

Gamified Physical Timers: Multiple Baseline Study of the Attention Support Apparatus

Nick Vasiljevic

English Taught Program in International Business, Shih Chien University, Taipei, Taiwan

profnickv@gmail.com

Abstract: Gamification is a promising strategy for sustaining student motivation. Most implementations rely on screen-based platforms that become sources of distraction, particularly with adolescent learners. This research provides a proof-of-concept investigation of the Attention Support Apparatus (ASA), a physical device that embeds gamification into the Pomodoro Technique to sustain learner attention and motivation over extended study periods. The idea is to preserve what gamification does well while taking it off multi-function devices and putting it on a dedicated apparatus. The ASA rewards learners with visual Pomodoro Points which are displayed on a monochrome E-ink screen. Pomodoros are earned after each completed 25-minute focused learning interval. A multiple baseline single-case design was employed across senior high school students who self-identified as having difficulty sustaining attention. The research is framed as design-based research (DBR), a methodology that integrates intervention design with the study of real-world learning contexts. As a feasibility investigation using self-reported Likert data from a small sample ($N = 5$) with no control group, the findings should be interpreted with caution and cannot establish efficacy. Although a co-inventor of the Taiwan patent underlying the ASA, the researcher holds no assigned rights or commercial interests. The results indicated a level shift in self-reported Task Focus and Perceived Helpfulness for four of the five participants once the apparatus was introduced. Participant E's lower score suggests that individual differences may affect the efficacy of ASA. A larger-scale controlled study is warranted to establish efficacy and explore when tangible gamification works best.

Keywords: Tangible user interface, Gamification, Pomodoro technique, Attention, Single-case design

1. Introduction

Gamification, the use of game design elements in non-game contexts (Deterding et al., 2011), is widely used in learning. A meta-analysis of gamified learning reports small but significant effects on motivational and cognitive outcomes (Sailer and Homner, 2020). Although tangible, unplugged and classroom-based gamification is well established, many widely used gamified study tools still run on general-purpose devices such as smartphones. The same screen that delivers points and progress bars also delivers messaging, social media and video. Adolescent learners switch between these during study (Rosen, Carrier and Cheever, 2013). This research asks whether gamification's motivating properties can be preserved when delivery is shifted to a single-purpose physical object.

The Attention Support Apparatus (ASA) is a tangible learning device with a monochrome E-ink screen. At its core it is a Pomodoro timer (Cirillo, 2018) with an included set of gamification features.

2. Background

2.1 Gamification and the Pomodoro Technique

The Pomodoro Technique (Cirillo, 2018) uses 25-minute intervals and scheduled breaks to maintain focus. It provides clear goals and specific endpoints and mirrors the conditions for "flow" (Csikszentmihalyi, 1990). According to Sailer et al. (2017), such elements raise motivation chiefly by satisfying the need for competence. Elements that feel controlling, though, can undermine it. The ASA is built to stay on the helpful side of that line, foregrounding progress while keeping the mechanics light.

Frequent interruptions raise stress and effort even when task quality holds (Mark, Gudith and Klocke, 2008), so a single-purpose device that removes the in-screen interruptions of multi-function tools is one response.

2.2 Moving Gamification onto a Physical Device

By moving the interaction from a pixel-based screen to a dedicated physical device, the ASA achieves the seamless integration of digital information and physical objects proposed by Ishii and Ullmer (1997). Moving a gamified focus tool off the phone or laptop narrows the set of deliverable mechanics, since a small E-ink screen cannot host leaderboards, avatars or rich animation, but also prevents the device from presenting anything other than its own task. This positioning aligns with Calm Technology (Weiser and Brown, 1996): technology that stays on the periphery of attention until needed. The ASA is intended to operate in this way: visible enough to support the focused interval, unobtrusive enough not to compete with it.

3. The Attention Support Apparatus

The ASA is a standalone battery-powered device with a monochrome E-ink display, a small set of physical controls and limited network connectivity. The learner starts a 25-minute Pomodoro, the device runs the countdown, and on completion registers one Pomodoro Point against the day's goal. The device's factory default is eight Pomodoros per day; for this study the target was set to four (see Section 4).



Figure 1: Photograph of the ASA showing the E-ink display with a running Pomodoro countdown. The visible red light signals to others that the learner has begun a focused interval and should not be interrupted

3.1 The Gamification Mechanics

The ASA implements four gamification elements. The set is small relative to mechanics typically available in screen-based gamified study applications, which can also include leaderboards, avatars, social comparison, unlockable cosmetics and notifications. Each element is intended to support motivation by making competence and progress visible, the conditions Sailer et al. (2017) link to gamified motivation.

Goal setting. Learners set a daily target of focused sessions (four in this study; learner-adjustable), providing an explicit learning objective.

Quantified progress. Completed intervals are rendered as tomato (pomodoro) icons.

Feedback and rewards. Each interval ends with a completion screen, and meeting the daily goal triggers a reward screen on the device itself (see Figure 3).

Long-term achievement tracking. The device logs sessions, giving learners a visible record of completed work.



(a)



(b)



(c)



(d)

Figure 2: (a) full session started; (b) break time, the red light is off; (c) continued learning session; (d) daily learning goal almost reached



Figure 3: Learning goal reward screen

4. Method

This study uses a design-based research approach (Anderson and Shattuck, 2012). Five final-year senior high school students ($N = 5$), all aged 18 or over, volunteered to take part. All self-identified as having difficulty sustaining attention during study. The daily target was set to four Pomodoros of 25 minutes each, timed to fit the typical after-school homework window of 5pm to 7pm.

A concurrent multiple-baseline single-case design (Kazdin, 2021) was used. Staggered intervention onsets occurred on days 3, 4, 5, 6 and 8 of a 15-day window. Two outcome measures were collected daily on five-point Likert scales: Task Focus and Perceived Helpfulness (for the intervention phase only). Comments were collected at study end. Each participant's baseline and intervention phases were compared visually for shifts in level and trend, in keeping with standard single-case practice.

5. Preliminary Observations

Table 1: Shown are per-participant means (five-point Likert scale): Task Focus (TF) for baseline and intervention; Perceived Helpfulness (PH) for intervention only

Participant	TF Baseline	TF Intervention	TF Change	PH Intervention
Participant A	3.00	4.50	+1.50	5.00
Participant B	3.50	4.22	+0.72	4.00
Participant C	4.08	4.49	+0.42	4.60
Participant D	3.80	4.70	+0.90	4.80
Participant E	4.10	3.50	-0.60	3.23

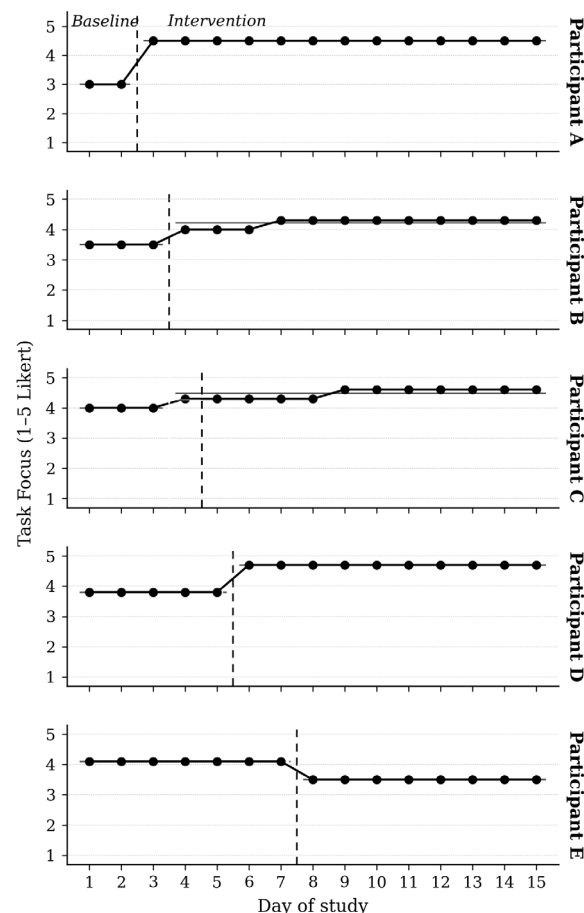


Figure 4: Daily Task Focus scores across the 15-day study: five vertically stacked panels (one per participant A to E) with dashed vertical lines marking each participant's intervention-onset day; short grey horizontals show baseline mean (dashed) and intervention mean (solid)

Because intervention onset was staggered, improvements tracked each responder's own start date rather than a common day, pointing to the device as the driver. Baseline levels also varied: Participant A began lowest (3.00) and gained most (+1.50), whereas Participants C and E started near the scale ceiling (around 4.1), leaving little room to rise. The individual trajectories, rather than the group mean, therefore carry the signal. Participant E was the exception: their Task Focus declined after Day 8, the day their intervention began. Their Perceived Helpfulness ratings remained low throughout and in their feedback, they described the device as "constraining." This response is consistent with research showing that motivational mechanisms can backfire when learners experience them as controlling (Sailer et al., 2017). Participants A, C, and D responded positively, and Participant D noted that completing Pomodoro cycles was itself motivating.

6. Discussion

These initial findings suggest that combining a Pomodoro protocol with gamification on a dedicated physical device can positively influence learner focus. For the four responders, the limited mechanics of an E-ink screen did not weaken the gamified feel of the session.

Participant E's response is the most informative finding. The drop in both self-reported measures, together with the comment that the device felt constraining, indicates that this form of gamification is not universally supportive. This is consistent with gamification literature on individual differences and on mechanics being experienced as controlling (Sailer et al., 2017), and with evidence that learners differ in how they tolerate imposed structure (Mark, Gudith and Klocke, 2008). A larger study will need to be designed to detect this variability rather than average over it.

7. Limitations and Next Steps

This research cannot isolate what drove the change. The ASA delivers a structured timer and gamification mechanics at once, so the two are confounded by design, and the improvement can't be credited to one over the other. The study is also limited by its small sample ($N = 5$), its reliance on self-report, and a 15-day window that is too short to say much about habit formation. Above all, with no control group the design can establish feasibility but not efficacy, consistent with its design-based research aim; the trial below addresses this.

The next study is a three-arm trial: the ASA, a matched non-gamified physical Pomodoro timer, and a phone application with equivalent gamification. Comparing the ASA against the timer shows what the gamification contributes; comparing it against the phone app shows what the dedicated device contributes. Objective task-switching and individual-difference measures will be added.

Ethics Declaration: This study did not require formal ethical clearance. All participants were adults who volunteered to take part and were free to withdraw at any time. Informed written consent was obtained from each participant before data collection began.

AI Declaration: A large language model was used as an editing and drafting aid. All substantive arguments, design decisions, data collection, analysis, and interpretation were carried out by the author. All references were checked against the original sources.

References

- Anderson, T. and Shattuck, J. (2012) "Design-based research: A decade of progress in education research?", *Educational Researcher*, Vol 41, No 1, pp 16–25. <https://doi.org/10.3102/0013189X11428813>
- Cirillo, F. (2018) *The Pomodoro Technique: The Life-Changing Time-Management System*, Virgin Books, London.
- Csikszentmihalyi, M. (1990) *Flow: The Psychology of Optimal Experience*, Harper & Row, New York.
- Deterding, S., Dixon, D., Khaled, R. and Nacke, L. (2011) "From game design elements to gamefulness: Defining gamification", *Proceedings of the 15th International Academic MindTrek Conference*, Tampere (Finland), 28–30 September, ACM, New York, pp 9–15. <https://doi.org/10.1145/2181037.2181040>
- Ishii, H. and Ullmer, B. (1997) "Tangible bits: Towards seamless interfaces between people, bits and atoms", *Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems*, Atlanta (USA), 22–27 March, ACM, New York, pp 234–241. <https://doi.org/10.1145/258549.258715>
- Kazdin, A.E. (2021) *Single-Case Research Designs: Methods for Clinical and Applied Settings*, 3rd edn, Oxford University Press, New York.
- Lu, H.-Y., Vasiljevic, N. and Cheng, C.-H. (2025) *Apparatus for Concentration Enhancement*, Taiwan Patent No. TWI895232B.
- Mark, G., Gudith, D. and Klocke, U. (2008) "The cost of interrupted work: More speed and stress", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Florence (Italy), 5–10 April, ACM, New York, pp 107–110. <https://doi.org/10.1145/1357054.1357072>

- Rosen, L.D., Carrier, L.M. and Cheever, N.A. (2013) "Facebook and texting made me do it: Media-induced task-switching while studying", *Computers in Human Behavior*, Vol 29, No 3, pp 948–958.
<https://doi.org/10.1016/j.chb.2012.12.001>
- Sailer, M., Hense, J.U., Mayr, S.K. and Mandl, H. (2017) "How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction", *Computers in Human Behavior*, Vol 69, pp 371–380. <https://doi.org/10.1016/j.chb.2016.12.033>
- Sailer, M. and Homner, L. (2020) "The gamification of learning: A meta-analysis", *Educational Psychology Review*, Vol 32, No 1, pp 77–112. <https://doi.org/10.1007/s10648-019-09498-w>
- Weiser, M. and Brown, J.S. (1996) "The coming age of calm technology", Xerox PARC, 5 October. Reprinted in Denning, P.J. and Metcalfe, R.M. (eds) (1997) *Beyond Calculation: The Next Fifty Years of Computing*, Copernicus, New York, pp 75–85. https://doi.org/10.1007/978-1-4612-0685-9_6