Cognistop: Utilizing Cognitive Friction to Mitigate Habitual Social Media Scrolling among Pre-Service Teachers in the College of Teacher Education

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ABSTRACT

This study investigates the effectiveness of CogniStop, a custom-developed Android application designed to mitigate habitual social media scrolling among pre-service teachers through the implementation of cognitive friction. Grounded in Dual Process Theory (Kahneman, 2011), the Ludic Loop (Schüll, 2012), and Cognitive Friction Theory (Alter, 2017), the intervention introduces arithmetic challenges and intention declarations to disrupt automatic behavior associated with "Digital Autopilot."

A mixed-method explanatory sequential design was employed, involving purposively selected participants from the College of Teacher Education. Behavioral data were collected through application logs during a 14-day protocol consisting of a baseline phase and an intervention phase. Quantitative results revealed no significant change in app launch frequency ($p = .230$), but a highly significant reduction in usage density ($p = .004$). The intervention achieved a deterrence rate of 57.83% and significantly improved perceived digital self-control ($p < .001$).

These findings confirm that cognitive friction effectively reduces mindless scrolling and enhances metacognitive awareness without restricting user autonomy. The study contributes to the development of ethical digital wellbeing tools that promote self-regulation through deliberate cognitive engagement.

Keywords: Cognitive Friction; Digital Self-Control; Mindless Scrolling; System 1 and System 2 Thinking; Digital Wellbeing

INTRODUCTION

Smartphones have transformed higher education by making information more accessible, enabling real-time communication, and supporting flexible learning. However, these same tools have also led to the rise of mindless scrolling—a habitual and often unconscious consumption of short-form digital content. Among college students, this behavior frequently shifts from purposeful use to passive engagement, negatively affecting attention, productivity, and self-regulation.

From a cognitive standpoint, this behavior is explained by Dual Process Theory, which distinguishes between automatic (System 1) and deliberate (System 2) thinking (Kahneman, 2011). Smartphone use, particularly social media engagement, is largely driven by System 1—fast, impulsive, and effortless. As a result, students often open apps reflexively and continue scrolling without conscious intent, making it difficult to regulate their behavior.

This tendency is reinforced by the design of modern platforms. Social media applications use variable rewards—unpredictable and engaging content—to keep users hooked (Schüll, 2012). At the same time, features like infinite scrolling remove natural stopping points, making it harder for users to disengage (Newport, 2019). Together, these create what Schüll (2012) describes as a "Ludic Loop," where users remain trapped in continuous consumption.

The impact of this behavior is especially concerning for pre-service teachers. As future educators, they are expected to demonstrate discipline and self-regulation, yet persistent digital distraction undermines both their academic performance and their ability to model responsible technology use.

Despite growing awareness, current digital wellbeing tools remain limited. Screen-time trackers rely on self-discipline and are often ignored, while restrictive tools such as app blockers can trigger psychological reactance, causing users to resist or bypass them (Brehm, 1966; Lyngs et al., 2020). This suggests that effective solutions must guide behavior without removing autonomy.

One promising approach is cognitive friction, which introduces small, deliberate obstacles to interrupt automatic behavior and encourage reflection (Alter, 2017). Instead of blocking access, it creates a pause that activates System 2 thinking, allowing users to reconsider their actions.

Building on this idea, this study introduces CogniStop, an Android application that applies cognitive friction through arithmetic challenges and intention prompts before accessing social media. These brief tasks are designed to disrupt habitual behavior and promote more conscious engagement.

This study aims to evaluate the effectiveness of CogniStop in reducing mindless scrolling and improving digital self-regulation among pre-service teachers. By focusing on the moment of decision rather than restriction, it contributes to the development of more sustainable and user-centered digital wellbeing interventions in higher education.

LITERATURE REVIEW

This study is anchored on three major theoretical perspectives that explain the cognitive, behavioral, and design mechanisms underlying mindless scrolling: Dual Process Theory, the Ludic Loop, and Cognitive Friction. Together, these frameworks provide a comprehensive explanation of how automatic digital behaviors are formed, sustained, and potentially disrupted.

The first theoretical foundation is Dual Process Theory, proposed by Kahneman (2011), which distinguishes between two modes of human cognition: System 1 and System 2. System 1 is characterized by fast, automatic, and intuitive thinking, operating with minimal cognitive effort, while System 2 is slow, deliberate, and analytical, requiring conscious attention and effort. In digital environments, particularly in the context of smartphone use, user behavior is largely governed by System 1 processes. Individuals often engage with social media applications reflexively, without deliberate intention, leading to habitual patterns of use. Mindless scrolling occurs when System 1 dominates behavior, allowing users to continuously consume content without engaging in reflective decision-making. As a result, the ability to regulate digital consumption is diminished, increasing susceptibility to distraction and academic procrastination.

Complementing this cognitive perspective is the concept of the Ludic Loop, introduced by Schüll (2012), which explains how digital platforms are intentionally designed to sustain user engagement. The Ludic Loop is characterized by a continuous cycle of interaction driven by intermittent variable rewards, where users are exposed to unpredictable yet potentially rewarding content. This unpredictability activates the brain's reward system, reinforcing repeated engagement and making disengagement more difficult. Social media platforms further strengthen this loop through features such as infinite scrolling, autoplay videos, and algorithmically curated feeds. These design elements remove natural stopping cues, such as the end of a page or content boundary, thereby prolonging user interaction. Consequently, users become trapped in a cycle of continuous consumption, often losing track of time and intention.

While Dual Process Theory and the Ludic Loop explain the formation and persistence of mindless scrolling, Cognitive Friction, as proposed by Alter (2017), offers a potential mechanism for disrupting this behavior. Cognitive friction refers to the deliberate introduction of effort or resistance into an interaction to interrupt automatic processes and promote conscious decision-making. Unlike traditional user experience (UX) design, which emphasizes efficiency and ease of use, cognitive friction intentionally slows down interaction to encourage reflection. By increasing the cognitive cost of accessing digital content, users are prompted to engage

System 2 thinking, thereby regaining control over their actions. This approach is particularly relevant in addressing habitual digital behaviors, as it targets the moment of action rather than imposing external restrictions.

Empirical studies provide substantial support for these theoretical perspectives. For instance, Lorenz-Spreen et al. (2020) found that the removal of stopping cues through infinite scrolling significantly reduces users' ability to self-regulate, leading to prolonged engagement. Similarly, Chen et al. (2026) reported that frequent consumption of short-form video content is associated with diminished executive control and reduced attention span, further exacerbating the tendency toward automatic behavior. These findings highlight the cognitive and neurological implications of prolonged exposure to algorithmically driven content.

In addition, research on digital wellbeing interventions reveals the limitations of commonly used strategies. Lyngs et al. (2020) demonstrated that hard-blocking tools, such as application timers and access restrictions, often fail due to psychological reactance, a motivational response in which individuals resist perceived threats to their autonomy. Users frequently circumvent or disable these tools, resulting in minimal long-term behavioral change. This suggests that interventions relying solely on restriction may be ineffective in promoting sustainable digital self-regulation.

Conversely, studies examining cognitive-based interventions suggest more promising outcomes. Kim et al. (2022) found that introducing simple arithmetic tasks as a barrier to app access effectively interrupts habitual behavior by engaging working memory and activating higher-order cognitive processes. This shift from automatic to deliberate thinking reduces impulsive engagement and encourages users to reconsider their actions. Furthermore, such interventions are perceived as less restrictive and more engaging compared to traditional blocking methods, increasing user acceptance and compliance.

Taken together, the reviewed literature underscores the complex interaction between cognitive processes and technological design in shaping digital behavior. While System 1 dominance and the Ludic Loop contribute to the persistence of mindless scrolling, cognitive friction emerges as a viable strategy for restoring conscious control. These insights provide the theoretical and empirical foundation for the present study, which seeks to evaluate the effectiveness of cognitive friction, operationalized through the CogniStop application, in mitigating habitual social media use among pre-service teachers.

METHODOLOGY

This study employed a mixed-method explanatory sequential research design, integrating both quantitative and qualitative approaches to comprehensively evaluate the effectiveness of the CogniStop application in mitigating habitual social media scrolling. This design was selected to allow the researcher to first measure the magnitude of behavioral change through quantitative data, followed by an in-depth exploration of participants' experiences to explain the underlying mechanisms of the observed outcomes. By combining these approaches, the study ensures both statistical validity and contextual understanding of the intervention.

Participants

The participants of this study consisted of thirty (30) pre-service teachers enrolled in the College of Teacher Education at Negros Oriental State University. A purposive sampling technique was employed to select individuals who met specific inclusion criteria, including ownership of an Android smartphone compatible with the application and self-reported tendencies toward social media overuse during study periods.

Despite the initial sample size, only eleven (11) participants successfully completed the full 14-day protocol. This reduction was primarily due to technical constraints, such as device incompatibility, application interruptions caused by system restrictions, and participant withdrawal. To ensure data integrity, only the complete datasets from participants who maintained continuous tracking throughout both the baseline and intervention phases were included in the final analysis.

Procedure

The study followed a structured 14-day experimental design, divided into two consecutive phases to allow for within-subject comparison.

During Week 1 (Baseline Phase), the CogniStop application operated in Log-Only Mode, where it passively recorded participants' social media usage without introducing any form of intervention. This phase aimed to capture the participants' natural "Digital Autopilot" behavior, including the frequency and duration of application usage during their self-selected Focus Hours.

During Week 2 (Intervention Phase), the application was switched to Active Mode, activating the cognitive friction mechanism. In this phase, each attempt to open a targeted social media application triggered a micro-barrier consisting of an arithmetic challenge and an intention declaration prompt. Participants were required to complete these tasks before gaining access to the application. Behavioral logs continued to be recorded, capturing both successful access and instances where participants abandoned the attempt (deterrence).

This two-phase structure enabled a direct comparison between uninhibited behavior and behavior under the influence of cognitive friction, thereby isolating the effect of the intervention.

Instruments

Data for this study were collected using a combination of technological and psychometric instruments to capture both behavioral and psychological variables.

The primary instrument was the CogniStop application, a custom-developed Android-based tool designed to function both as an intervention mechanism and a behavioral data logger. The application recorded key metrics such as application launch attempts, duration of usage, successful task completion, and user-initiated exits during the intervention phase.

To assess psychological outcomes, the study utilized the Digital Self-Control Scale, a 20-item Likert-type questionnaire designed to measure participants' perceived ability to regulate their digital behavior. The instrument included items related to habitual automaticity and metacognitive awareness, with responses ranging from strong disagreement to strong agreement.

Additionally, semi-structured interviews were conducted after the intervention phase to gather qualitative data. These interviews aimed to capture participants' lived experiences, focusing on their reactions to the cognitive friction mechanism, their decision-making processes, and their perceptions of the intervention's effectiveness.

Data Analysis

Quantitative data were analyzed using appropriate statistical techniques to determine the significance of changes between the baseline and intervention phases. A paired sample t-test was employed to compare the mean differences in behavioral metrics, specifically the frequency of application launches and usage density. This test was chosen due to its suitability for analyzing repeated measures from the same participants. To account for variations in participants' self-selected Focus Hours, a Usage Density normalization method was applied. This metric calculated the amount of social media usage per hour, allowing for standardized comparison across participants with different schedules.

The effectiveness of the intervention was further evaluated through the calculation of the Deterrence Rate, defined as the proportion of application launch attempts that were abandoned following the presentation of the cognitive friction barrier. This measure provided a direct indicator of the intervention's ability to disrupt habitual behavior.

Qualitative data obtained from the semi-structured interviews were analyzed using thematic analysis, following a systematic process of coding, categorization, and theme development. This approach enabled the identification

of recurring patterns in participants' experiences, particularly in relation to the transition from automatic to conscious behavior.

By integrating quantitative statistical analysis with qualitative thematic insights, the study achieved a comprehensive evaluation of the CogniStop application, ensuring both empirical rigor and contextual depth in understanding its impact on digital self-regulation.

RESULTS

This section presents the findings of the study based on the quantitative analysis of behavioral logs and the Digital Self-Control Scale, as well as the computed deterrence rate of the CogniStop intervention. The results are organized according to the key variables identified in the study.

Frequency of Application Launches

The comparison of application launch frequency between the baseline phase (Week 1) and the intervention phase (Week 2) revealed no statistically significant difference ($p = .230$). Although there was a slight increase in the number of app launch attempts during the intervention phase, this change was not significant at the 0.05 level. This finding suggests that the cognitive friction mechanism did not reduce the impulse to open social media applications. Instead, participants continued to initiate app access attempts at a similar rate, indicating that habitual tendencies associated with System 1 thinking remained present despite the intervention.

Usage Density

In contrast to launch frequency, a statistically significant reduction in usage density was observed between the two phases. The mean usage density decreased from 11.71 during the baseline phase to 5.63 during the intervention phase, with a p-value of .004, indicating a highly significant difference.

This result demonstrates that while participants continued to attempt access to social media applications, the amount of time spent engaging in scrolling behavior significantly decreased. The intervention effectively reduced the duration of usage, suggesting that the cognitive friction mechanism was successful in interrupting prolonged engagement with digital content.

Deterrence Rate

The effectiveness of the cognitive friction mechanism was further evaluated through the computation of the deterrence rate, which represents the proportion of app launch attempts that were abandoned following the intervention prompt.

The results indicate a deterrence rate of 57.83%, meaning that more than half of all app launch attempts were discontinued after participants encountered the arithmetic challenge and intention declaration.

This finding provides strong evidence that the intervention successfully disrupted automatic behavior, prompting users to reconsider their actions and, in many cases, refrain from proceeding with app usage.

Perceived Digital Self-Control

The analysis of the Digital Self-Control Scale revealed a statistically significant improvement in participants' perceived ability to regulate their digital behavior. The mean score decreased from 3.99 in the pre-test to 3.16 in the post-test, with a p-value of less than .001.

Given that higher scores indicate poorer self-regulation, this reduction reflects a meaningful enhancement in participants' metacognitive awareness and perceived control over their digital habits. The results suggest that the intervention not only influenced observable behavior but also contributed to positive psychological outcomes.

Qualitative Findings: Thematic Analysis

To triangulate the quantitative findings and provide richer insights into the user experience, post-intervention interviews were analyzed, revealing four distinct themes regarding the transition from "Digital Autopilot" to conscious awareness:

- **Theme 1: The Micro-Barrier as a Cognitive Awakener.** The intervention successfully forced a neurological shift from automatic to conscious reasoning. Prior to the intervention, participants exhibited heavy automaticity. Respondent P005-P explicitly recognized this disrupted behavior, stating, "There are times where I just mindlessly opened an app... without really having any idea why (kinda like a muscle memory). Through the app, I was made aware of this habit." The strict nature of the barrier forced deep reflection, as noted by Respondent P0011-R: "I realized that you really must balance your studies and social media use."

- **Theme 2: Psychological Reactance and the "Friction" Threshold.** The universal initial reaction to the cognitive prompt was frustration, aligning with psychological reactance. Respondent P002-V admitted the barrier was "really annoying" and that she clicked exit "because I felt lazy answering it." Respondent P005-P described her annoyance morphing into a "sense of defeat in a sense that I got tired answering the math questions." This psychological exhaustion indicates a successful friction mechanism; making the process of opening an app tiring successfully raised the cost of entry, deterring the behavior.

- **Theme 3: The Intention-Behavior Gap and Task Redirection.** The forced 5-to-10 second pause interrupted the immediate gratification cycle, allowing System 2 thinking to engage. Respondent P003-C emphasized that the intention declaration prompt was the catalyst for task redirection: "It reminded me to finish the task... It was more just a wake-up call." Respondent P002-V echoed this, stating, "It helped me finish my tasks, it reminded me to do my work."

- **Theme 4: The "Gamification" Loophole.** The qualitative data also explained why 42.17% of attempts bypassed the barrier. For highly analytical students, simple arithmetic did not provide enough cognitive load. Respondent P0010-V, who bypassed the app frequently, admitted his System 1 brain hijacked the intervention: "I got used to it and had fun answering all math questions... I'd say a mini-game to at least refresh my basic math skills." This indicates a need for adaptive friction in future designs.

DISCUSSION

The findings of this study provide important insights into the effectiveness of cognitive friction as an intervention for mitigating mindless scrolling behavior. While the results indicate that the intervention did not significantly reduce the frequency of application launches, it had a substantial impact on usage duration, behavioral interruption, and psychological self-regulation.

The absence of a significant reduction in app launch frequency can be interpreted through the lens of habitual behavior and psychological reactance. According to Dual Process Theory (Kahneman, 2011), System 1 processes operate automatically and are resistant to immediate change. The persistence of launch attempts suggests that the underlying habit of opening social media applications remained intact. Additionally, the slight increase in attempts may reflect a form of psychological reactance, where users respond to perceived barriers by repeating the behavior (Brehm, 1966; Lyngs et al., 2020).

However, despite the persistence of these impulses, the significant reduction in usage density indicates that the intervention effectively disrupted the execution of the behavior. This finding supports the premise that cognitive friction does not eliminate habitual impulses but instead interrupts the continuation of the behavior at the point of action. By requiring users to engage in an arithmetic task and reflect on their intentions, the application created a cognitive pause that allowed System 2 thinking to override automatic responses.

The deterrence rate of 57.83% further reinforces the effectiveness of this mechanism. The fact that more than half of the app launch attempts were abandoned demonstrates that the intervention successfully introduced

sufficient cognitive effort to discourage impulsive engagement. This aligns with the concept of cognitive friction proposed by Alter (2017), which emphasizes the role of increased effort in promoting deliberate decision-making. The qualitative interviews corroborate this, as participants explicitly reported feeling "tired" or "lazy" when faced with the arithmetic barriers. As Respondent P002-V admitted, she clicked exit "because I felt lazy answering it," while Respondent P005-P described a "sense of defeat in a sense that I got tired answering the math questions," proving that the app successfully exhausted the impulse to scroll.

Moreover, the significant improvement in perceived digital self-control highlights the psychological impact of the intervention. The decrease in self-control scores indicates that participants developed greater awareness of their digital habits and improved their ability to regulate their behavior. This suggests that repeated exposure to the cognitive friction mechanism may have facilitated a form of metacognitive training, enabling users to become more intentional in their digital interactions. As supported by the thematic analysis, the intervention acted as an academic "wake-up call," restoring volitional agency to the students. Respondent P003-C emphasized this transition, stating that the intention prompt "reminded me to finish the task... It was more just a wake-up call."

Taken together, these findings suggest that cognitive friction is a viable and effective alternative to traditional digital wellbeing interventions. Unlike restrictive tools that impose external control, the CogniStop application preserves user autonomy while promoting self-regulation through conscious engagement. By targeting the moment of behavioral initiation, the intervention addresses the root of mindless scrolling rather than merely limiting its outcomes.

Overall, the results support the theoretical framework of the study, demonstrating that interrupting System 1 processes and activating System 2 thinking can significantly reduce the impact of habitual digital behaviors. These findings contribute to the growing body of research on ethical technology design and highlight the potential of cognitive-based interventions in addressing digital distraction in educational settings.

CONCLUSION

This study aimed to evaluate the effectiveness of CogniStop, a cognitive friction–based intervention, in mitigating mindless scrolling behavior among pre-service teachers. The findings provide substantial evidence that cognitive friction is a viable and effective strategy for promoting digital self-regulation without compromising user autonomy.

The results demonstrated that while the intervention did not significantly reduce the frequency of application launch attempts, it produced a statistically significant reduction in usage duration, as reflected in the decrease in usage density. This indicates that although habitual impulses to access social media remained present, the intervention successfully disrupted the continuation of these behaviors. In addition, the recorded deterrence rate of 57.83% confirms that the cognitive friction mechanism effectively prompted users to abandon more than half of their app launch attempts, thereby reducing engagement in mindless scrolling.

Furthermore, the study revealed a significant improvement in perceived digital self-control, suggesting that the intervention had not only behavioral but also psychological benefits. The integration of arithmetic challenges and intention declarations appeared to facilitate metacognitive awareness, encouraging users to reflect on their digital habits and make more deliberate choices. This supports the premise that activating System 2 thinking can restore conscious control over behaviors that are typically governed by automatic processes. Ultimately, the mixed-method design of this study successfully bridged these quantitative results with the lived experiences of the users; the qualitative thematic analysis proved exactly why the intervention was successful, Respondent P005-P confirmed that the app disrupted her "muscle memory," while Respondent P0011-R reflected that the barriers made him realize "you really must balance your studies and games," demonstrating that the barriers functioned as cognitive awakeners that disrupted digital muscle memory.

These findings underscore the limitations of traditional digital wellbeing tools that rely on passive monitoring or restrictive controls. Unlike such approaches, CogniStop operates by introducing a momentary cognitive barrier at the point of action, enabling users to retain autonomy while promoting intentional engagement. This

highlights the importance of designing digital interventions that prioritize behavioral awareness and cognitive engagement rather than enforcing external restrictions.

In conclusion, the study affirms that cognitive friction represents a promising direction for addressing digital distraction in educational contexts. By shifting the focus from control to cognition, interventions such as CogniStop can foster sustainable self-regulation and support students in managing their digital behaviors more effectively. Future research may further explore the long-term impact of such interventions, their applicability across different populations, and their integration into broader digital wellbeing strategies.

RECOMMENDATIONS

Based on the findings and conclusions of this study, several recommendations are proposed to enhance the application of cognitive friction as a strategy for mitigating mindless scrolling and promoting digital self-regulation among students.

- **For Students (Pre-Service Teachers):** Students are encouraged to adopt tools and strategies that promote intentional digital use, particularly during academic activities. The use of applications such as CogniStop can help develop metacognitive awareness by encouraging individuals to reflect on their purpose before engaging with social media. Additionally, students should establish structured Focus Hours and practice self-monitoring techniques to strengthen their ability to regulate digital habits. Cultivating these skills is essential not only for academic success but also for their future roles as educators who are expected to model responsible technology use.

- **For Educational Institutions.** Colleges and universities, particularly teacher education programs, should integrate digital self-regulation strategies into their curriculum and student development initiatives. Rather than implementing strict prohibitions on smartphone use, institutions are encouraged to promote evidence-based interventions such as cognitive friction and Focus Hour frameworks. Workshops, seminars, and orientation programs may be conducted to raise awareness about the effects of mindless scrolling and to equip students with practical tools for managing digital distractions.

- **For Software Developers and UX Designers.** Developers are encouraged to explore the integration of ethical design principles, particularly the use of cognitive friction, in digital applications. While traditional user experience design emphasizes seamless and frictionless interaction, this study demonstrates that introducing deliberate cognitive effort can positively influence user behavior. Developers should consider incorporating features such as intent prompts, reflective pauses, and cognitive tasks to support user wellbeing while preserving autonomy. This approach aligns with the growing movement toward humane and responsible technology design. Furthermore, to address the "gamification loophole" discovered in user feedback, future applications should consider adaptive difficulty algorithms to ensure the cognitive barrier remains effective over time.

- **For Future Researchers.** Future studies are recommended to expand the scope of this research by increasing the sample size and including participants from diverse academic disciplines to improve generalizability. Longitudinal studies may also be conducted to examine the long-term effects of cognitive friction on digital behavior and self-regulation. Additionally, researchers may explore the adaptation of similar interventions across different platforms, including iOS environments, and investigate alternative forms of cognitive friction beyond arithmetic tasks. Further qualitative studies may also provide deeper insights into user experiences and the psychological mechanisms underlying behavioral change.

- **For Policy Makers and Educational Leaders.** Policy makers and academic administrators are encouraged to support the development and implementation of non-restrictive digital wellbeing policies that emphasize self-regulation rather than control. Institutional guidelines should promote balanced technology use while respecting student autonomy. By adopting a proactive approach to digital wellbeing, educational institutions can foster environments that support both academic productivity and responsible technology engagement.

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