-analysis.

In addition, our results indicated that many studies focused only on pre-service teachers. Another way to extend such studies would be to examine effects in actual classrooms and schools over time. Effects within such future studies might address not only about teachers' knowledge and attitudes, but also changes in teacher practice and in students' academic, attitudinal, or behavioral outcomes. Moreover, scholars could think more carefully about the ways in which technologies spill over into social and organizational dynamics, such collaboration, authority, and problem-solving (e.g., Leonardi, 2013). For example, classroom management issues are often tied to issues of race, social identity, and implicit bias (Deckman, 2017; Irby, 2018; Welsh & Little, 2018); technologies impacting classroom management could also impact how educators collaborate, develop relationships with students, or address issues of inequity and oppression.

Another recommendation to researchers is to prioritize the detailed reporting of methodologies and results. For example, in conducting their meta-analysis of classroom management strategies, Korpershoek, Harms, de Boer, van Kujik, and Doolard (2016) found that lack of detail about particular contexts, procedures, and results made it difficult to evaluate program effects. Providing such details would help position future researchers to replicate or extend other work, as well as to conduct meta-analyses. In addition, it is helpful to the field when researchers clarify the limitations of their studies. For instance, Jull (2006) detailed how the study's small-scale design afforded only a snapshot into Auto-Graph's potential contributions to classroom

management, clearly naming how future research might delve more deeply into the platform's actual uses and effects. Altogether, these kinds of practices help the field to better situate specific studies, helping the field to generalize about particular classroom management technologies—or the contexts and conditions influencing their impact.

Acknowledgements

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tate.2020.103037.

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