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Toward Trauma-Informed Design of Behavioral Interventions: A Case Study on Classroom Management

Gabriela Marcu
University of Michigan School of Information
gmarcu@umich.edu

Abstract. Trauma theory can complement behavior change theory in the design of digital interventions by providing different insights into the social and contextual factors that influence a person's behavior. Two thirds of the population in the U.S. and Europe have experienced at least one traumatic event in their lives, and trauma can have lasting effects on an individual's functioning and behavior. A trauma-informed approach to design recognizes the prevalence of trauma and considers its potential effects on an individual, to shape interactions that more effectively meet their needs. To illustrate how trauma-informed design can enhance a human-centered design process, I present a case study of a long-term project that resulted in the deployment of multiple digital technologies for classroom management. Through a retrospective needs assessment drawing on trauma theory and trauma-informed practices, I identify new possibilities for intervention by reframing children's behaviors, shifting the focus of intervention to their environment, and addressing structural inequity.

Introduction

Use of behavior change theory is common in the design of digital interventions. A significant body of CSCW literature has focused on behavior change by targeting specific behaviors, toward improving health and well-being (e.g., for a review of personal informatics literature see Epstein et al., 2020). Behavior change can involve designing around such strategies as reinforcement, rewards, consequences, goal setting, improving self-efficacy, and learning from observing others. However, focusing on a person's individual behavior does not work for all types of interventions. Employing digital technologies to increase data and reflection on behavior may even lead to harmful rumination (Eikey et al., 2021). The importance of designing for the collaborative, ecological, cultural, social, and emotional aspects surrounding a person's behavior has increasingly been highlighted (Chung et al., 2016; Kaziunas et al., 2017; Murnane et al., 2018; Marcu and Spiller, 2020; Figueiredo et al., 2018; Berry et al., 2021; Martin-Hammond and Purnell, 2022). Complementary theoretical approaches are needed that offer insight into the complex social and contextual factors that impact a person's behavior, which may call for designing different types of interventions.

In this paper, I argue that trauma theory and trauma-informed practices can add a useful perspective during the human-centered design process, to help us design effective behavioral interventions. I focus especially on the early stages of needs assessment, discovery, problem definition, and ideation that defines what role the digital intervention can and should play in addressing the problem as defined. Approximately two thirds of the population in the U.S. and Europe have experienced at least one traumatic event in their lives (Trautmann and Wittchen, 2018; Solomon and Davidson, 1997). A portion of those with trauma exposure will have such a severe reaction that they develop post-traumatic stress disorder (PTSD), but many will have a reaction that does not rise to the level of such a diagnosis, even as it has an adverse effect on their lives. Despite the existence and effectiveness of treatment options after trauma exposure, many individuals may not be conscious of how trauma has affected them, may not seek help, and when they do it is often not obvious that trauma is the underlying cause of their presenting challenges. Substance use, mental health conditions, chronic illness, housing instability, and incarceration have all been linked to trauma. Trauma-informed practice emerged from treatment and services for substance use, following the realization that focusing on substance use behavior would not lead to change without addressing trauma if it is at the root of that behavior. Trauma-informed behavior change theory is also being developed to show how "trauma impacts an individual's ability to undertake beneficial behavioural change" (Marks et al., 2022).

I discuss trauma-informed design within the school context for several reasons. Having originated within services for substance use and mental health, trauma-informed practices have expanded to schools and other settings in which clinical treatment is not the focus, but in which acknowledging the prevalence of

trauma enables the design of services that better meet the needs of individuals (Overstreet and Chafouleas, 2016; Elliott et al., 2005). Trauma-informed service delivery can be especially beneficial preventatively for health promotion, and “schools represent an opportune system for prevention and early intervention across domains related to child success” (Chafouleas et al., 2016). The school day provides a consistent routine for trauma-informed interventions to help students develop healthy social behavior (Perry and Daniels, 2016).

Schools are also a context in which digital interventions have been designed and explored using a range of approaches, from behavior change theory (Matic et al., 2014; Spiller et al., 2019) to social and emotional skill learning (Slovák and Fitzpatrick, 2015). Digital interventions can address behavior at the individual and classroom levels, and teachers may seek them out when they find themselves with inadequate training, resources, or support for effectively managing behavior in the classroom (Beran, 2005; Mitchell and Arnold, 2004). There have been calls against digital technologies that enable surveillance, control, and bias in the care of children through datafication of their behaviors that is decontextualized from their lived experiences (Manolev et al., 2019; Cho et al., 2020; Lu et al., 2021a,b)—but alternative approaches to design are unclear.

This paper makes the following contributions:

- Presenting trauma theory and trauma-informed practices as a complementary approach to behavior change theory in the design of digital interventions.
- Defining trauma-informed design of digital behavioral interventions.
- Comparing outcomes from a typical human-centered design process to other directions that could have been identified through trauma-informed design.
- Describing trauma-informed alternatives to designing digital interventions that increase datafication and control in schools.

Related Work

Trauma Theory

Traumas can be naturally occurring, such as an earthquake, wildfire, or epidemic; they can be accidents such as a train derailment, structural collapse, or car accident; or they can be intentionally caused such as violence, childhood abuse or neglect, sexual assault, or racial discrimination (SAMHSA, 2014b). Traumas can be experienced at an individual level (e.g., intimate partner violence), at a community level (e.g., school shooting), or at a mass level (e.g., war). Traumas can affect a culture and be passed down to generations who did not experience them directly—such as colonialism, genocide, slavery, or the forced relocation of Native Americans (SAMHSA, 2014b).

The following definition of psychological trauma from the U.S. Substance Abuse and Mental Health Services Administration (SAMHSA) is most commonly used across the country when bridging trauma theory and practice:

Individual trauma results from an event, series of events, or set of circumstances that is **experienced by an individual as** physically or emotionally harmful or life threatening and that has **lasting adverse effects** on the individuals' functioning and mental, physical, social, emotional, or spiritual well-being. (SAMHSA, 2014; emphasis added)

The two points that I have emphasized in this definition are most relevant for how we design behavioral interventions, and they explain why trauma tends to be overlooked as a cause of behavior. The exact nature of events or circumstances are not as important as how an individual experiences them. When feeling threatened or overwhelmed, different people will respond to the same event in different ways. However an individual responds to the event (e.g., what are commonly referred to as fight or flight responses) is their brain and body's way of surviving the real or perceived threat. Any response is therefore natural and healthy in the moment the trauma is experienced. Unfortunately, the same response may show up and influence a person's future interactions because "trauma results in a fundamental reorganization of the way mind and brain manage perceptions" (van der Kolk, 2015). A person can unknowingly and unexpectedly be influenced by a past trauma at any time, potentially making their perceptions and behaviors inappropriate or ineffective in the present moment.

Long-term adverse affects of trauma can also be prevented or reduced. Trauma can be viewed as a psychological wound, because the appropriate environment and circumstances can help an individual heal (van der Kolk, 2015). A trauma-informed approach therefore provides a theoretical framework and practical guidance for how individuals, programs, services, and organizations can contribute to cultures that are physically and emotionally safe and empowering for all (Esaki et al., 2013; Bloom and Farragher, 2013; SAMHSA, 2014a). To this end, trauma-informed practices aim to resist retraumatization:

The term [retraumatization] not only refers to the effect of being exposed to multiple events, but also implies the process of reexperiencing traumatic stress as a result of a current situation that mirrors or replicates in some way the prior traumatic experiences (e.g., specific smells or other sensory input; interactions with others; responses to one's surroundings or interpersonal context, such as feeling emotionally or physically trapped). (SAMHSA, 2014b)

Retraumatization often occurs in invisible and subtle ways such as microaggression or a lack of transparency, because a traumatic experience makes someone feel disempowerment and a loss of control (SAMHSA, 2014b). The purpose of trauma-informed practices is to create environments, services, and interactions that minimize the risk of retraumatization that could be caused by stress, unpredictability, misdiagnosis, conformity, coercion, seclusion, exclusion, discrimination, oppression, or erosion of cultural and personal identity (SAMHSA, 2014b; Bloom and Farragher, 2013; Comas-Díaz et al., 2019; Elliott et al., 2005).

Trauma-Informed Design as Building the Right Thing

Understanding the prevalence of trauma and its effects on behavior can lead to more effective intervention by enabling us to consider trauma as a potential factor through each decision in the design process. The scope of this paper is to address the earliest stages of design because our decisions therein set the course for the rest of an intervention's design. A trauma-informed approach to design must begin from the earliest stages of discovery, learning about current practices, assessing needs, and defining the problem to be solved. Determining the role of a digital intervention in addressing the problem requires ensuring that we are building the right thing, before we build the thing right.

In human-centered design, a trauma-informed approach can have a similar influence as when we consider accessibility. Designing with an understanding of how disabilities effect a person's lived experience informs designs that are ultimately more accessible and impactful for all. Similarly, the aim of trauma-informed practice is not to provide clinical treatment that directly addresses the trauma. Rather, trauma-informed practice can help us avoid isolating and decontextualizing a person's behavior to the point of losing sight of their humanity, or the broader context and lived experience wherein their true challenges lie. If trauma is the root cause of a person's challenges, and seeking treatment for PTSD or related symptoms could be most helpful for improving their health and well-being, they may need help in identifying and considering this course of action. Another aim, whether a person is or may eventually be pursuing such treatment, is to avoid inadvertently causing harm by encouraging behavior change that is fruitless if its cause is tied to trauma.

Applying Trauma-Informed Principles to Design

A trauma-informed approach must be tailored to each context, but is guided by a set of principles that are used to assess, implement, and evaluate an organization, service, or intervention's responsiveness to the adverse effects of trauma (SAMHSA, 2014a). There are six key principles of a trauma-informed approach: (1) safety, (2) trustworthiness and transparency, (3) peer support, (4) collaboration and mutuality, (5) empowerment, voice and choice, and (6) cultural, historical, and gender issues (SAMHSA, 2014a).

When applied to behavioral health interventions, these principles are adapted as follows (SAMHSA, 2014b):

- Recognize that trauma-related symptoms and behaviors originate from adapting to traumatic experiences
- View trauma in the context of individuals' environments
- Create a safe environment through consistency, transparency, and compassion
- Identify recovery from trauma as a primary goal
- Support control, choice, and autonomy
- Create collaborative relationships and participation opportunities

- Conduct universal routine trauma screening
- View trauma through a sociocultural lens
- Use a strengths-focused perspective to promote resilience

My aim is to discuss how these principles can be translated into the design of digital behavioral interventions. Trauma-informed design is a new concept as applied to digital technologies. The term began appearing in blog posts written by user experience (UX) professionals in the U.S., U.K., and Australia in 2021, which briefly discussed applying trauma-informed principles in human-centered design and interaction design projects¹²³. Trauma-informed design has perhaps gained more momentum in architecture, where, also in 2021, scholarship focused on the built environment began using the term trauma-informed design and describing its applicability to promoting the dignity, personal autonomy, and healing of individuals experiencing housing instability (Bollo and Donofrio, 2021). Trauma-informed design of school buildings and environments has similarly been identified as a critical part of trauma-informed schools (Kopec and Harte, 2020). This paper extends trauma-informed design to digital technologies and how they are conceived, generated, and deployed via the human-centered design process. In doing so, this paper advances the nascent scholarship on trauma in UX, for example (Chen et al., 2022) suggesting the application of trauma-informed principles to user research and user interface design.

Classroom Management

Classroom management refers to the strategies and behavior that a teacher uses to manage the individual and group behavior of their students (Emmer and Stough, 2001). Classroom management includes a broad range of evidence-based practices for: organizing and managing students as a group to help them stay on-task, fostering positive teacher-student and peer relationships, responding to the psychological and learning needs of individual students, and using counseling and behavioral methods to support students who demonstrate behavior problems (Emmer and Stough, 2001; Emmer and Sabornie, 2015).

A systematic review of digital technologies for classroom management classified them into three roles: (1) teacher training through video-based professional learning and interactive simulations, (2) tools for teachers and administrators such as classroom management apps used to give student points for or gamify their behavior, and (3) supporting student self-regulation by enabling them to log their own behavior and/or reflect on documentation of their behavior (Cho et al., 2020).

This recent review found that, of the three paradigms used for classroom management—behavioral, ecological, and social-emotional—digital technologies were most likely to support a behavioral approach (Cho et al., 2020). Moreover,

¹ <https://uxmag.com/articles/trauma-informed-design-understanding-trauma-and-healing>

² <https://uxdesign.cc/trauma-informed-design-research-69b9ba5f8b08>

³ <https://airbnb.design/designing-for-crisis/>

the use of digital technologies for collection and review of behavioral data by teachers and administrators has led to concerns that they can put more focus on data rather than the individual, promote a culture of control rather than care, and empower surveillance and bias rather than understanding (Manolev et al., 2019; Cho et al., 2020; Lu et al., 2021a,b). This paper extends this literature by proposing trauma-informed design of digital interventions as an approach that can help to avoid such unintended consequences, in part by shifting from a behavioral focus to the ecological and social-emotional.

Human-Centered Design Process

Over the course of a decade, I have studied behavioral intervention in school settings using the approaches of human-centered design and action research. I focused on special education services and supports for children in grades K-8 who display behavioral challenges. I began with fieldwork across settings observing daily interactions among children and staff, and broadly examining the role of digital technology in their activities. From informants such as educators, paraprofessional educators, therapists, social workers, psychologists, and clinical supervisors, I identified challenges in coordination of services. Together we designed and deployed several systems targeting these challenges, to learn more about digital technology's role in coordination, and identify strategies for how systems should be designed to meet sometimes competing stakeholder needs.

As I iteratively revisited problem definition and needs assessment, I continued down a path of how children's behaviors are documented so that appropriate services and accommodations can be provided to meet their needs. The intertwined systems of education and healthcare require staff to record behavioral data demonstrating each child's needs and progress, to account for additional levels of services when they are required (Marcu et al., 2021). The process I observed for recording, monitoring, and managing these data was a patchwork of paper data sheets, general software systems like spreadsheets, and specialized software systems such as those for reporting (Marcu et al., 2013). As a result, data collection emerged as a significant problem affecting the staff's work, with perceived consequences for the quality of care they felt they were able to provide children (Marcu et al., 2016). This problem was also corroborated by parents, who reported that they did not receive timely or detailed enough information to help them in understanding their child's behavior at school, the adequacy of services provided, or how their behavioral reinforcement at home might be aligned with the efforts of school staff (Marcu et al., 2019; Richards et al., 2021).

In the design and implementation stages of this work, I facilitated the successful adoption of technologies that became integrated into classroom settings because they met the needs of staff on the front lines of delivering behavioral services. I created a tablet-based data collection platform, Lilypad, which has been used in eight classrooms across three school districts. The longest deployment of three years has been with all of the staff in a three-classroom, self-contained

special education program focused on behavior disorders in a public elementary school. This program came to rely on Lilypad, requesting to use it for three consecutive school years until the COVID-19 pandemic upended their activities. They were persistent through the logistical and technical challenges of maintaining a research prototype for such a long period of time because they were so motivated to abandon paper-based data collection, which they referred to as being “back in the Stone Age” after adopting Lilypad. Our deployment of Lilypad also spread to additional schools by word of mouth when the staff from this program mentioned it to colleagues across their school district. Over time, I refined the Lilypad system by responding to user requests and adding various administrative features for customized data monitoring.

Additional design opportunities came from my observation of students’ tendency to seek updates on whether they were meeting behavioral expectations, along with the challenges that staff faced in providing them with consistent, individualized verbal feedback. Data management tools, including Lilypad, were largely focused on documenting behaviors for organizational use rather than using that data to provide meaningful feedback. Ideation and prototyping included individual desk-mounted displays and smartwatch applications, which could facilitate more frequent and individualized feedback for students, as well as opportunities to self-assess and self-monitor their own behavior at school. My most extensive exploration aligned with existing technologies, such as ClassDojo, which allow for class-wide behavior monitoring. Partnering with a teacher who had experience using ClassDojo but wanted a more custom form of data monitoring and feedback, I co-designed a wall-mounted display that enabled students to see their Lilypad data in real time throughout the school day. In a deployment lasting a full school year, I focused on classroom dynamics such as how the teacher incorporated the display into their activities, and how students reflected on the data collectively (Spiller et al., 2019).

The Limitations of Human-Centered Design

The human-centered design process enabled me to define and then meet the needs of users who were central in the delivery of services to children, toward how they wanted to improve the quality of care and behavioral outcomes for those children. I not only involved the users themselves in design and evaluation of these systems, but also domain experts who helped me design in support of evidence-based behavioral interventions. The resulting systems saw such metrics of success as adoption, acceptance, and sustained use over months or years.

Yet, I began to wonder whether behavioral data collection—encompassing the processes, practices, and tools I had homed in on through this process—may ultimately be incompatible with my goal of supporting coordination and my intended impact of improving outcomes for children. I found that behavioral data are subjective and difficult to represent within organizational records that might be used for coordination, such as a behavioral report card in schools (Marcu et al.,

2021). Moreover, paper-based and electronic records are created primarily for internal use, and as such do not meaningfully support distributed coordination (Marcu et al., 2016; Richards et al., 2021). Due to such issues, I identified record keeping as a factor contributing to breakdowns that cause stakeholders such as parents and teachers to be at odds with one another rather than working together (Marcu et al., 2019). My design efforts had met the needs of those primarily responsible for data collection, by allowing them to more easily capture, manage, and share data, while freeing up more of their attention for working with students and other stakeholders. But by maintaining the status quo and supporting existing practices centered around data, I did not explore design for more transformative change.

For example, an ongoing challenge throughout this work has been the difficulty of translating evidence-based strategies into classroom practice. According to the literature, punishing undesired behavior is not as effective as proactively setting clear expectations for behavior and then reinforcing behaviors that meet those expectations. But in real classroom settings, punishment is common, from verbal corrections to consequences such as loss of privileges. During iterative design and deployment of Lilypad, I explored this issue with users. We discussed how the Lilypad interface and functionality might reduce use of punishment by making it easier for staff to communicate expectations, positive reinforcement, and individualized feedback to students. However, these aspects of Lilypad were difficult to sustain and regularly abandoned.

Shifting to explore a broader role for technology beyond record keeping, I then compared practices among stakeholders to model how shared understanding of a child's needs and progress is developed across organizational boundaries, and described how we can design coordination tools that facilitate this process (Richards et al., 2021). A key finding was the importance of relationship building practices – often a distinct mechanism separate from data collection, and not always improved by the presence of digital technology. Having learned that Lilypad, strictly as a data collection or record keeping tool, could not improve coordination or prevent breakdowns, I still did not have a clear path for design alternatives (Richards et al., 2021).

Finally, I found a trauma-informed approach to be pivotal in helping me identify alternative ways that technologies like Lilypad could support students and staff. Interestingly, during a field visit early on, I happened upon an artifact that revealed the school's use of a trauma-informed approach, but at the time I did not understand its significance, and trauma-informed practice never came up over the course of many months working together. This could be because my informants did not think to bring up trauma-informed practices, perhaps thinking they were not relevant to the use of digital technologies or data collection. Or it could be because I did not know enough about trauma-informed practice at the time, or I did not ask the right questions of my informants. Whatever the case, I believe this missed opportunity speaks to the need for human-centered designers to be knowledgeable about trauma

theory and practice, as perhaps the only way to bring a trauma-informed approach to their own work.

This paper, and my definition of trauma-informed design, is the result of my reviewing literature and receiving training on trauma theory and trauma-informed practice. The following is a needs assessment that I conducted on this project mostly retrospectively, in an iterative, reflexive process over several years as I looked back on my design process the more I gained knowledge on trauma. This included comparing prior analyses across studies (e.g., interviewing vs. observational methods, Lilypad vs. ClassDojo use, teacher vs. parent perspectives) and applying trauma-informed principles to various junctions throughout this long-term project to assess how they would have influenced my interpretation or design decisions.

Trauma-Informed Design of Behavioral Interventions

A trauma-informed approach to design helped me consider how the effects of trauma could be influencing the behaviors of children as well as staff. Retrospectively performing a needs assessment through the lens of trauma changed my understanding of the issues, and also indicated different opportunities for design.

Understanding the Root Cause of Behavior

Children's behavior cannot be effectively addressed without an understanding of its root cause, which requires adequate training, tools, and time to assess. A trauma-informed approach covers one type of root cause, reframing problem behavior as potentially being a part of how students have been affected by adverse events. A person's brain, body, and behavior can undergo fundamental changes in response to a traumatic experience. These changes are a natural response to something very stressful, and are functional in allowing the person to survive and cope with the experience. After the traumatic experience, however, these changes may reappear in situations in which they are not functional. In the present, a person's behavior may appear on the surface to be inappropriate to the situation, but this is not something they can control even if this is pointed out to them or they face consequences. If the behavior stems from a past trauma, the best way to help the person adjust their behavior is by helping them process and heal from the trauma. Trauma can also be overlooked as a factor in assessing behavioral needs and misdiagnosing disabilities, for example "extra caution needs to be taken when children with the history of trauma are evaluated for ADHD, as the overlap with the symptoms of PTSD and other trauma-related psychopathology can easily lead to misdiagnosis" (Szymanski et al., 2011).

What does this mean for the role of a system like Lilypad in addressing student behavior? When we interviewed teachers with experience using classroom management technologies (ClassDojo is the most popular commercially available

app), they pointed out that their standard approach of quantifying a behavior and using gamification to increase or decrease a student's points in response to specific behaviors may not be address the root cause:

"If you have challenging students in the classroom, you know they're not on medication, you suspect that they might be ADHD or ADD. [...] But you're penalizing them for something that is beyond their control. So, that's another reason why I really don't like ClassDojo, [...] because teachers are going to end up punishing a child that can't help it. It's beyond their control. So why bother? I mean, this is not going to help." (Lu et al., 2021b).

Tools like Lilypad and ClassDojo support school staff in their typical practices of documenting problematic student behavior by capturing quantitative data such as frequency and duration of behaviors, and organizing the data under broad categories such as not being safe, kind, or on task (Marcu et al., 2021). Enhancing these practices through streamlined data management and visualization increases the potential for staff to focus on behaviors noticeable on the surface, without probing for their root cause.

Identifying a past trauma that may be affecting a child's behavior can fundamentally shift the ways that staff respond to the behavior, and change the trajectory of how they plan behavioral interventions for the child. Trauma training and screening are the recommended ways to integrate an awareness of trauma into behavioral health services (von der Embse et al., 2019). Lilypad could support training all staff to understand the effects of trauma, and remind them to consider these effects each time they encounter various student behaviors. Lilypad could facilitate trauma screening via validated questionnaires (e.g., Lang and Connell; Bernstein et al., 2018), some of which are already developed for computerized or online administration (e.g., Frewen et al., 2013). Data collection tasks could be presented alongside relevant resources, so that users have materials on trauma and a trauma screening questionnaire on hand—serving as reminders to compare behaviors they are observing in students to what they have learned about trauma. A challenge of implementing trauma-informed practices is integrating them into all aspects of work across an organization or program. Thus, Lilypad could provide a structure for training staff, refreshing their training periodically, and ensuring screening occurs systematically and equitably for students without relying as much on staff to remember, prepare, or facilitate screeners.

Intervening on the Environment Rather Than the Individual

Another aspect of considering the effects of trauma on an individual is examining the interactions between them and their environment. Staff communicating their behavioral expectations and reinforcing them in certain ways may work for some students, while inadvertently causing retraumatization for other students who may be reminded of past traumatic experiences. Retraumatization occurs unexpectedly when stimuli in the person's environment causes them to feel as if they are re-experiencing a past traumatic event in their brain and body, rendering them

unable to focus on and respond to the present moment. This phenomenon can cause more problematic behavior and worsen interactions, for example if a student is called out for not following directions and the student responds by inappropriately talking back to the teacher. Developmental trauma, which stems from cumulative experiences of abuse or neglect in early childhood, can alter interactions with others (van der Kolk and Courtois, 2005). Racial trauma is caused by repeated exposure to race-based discrimination and devaluation, and is experienced at both the individual and collective levels, which can lead to internalized oppression and the wound of rage (Comas-Díaz et al., 2019; Hardy, 2013).

Understanding that behavior may be explained by different kinds of trauma can drastically change how environments respond to that behavior, and how staff determine appropriate interventions: “Youth of color are often prescribed anger management interventions, while rage from the hidden wound of racial oppression remains unaddressed” (Hardy, 2013). It is also important to confront the fact that the very institutions attempting to serve children—such as education, special education, healthcare, and behavioral research—also have a history of traumatizing children through systemic oppression, exclusion, and violence (Henderson et al., 2019; Marks et al., 2022; Powell, 2020; Yoon, 2019; Gagnon et al., 2017). This history influences interactions with a child and their community, requiring trust to be rebuilt over time, and opportunities for healing rather than perpetuating harms such as blaming indigenous parenting practices when assessing children’s behavior (Maxwell, 2014), or continuing use of practices like seclusion and restraint, which have been shown to be dangerous (Gagnon et al., 2017).

To shift the focus of interventions from the individual to their environment, the human-centered design process for a system like Lilypad could support classroom management by aiming to change the behavior of teachers and staff, rather than the behavior of students. Trauma-informed practices include providing classroom management training to school staff so that they cultivate an effective environment for their students (von der Embse et al., 2019). Use of Lilypad made some practices more visible so that perhaps staff could more easily reflect on them, but was not an effective tool for meaningfully changing staff’s behavior with children (Marcu et al., 2021). For example, Lilypad enabled staff to capture instances of a student using inappropriate language or exhibiting violent behavior toward peer, staff, or property. But key contextual details were not consistently documented, and there was no way to compare the student’s behavioral data to specific preventative or reactive strategies used by the staff. Some of the earliest—and most successful—Lilypad adopters were recommended by community gatekeepers because they displayed generally effective classroom management along with rigorous data collection practices, which they were motivated to transition from paper-based to computerized methods. In contrast, staff who would later approach us about using Lilypad were characterized by greater challenges with classroom management, and they hoped Lilypad could help them create and implement a classroom management plan. Meeting this need would have required us to shift the

role and design of Lilypad toward providing staff with structure and guidance for developing their classroom management plan.

Attending to the impacts of trauma and following a trauma-informed approach therefore leads to a markedly different type of intervention. Rather than collecting data on individual student behaviors for the purpose of analyzing patterns in their behavior with limited context, designing an intervention may instead focus entirely on their context by supporting the training of staff on classroom management, ensuring they have an effective classroom management plan, and facilitating how they enact that plan.

Targeting Structural Inequity

Finally, interventions concerned with trauma must address structural and historical causes of inequity. Students of color and students with disabilities, for example, have not historically had equal access to education, and in myriad ways continue to experience exclusion and discrimination. If behavior management systems like Lilypad focus on quantifying behavior in a decontextualized way, they can replicate existing bias (Lu et al., 2021b). Data collection can also perpetuate oppression if its purpose is functionally as surveillance and control—on students as well as teachers themselves, who may bear pressure from school administrators or parents (Lu et al., 2021a). I observed indications of such unintended consequences with the use of Lilypad, and confirmed them in a broader interview study with teachers using the similar commercially available app, ClassDojo. These apps help to make behavioral expectations more visible, and provide feedback to students through gamification—students can see each time they earn or lose points based on how well they are following behavioral rules throughout the school day. As a result, students may feel their behavior is being more closely observed, documented, and rewarded or punished in real time. Similarly, teachers know that the data they capture on their students can be reviewed by others and provide only a limited perspective on their classroom management skills.

At the same time, data are important to a trauma-informed approach because they can help to identify students “who have been exposed to adverse events and may be at risk of or are already exhibiting effects of those experiences” (Chafouleas et al., 2016). As I have discussed, framing behavior using trauma as a lens can shape how the behavior is addressed. Data that help to contextualize behavior and guide a trauma-informed approach to intervening may therefore serve to provide staff an alternative perspective, counteracting implicit bias that is more likely to play a role when they draw their own interpretations of behavioral data. For example, a system like Lilypad could structure collection and representation of data in such a way that staff approach the data with a trauma-informed lens, to holistically consider what factors may be affecting attendance patterns, behaviors, and grades (Chafouleas et al., 2016). Behavioral data might also be represented within the context of a student’s interactions with others, so that the staff are accountable for their role in creating a supportive and inclusive school climate.

However, I have observed that use of Lilypad focused on accounting for one's work can interfere with effectively delivering services to children (Marcu et al., 2021). Therefore, accounting of one's work should be linked to training and support for teachers, rather than placing teachers under surveillance or scrutiny (Lu et al., 2021a). A trauma-informed approach to delivering services recognizes that the organizational culture and processes must be democratic and ensure that staff feel empowered in doing their work.

Conclusion

I have defined trauma-informed design of behavioral interventions by drawing on trauma theory and practice. Psychological trauma can be understood as a wound caused by any event experienced by an individual as physically or emotionally harmful, with lasting effects on how the person functions in the world. With the appropriate environment and support an individual can heal from trauma, otherwise lasting adverse affects can change their behavior, mental health, or physical health. The aim of trauma-informed practices is not to treat trauma, but they do enable the healing process to take place by preventing further harm. Due to the high prevalence of trauma, it is important to have an understanding of its potential impact on individuals when designing services and interventions for behavioral health. Using a case study of the Lilypad platform, which supports behavioral data collection for classroom management, I showed how a trauma-informed approach reframes a child's behavior through the lens of trauma, and broadens the focus of intervention beyond a specific behavior to the child's social, emotional, organizational, and cultural context. With the increasing use of digital technologies for behavior management and discipline in schools, trauma-informed design can help us find alternatives to the use of these technologies for datafication, punishment, surveillance, and control.

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