1. Rationale and positioning with regard to the state-of-the-art

One of the most debated issues in contemporary education is the *omnipresence of smartphones in secondary schools*[1], which presents ongoing challenges for adolescents, school staff, and policymakers[2]. Although schools have taken important steps to integrate digital tools into education, they face the challenge of preparing students for responsible technology use in daily life[3]. This is a critical issue as students' personal smartphones and smart devices in schools are widely perceived as sources of distraction and mental ill-being[4]. Beyond the classroom, teachers have raised concerns that smartphones divert students' attention during breaks and prevent them from engaging in potentially more rewarding activities, such as physical exercise or in-person social interactions[5]. Amid a broader moral panic surrounding adolescents' digital practices[3], these concerns have prompted increasingly strict smartphone policies worldwide[4]. In line with international trends (e.g., France in 2017, China in 2018, Canada in 2019), the Flemish Ministry of Education has introduced a total ban on smartphones and smart devices in secondary schools—up to and including Grade 10 (approximately ages 12–16; Belgium: 1ste–4de middelbaar)—starting in the 2025–2026 school year[6].

Despite political claims and a widespread belief that strict bans will enhance student focus, academic performance, and well-being[4], there is *little, if any, robust evidence* to support smartphone bans in schools[3]. The only systematic review to date, based on five peer-reviewed quantitative studies (2016-2024), found no significant effect of school smartphone bans on academic performance (d = .05, *ns*), but reported a small positive effect on specific social outcomes, such as reduced bullying (d = .22, p < .01)[2]. However, another study found the opposite: bullying was more prevalent in schools where smartphones were banned[7]. Reflecting these mixed findings, a scoping review (2013-2023) examining effects of smartphone bans on academic performance, mental health, and cyberbullying concluded that available evidence remains weak, inconclusive, and insufficient to justify such policies[3]. More recently, a cross-sectional observational study compared 20 secondary schools with strict smartphone policies to 10 secondary schools with permissive approaches. While the study – published in *The Lancet*, one of the world's most prestigious peer-reviewed medical journals – found no link between restrictive policies and improved adolescent well-being[8], its conclusions were criticized for methodological (see 2.1.) and conceptual flaws (see 2.2.)[9]. The lack of methodologically rigorous, conceptually well-grounded and practice-oriented research on the impact of smartphone bans stands in contrast to the attention the topic receives in public discourse.

In this project, we will examine the recently announced smartphone ban in Flemish secondary schools as a **natural field experiment, including three waves of student- and teacher survey data** across two school years. This longitudinal design will allow us to evaluate both **short- and long-term effectiveness** of the policy on secondary school students' cognitive, emotional, social, and motivation functioning, thereby providing schools with **much-needed, evidence-based guidance** to shape their smartphone policy. This project offers a novel lens on why school policies succeed or fail—an aspect often overlooked in prior studies. Our proposed framework (*Figure 4*) integrates policy characteristics, motivational mechanisms, and behavioral adherence within a developmental perspective.

2. Scientific research objectives

Drawing from Self-Determination Theory[10], the Social Development Model[11], and insights from the Motivation Barometer[12,13] project on policy compliance during the COVID-19 pandemic, this research project aims to contribute to both the scientific literature and the public debate by providing schools and policymakers with evidence-based insights and tools into how smartphone restrictions can be implemented in a motivating, effective manner. Methodologically, this project aims to strengthen the available evidence base by making use of more precise measures of a smartphone ban, shedding light causality using an experimental approach and understanding the short- and long-term effects through longitudinal follow-up. Conceptually, we will assess a broad set of developmental outcomes, examine explanatory mechanisms, and address potential spillover effects across life domains. Finally, the project has a strong practical and societal orientation, ensuring valorization by translating findings into usable, context-sensitive tools and recommendations for adolescents and schools– this last aim will be

immediately addressed in section three (methodology) of this proposal. Below, we describe the three methodological and three conceptual RGs'.

Figure 1. Overview of key research gaps (RG) and corresponding research objectives (RO)

Methodological aim	Conceptual aim
- Vague definitions (RG1) to **clear operationalization** (RO1). - Weak causal claims (RG2) to **field experiment** (RO2). - Short-term snapshots (RG3) to **longitudinal insight** (RO3).	- Crude measures (RG4) to **broad outcomes** (RO4). - No mechanisms (RG5) to **explanatory pathways** (RO5). - Isolated school-focus (RG6) to **cross-context focus** (RO6)

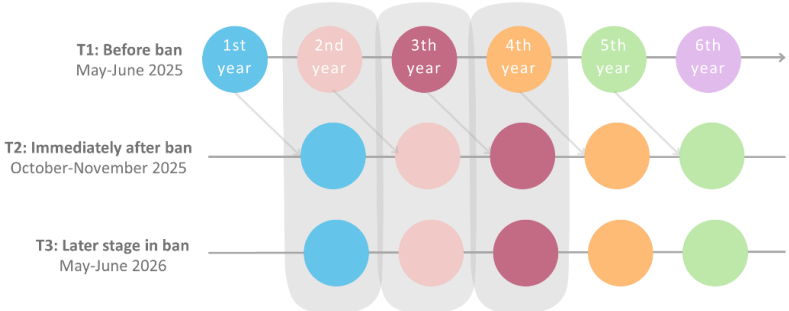
2.1. Toward Methodological Rigor

RG1: A first research gap concerns the lack of a clear operationalization of policy stringency and ambiguity around what constitutes a smartphone ban. Definitions vary widely across studies or are omitted in publications altogether[9], thereby undermining comparability across studies. For instance, the abovementioned *Lancet*-study defined permissive school policies quite broadly as those allowing phone use "at any time or at certain times (e.g., breaks/lunch) and/or in certain zones (e.g., outside)". However, as Haidt[9] pointed out, one of the ten "permissive" schools in their study had no phone policy, while the remaining nine had at least some form of restriction. In addition, some studies[14] did not distinguish between partial bans (i.e., limited access) and complete bans, making it entirely possible that students in "ban" schools are still using phones during breaks or classes. To meaningfully evaluate the recently announced smartphone ban in Flemish schools, a clear and nuanced operationalization of policy types and levels of stringency is urgently needed. While the Flemish policy has been introduced as a "total ban," it should be noted that (1) the mandatory ban applies only to students in grade 7-10 (Belgium: 1ste-4de middelbaar) of secondary education; (2) exceptions of smartphone use are allowed, such as for educational purposes; and (3) schools can choose themselves how the ban is implemented and which sanctions are applied[6]. Our first research objective (RO1) is to cleanly operationalize schools' smartphone policy by relying on Haidt's proposed levels of stringency in smartphone policies[9]. As illustrated in *Figure 2*, this taxonomy differentiates policies based on the degree of access adolescents have to their smartphones during school hours, with most schools today being situated at levels 1-3[9], whereas only levels 4-5 qualify as a complete ban or rendering the school a smartphone-free zone. In what follows, *smartphone ban* refers to levels 4–5, while *smartphone restrictions* or *policy* are used more broadly and may refer to any level, including levels 1–3.

Figure 2. Levels of stringency in smartphone policies

Level	Stringency of Policy	Phone Access
0	No restrictions	**Full access anytime**
1	Phones allowed in class for academic use only	**Limited in-class use**
2	Phones kept in pockets/backpacks; not to be used during class	**No in-class use**
3	Phones placed in caddies at the start of each class	**No in-class access**
4	Phones locked in personal pouches on arrival; unlocked after school	**No access all day**
5	Phones locked in school lockers until students leave	**No access all day**

Figure 3. Study Design Natural field experiment with a longitudinal panel design.



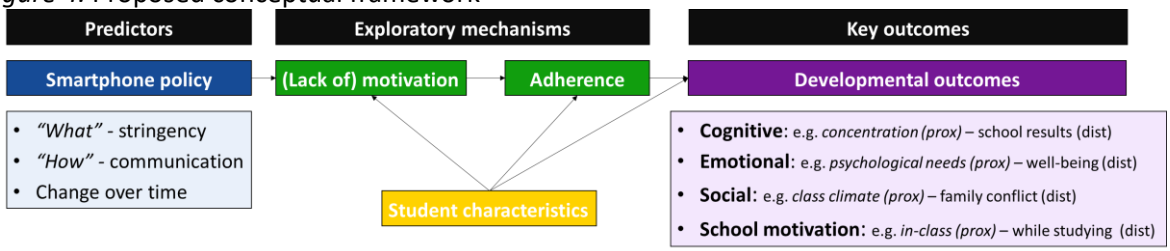
RG2: A second research gap is that most of the existing research on school smartphone bans is either cross-sectional[8] or based on region-level trend comparisons without tracking individuals over time[15], making it impossible to draw firm causal conclusions[3]. Our second research objective (RO2)

is to address this gap by leveraging the upcoming policy shift in Flanders as a rare and timely opportunity to conduct high-quality, real-world research on the effects of school smartphone bans. The large-scale and coordinated nature of this policy change provides an ideal context for a natural field experiment that is methodologically robust and can help to draw conclusions on cause and effect. Specifically, the first wave of data collection will take place prior to the implementation of the collective smartphone ban. At this stage, schools still operate under varying local smartphone policies, which will be systematically classified according to the taxonomy presented in *Figure 2*. A second measurement point will follow at the start of the 2025–2026 school year, after the policy has come into effect, requiring schools to adopt stricter regulations. Since the Ministry's regulations do not mandate changes for grades 11-12 (Belgium: 5de-6de middelbaar), these students will serve as a natural control condition – allowing us to assess the true effects of introducing a smartphone ban. If we may observe that the smartphone ban has real effects on student outcomes, positive changes should be observed among students who are still in grades 7-10 (Belgium: 1ste-4de middelbaar) after the transition to the smartphone ban, but not among students who are in grades 11-12 (Belgium: 5de-6de middelbaar). A third follow-up is planned for the same period in the 2026 semester as in 2025, ensuring comparability in terms of contextual variables such as season and school workload. Thus, the design allows us to account for naturally occurring developmental changes by comparing, for example, second-grade students at T1 (before the ban) with second-grade students at T2 and T3 (after the ban), thus controlling for age, grade, and maturation (see section 3 on research methodology and work plan).

RG3: A third research gap constitutes the lack of longitudinal follow-up in prior work. While one study adopted a quasi-experimental longitudinal design showing no effects of school bans[7], its insights remain limited, as it included only two data waves — providing just a short-term pre-post snapshot and offering little clarity on lasting effects. Therefore, the longitudinal follow-up at T3 will overcome this gap by capturing individual developmental trajectories and assess both short- and long-term impact of such policies[2] (RO3). The limited evidence for positive effects of smartphone bans may partly reflect a necessary *adaptation period*, during which students and schools adjust to newly imposed restrictions. For example, many adolescents report experiencing anxiety or restlessness when separated from their phones[16], which may undermine well-being and concentration in the beginning of a ban, thereby obscuring potential benefits of a stricter policy over time[2].

2.2. Toward a comprehensive conceptual framework

Figure 4. Proposed conceptual framework



RG4: A fourth research gap in existing literature is that most studies to date rely on a narrow and limited set of outcome variables to support broad claims about the effects of school smartphone bans[9]. In the five studies reviewed by Böttger and Zierer[2], only one[17] assessed both academic performance and social well-being, while the others focused on a single outcome domain. Moreover, many studies rely on crude or oversimplified measures. For example, in the *Lancet* study[8], academic performance was assessed using a single binary teacher rating (above or below target result), and well-being was measured with a one-item global scale. Other studies employed overly distal indicators, such as national standardized math test scores[15], which are unlikely to be influenced by smartphone policies in the short term. In contrast, more proximal outcomes – such as students' classroom concentration or perceived classroom climate – are more likely to capture early effects of policy changes and may serve as precursors to longer-term shifts. Despite their relevance, this distinction between *proximal and distal* outcomes remains neglected. To shed a more nuanced light on this matter, one also needs to consider the temporal unfolding of assessed outcomes. For instance,

improvements in concentration may emerge quickly following policy changes, whereas effects on more distal outcomes such as GPA may require longer periods to become evident. Investigating this temporal sequencing within a longitudinal design may help explain the inconclusive or null findings reported in earlier work[2]. As depicted in the right-hand side of *Figure 4* (purple), a fourth research objective (RO4) is to examine four key dimensions of developmental functioning – cognitive, social, emotional, and motivational – each of which includes both proximal and distal outcome variables.

RG5: A fifth research gap is that no prior work investigated why smartphone bans show inconsistent effects. The present study addresses this gap (RO5) by exploring potential motivational dynamics and exploratory mechanisms (see *Figure 4* in blue and green). One key reason why smartphone bans may fall short of expectations is that many secondary school students choose not to comply with the restrictions imposed. Surprisingly, *student adherence* to smartphone restrictions is overlooked in the majority of research on school bans, despite evidence indicating that up to 29% of students secretly use their phones despite restrictions[16]. Poor adherence likely stems from adolescents' perception that smartphone possession and use belong to their personal domain, making external restrictions feel intrusive and hard to accept[18]. Aside from ***what*** exact restrictions are imposed, variation in ***how*** smartphone bans are *implemented and communicated* across schools are likely equally important (see *Figure 4*). For instance, some studies evaluated policies introduced through top-down political mandates[7], while others focused on schools that voluntarily adopted stricter rules [14]. Even when smartphone policies get politically streamlined (as in Flandres), substantial variation likely arises in how schools communicate about the rules and expectations in a motivating (or demotivating) way. A similar dynamic was observed in the Motivation Barometer[12, 13] in which our research group studied how citizens responded to the social distancing policy during the COVID-19 pandemic in Belgium. We found that it was not only the strictness of the policy that mattered, but especially how several rules were introduced and communicated. Specifically, in line with SDT[10] when politicians conveyed the rules in an *autonomy-supportive way* – emphasizing understanding, validating resistance, and providing a meaningful rational – citizens were more likely to internalize and comply with the measures over time. In contrast, adopting a *controlling communication style* (i.e., guilt-induction, pressuring communication, threatening with sanctions), citizens were less likely to comply[13]. This aligns with research in educational contexts showing that autonomy-supportive communication by teachers fosters greater internalization of school rules and sustained student engagement, whereas controlling approaches often backfire[19, 20]. Despite the growing attention to smartphone bans, little is known about ***how*** schools actually implement and communicate smartphone bans – a factor likely to shape how students perceive and adhere to these rules.

Importantly, similar to prior work[12, 13], we expect that *both* the ***what*** (i.e., stringency, see 2.1., RO1) and the ***how*** (i.e., communication and implementation) of a school's smartphone policy will shape adolescents' *(lack of) motivation* to comply with the smartphone restrictions, which in turn is likely to influence their *behavioral adherence* to imposed policy (see *Figure 4* from blue to green). Based on SDT[10], students can have various motivations to (not) comply with the rules, depending on the degree to which they internalize and self-endorse them[19], with more internalization relating to less problem behavior and more long-term persistence in adolescents[20]. When students experience *external regulation*, they comply to avoid punishment or gain approval – for instance, turning off or putting away their phones to avoid sanctions. Under *introjected regulation*, adherence is driven by internal pressures such as guilt, shame, or ego involvement – for example, following the smartphone rules to feel like a "good student" or to avoid self-blame. More autonomous forms of motivation occur when students act out of *identified regulation*, recognizing personal relevance of the smartphone policy, such as its role in improving concentration. At the highest level of internalization, *integrated regulation*, students align the policy with their own values – for example, seeing reduced phone use as part of being respectful and socially engaged at school. Conversely, when students see little meaning in the policy, *amotivation* or a lack of motivation may prevail, leading to potential disengagement. Going one step beyond *amotivation*, some students may actively resist the imposed smartphone restrictions, displaying *oppositional defiance* or *reactance*. Such defiance is considered a form of anti-

internalization and has been associated with maladaptive functioning, including heightened feelings of resentment, rule-breaking behavior, and cheating[20]. In contrast, multiple studies demonstrate that more internalization predicts long-term, meaningful adherence to imposed measures, whereas - external regulation relates to short-term compliance and, over time, even backfires[13, 19, 20].

RG6: A sixth research gap is that existing studies on smartphone bans look at the school context in isolation. According to the Social Domain Model[11], adolescent behavior is shaped within a nested social ecology involving interactions between family, peers, and schools. Within this framework, school-based interventions such as smartphone bans may have effects that extend *beyond* the school setting. Therefore, a sixth research objective (RO6) is to explore spillover effects across life domains. Drawing on SDT, such effects may be either positive or negative, depending on the internalization processes outlined above (see RO5). To this end, we will examine two opposing hypotheses. Students may internalize school-based restrictions and generalize them to other life domains – such as the home environment (the integration hypothesis) – leading to broader reductions in (problematic) smartphone use. On the contrary, students may compensate by increasing their use outside school hours (compensation hypothesis). One study hinted at a compensatory effect, showing that while use during school hours was lower in stricter schools, total daily smartphone use remained comparable[8], suggesting displacement to leisure time. The degree to which students internalize the policy likely explains these diverging behavioral patterns. Additionally, when schools ban smartphones without promoting responsible use, digital supervision may shift disproportionately to parents, potentially involving escalation of parent-child conflict. Despite real-world relevance, such cross-contextual dynamics remain understudied. The present study will examine both school-based outcomes and how smartphone bans influence adolescents' behavior and family interactions beyond the school gates.

Finally, we will systematically examine whether student characteristics moderate the effects of policy characteristics on student outcomes (see *Figure 4*). Prior research has hinted that certain groups–such as lower-achieving students and lower SES-students–may benefit more from stricter regulations, but these effects may be driven by underlying factors like poor self-regulation or pre-ban problematic phone use[17]. By incorporating this into our analyses, we aim to identify which students struggle or thrive more under stricter policies and use insights to inform targeted support strategies.

3. Research methodology and work plan

Below, we elaborate on our research methodology (3.1) and associated work packages (3.2). To implement the study, analyze the data, and communicate findings to both academic and broader audiences, we have defined four work packages (WPs; see Table 1 below). WP0 covers preparatory work that will be completed before the final evaluation of this proposal. WP1 and WP2 focus on implementation, data analysis, and scientific dissemination, while WP3 centers on the valorization and translation of findings for practice and policy. The majority of these WPs will be carried out by a dedicated postdoctoral researcher, who will take the lead in coordinating the study, managing data collection and analysis, and dissemination efforts. This work will be closely supervised and supported by the interdisciplinary team of supervisors.

3.1. Methodology

3.1.1. Research design

The study will take the form of a natural field experiment combined with a longitudinal panel design, encompassing three waves of data collection over the course of two school years. This approach builds on the research group's extensive experience with complex longitudinal studies and multilevel analyses in large-scale educational contexts[21], [22], [23], [24]. Data will be collected in secondary schools during three time points: May–June 2025, October–November 2025, and May–June 2026. At each wave, students will be asked to self-report on their school's smartphone policy communication (i.e., autonomy-support vs. control), their motivation to comply with the policy, their behavioral adherence, and a set of key developmental outcomes (see *Figure 4*). In each wave, a teacher-report completed by the classroom teacher will be used to evaluate the strictness (see *Figure 2*) and implementation of the smartphone policy (e.g., sanctions for non-compliance), along with observable outcomes such as

perceived student concentration, engagement, class dynamics, and school results. All questionnaires used are standardized or adapted from established instruments in prior research[12, 13]. Each wave follows a standardized protocol: (1) schools will be contacted and briefed–via an online session for T1, via email or phone for T2 and T3; (2) parents and students will be informed through an information letter distributed via Smartschool or email; and (3) students will complete the survey in class, either via an online link or a paper-and-pencil format.

3.1.2. Participants and Recruitment.

Data will be collected in close collaboration with secondary schools across Flanders, leveraging the extensive school network of the research team. Schools from all educational tracks (i.e., general, technical, vocational, arts, special education) will be included to ensure *diversity* across the Flemish educational landscape. Data will be collected from secondary school students in grades 7-12 (Belgium: 1ste-6de middelbaar). School principals or coordinating staff will be contacted directly to invite schools for participation. The school principal designates specific class groups to participate, typically during a regular class period (e.g., social sciences) or during a collective moment (e.g., a homeroom session or school-wide activity period). The principal or coordinator is the contact person for the researcher throughout the study. This approach allows for both structured and organically initiated participation, increasing feasibility and reach of data collection across diverse school contexts. A priori power analysis was conducted to determine the required sample size to detect small to medium effect sizes ($\beta \geq .12$) with adequate statistical power (.80) at a conventional alpha level of .05, taking into account the multilevel structure of the data. Based on simulations using a linear mixed model with random intercepts for schools and students, we found that a design with approximately 20-25 schools and 100 students per school provides sufficient power to detect effects of this magnitude, while smaller effects are unlikely to be both statistically detectable and policy relevant. Yet, given our extensive network in the educational field, our target is aimed at 30 schools with an average of 150-200 students per school.

3.1.3. Risk assessment and fall-back plans.

A potential risk of the present study is the **number of participating** schools required to obtain a sufficiently large sample. At present (i.e., March 15th), already 11 secondary schools have confirmed participation. These include six schools offering academic tracks, six offering technical tracks, five offering vocational tracks, one special education school, and two schools that provide reception education for non-native newcomers (OKAN). Since some schools offer multiple educational tracks, the sum of listed tracks exceeds the total number of 11 participating schools. In total, around 9 585 students are enrolled across these schools. While this number provides a strong initial foundation, further recruitment efforts are ongoing via the extensive school network of the research team – including our close collaboration with the 'Warme Scholen' network and the launch event on April 2nd of the educational motivation book authored by two of the applicants.

Follow-up across the school years. To ensure continuity in our longitudinal panel design while accommodating the dynamic nature of school settings, we will implement several strategies. *First*, students will be tracked at the individual level across school years using a set of *identifying variables* collected at each measurement wave–such as e-mail address, school, and classroom teacher. This allows for reliable follow-up even when class compositions change. *Second*, the design remains flexible by allowing *new cohorts* to enter the study at later time points, thereby maintaining a robust sample and accounting for natural drop-out (e.g., students changing schools, being sick during the survey). This structure enables both continuity and growth within the sample, allowing us to capture individual developmental trajectories while also monitoring school-wide trends across cohorts and time points. To minimize drop-out, we engage in outreach with schools throughout the study (see WP3). Drop-out analyses will be conducted to detect and correct for any potential sampling bias.

Another risk concerns the **administrative burden** for schools. To reduce this, we will use a passive parental consent procedure based on the legal ground of public interest, allowing parents two weeks to opt their child out after receiving the information letter. Researchers will inform the school which students should not participate and provide an alternative task. While commonly used in large-scale school research, this procedure remains sensitive and requires formal approval. At present, we

received a *no-objection* decision from the Ethics Committee of the Faculty of Psychology and Educational Sciences (Ghent University) and currently await approval by the Data Protection Officer.

A final operational risk involves the **potential demand on research staff** for logistical support. While the administration of the questionnaire can proceed independently at the school site, some schools may request on-site assistance from the research team. To address this, we will offer support on request and provide a pre-recorded instructional video that teachers can play before administering the survey. This flexible approach aims to accommodate school preferences while managing the workload of the research team efficiently.

3.2. Work packages

Table 1. Overview of work packages and intermediate goals

	2025		2026				2027			
		Jan-Apr	May-Jun	July-Sep	Oct-Dec	Jan-Apr	May-Jun	July-Sep	Oct-Dec
3.2.1. WP0 – completed before start of funding										
Ethical approval		X								
Pre-registration		X								
Participant recruitment		X								
Data collection T1		X								
Data collection T2		X								
3.2.2. WP1 – short term effectiveness of ban										
Data-analyzing short-term effects			X							
Writing of manuscript (T1-T2)				X	X					
Revisions manuscript						X	X			
3.2.3. WP2 – long term effects and individual differences										
Data collection T3				X						
Data-analyzing short-term effects						X				
Writing of manuscript (T1-T2-T3)							X	X		
Revisions manuscript									X	X
3.2.4. WP3 – valorization										
Outreach and engagement		X	X		X					
Creating school-based report							X			
Dissemination of final results							X	X		
Creating of educational tools									X	X

3.2.1. WP0. Foundational work and initial data collection

WP0 covers all preparatory work and the first stages of data collection. This includes finalizing the research design, preparing the questionnaires, obtaining ethical approval, and preregistering in OSF.

3.2.2. WP1. Short-term effectiveness of smartphone bans evaluated at the school-level

WP1 consists of analyzing T1 and T2, which will result in a first set of peer-reviewed journal articles.

Data-analysis. To evaluate the immediate impact of the newly introduced smartphone ban, we will perform multilevel analyses using Linear Mixed Models (LMM), focusing on the transition from T1 (pre-ban) to T2 (immediately post-ban). We will adopt a stepwise analytical approach, gradually increasing model complexity to test our hypotheses. All models will be estimated using maximum likelihood estimation, and missing data will be handled using full information maximum likelihood (FIML) to retain power and reduce bias. Model comparisons will be based on fit indices (e.g., AIC, BIC), and sensitivity analyses will be conducted to assess robustness. **Step 1:** We will first examine whether the introduction of stricter smartphone policies leads to measurable changes in student outcomes. Time (T1 vs. T2) will be modelled as a within-person factor, and condition (i.e., natural experimental vs. natural control condition) as a between-person factor. Random intercepts for students and schools will be included to account for clustering and individual differences in baseline levels. The key predictor will be the interaction between time and condition, testing whether students in the experimental group (grades 8-10 at T2; Belgium: 2de-4de middelbaar) show greater improvement in outcomes than those in the control group (grades 11-12 at T2/Belgium: 5de-6de middelbaar; those *without* ban or policy change). Relevant covariates (e.g., gender, SES, prior smartphone use) will be included to control for confounding. **Step 2:** Only among students who encounter the transition to the smartphone ban, i.e., those in grades 8-10 at T2 (Belgium: 2de-4de middelbaar), we will examine variation in implementation by distinguishing between schools that introduced a full policy change (e.g., from

limited to full ban) and those that made only partial adjustments, based on the taxonomy of policy strictness (see *Figure 2*). This will be based on the teacher-evaluation of the smartphone policy at their school. This classification will be included as a between-school predictor. We will model the interaction with time to test whether students in full-change schools exhibit stronger improvements than those in partial-change schools. **Step 3:** Among students who encounter the transition to the smartphone ban, we will assess whether the manner in which the policy is communicated moderates its effectiveness. We expect that students in schools where the policy is introduced in an autonomy-supportive way will show more favourable outcomes than those exposed to controlling communication. We will test these effects both at the individual level, as well as at the school level, by including as a moderator in the LMM. School-level communication style will be derived from aggregated student ratings. We will test its interaction with time to determine whether the motivational climate enhances or dampens the policy's effects.

Risk assessment and supplementary analysis. An important question is whether observed changes in student outcomes reflect the introduction of the smartphone ban or simply natural developmental trends. As our primary comparison involves students from different grades, we acknowledge that the control group (grades 11-12; Belgium: 5de-6de middelbaar) is older than the experimental group (grades 7-10; Belgium 2de tot 4de middelbaar), which may introduce age-related confounds. To address this, we propose two supplementary analyses that control for age and grade and help disentangle policy effects from normative developmental change. *First,* if sufficient variation exists in policy implementation across lower (8-10 at T2) and higher (11-12 at T2) grades, we will compare outcomes among 11-12th grade (Belgium: 5de-6de middelbaar) students in schools that applied the ban uniformly across all years versus those that implemented it only in the lower ones in a supplementary analysis. In this way, some 11th and 12th grade students will fall under the experimental condition due to a school-wide ban, while others will not. Because this comparison is made within the same grades, it allows us to isolate the influence of broader policy decisions while controlling for grade-related developmental effects. *Second*, if such variation is lacking, we will adopt a cross-cohort, between-subjects approach. For instance, we will compare 8th grade students surveyed at T1 (pre-ban) with 8th grade students surveyed at T2 (post-ban), and if needed T3 (see WP2). This cross-temporal comparison[24] keeps both age and grade constant, helping determine whether any observed differences are due to the policy rather than normative changes. Together, these analyses complement the primary within-person models and enhance causal interpretation of policy's effects.

3.2.3. WP2. Long-Term Effects and Individual Growth Trajectories

In WP3, the third data wave will be collected. WP2 adopts a person-centred approach to explore *how students develop over time* and *why* some students benefit more than others. This will result in a second series of peer-reviewed journal articles.

Data-analysis: **Step 1.** Temporal Sensitivity of Change (T1–T2 vs. T1–T3): We will first investigate whether change in developmental outcomes occurs primarily in the immediate aftermath of the ban (T1–T2) and then decreases, remains stable, or accumulates further towards the end of the school year (T2–T3). We hypothesize that *proximal outcomes* (e.g., concentration, classroom climate) will show early improvements that may reach a plateau level, while *distal outcomes* (e.g., well-being, motivation) may follow more gradual upward trends. We will use latent change score models (LCSM) to compare T1–T2 and T1–T3 changes within each outcome domain. Crucially, all analyses will contrast students who experience the transition to a ban (i.e., moving from a non-ban to ban implementation) with students that did not undergo such a transition, allowing us to isolate the developmental impact of the policy change. **Step 2.** Next, we will use latent class growth modelling (LCGM) to uncover subgroups of students who follow distinct developmental trajectories across the three time points. This allows us to explore heterogeneity in response to the policy, such as students who show sustained improvement, delayed improvement, or no change at all. **Step 3.** Finally, we will test which factors predict membership in specific growth profiles. Central to this analysis is the school's policy condition, distinguishing between *no ban*, *newly strict*, and *already strict* schools (as defined in WP1). These between-school categories will be included as predictors to examine whether and how the nature and

timing of policy implementation shape long-term student trajectories. In addition, we will include individual-level predictors such as motivation and adherence and student characteristics (i.e., self-regulation, problematic phone use). Multinomial logistic regression within the LCGM framework will be used for this purpose. Together, WP2 deepens our understanding of how developmental change unfolds over time and which conditions foster lasting impact. The identification of growth profiles and their predictors will also feed directly into WP3, where these insights will be translated into tailored psychoeducational tools and school-specific feedback reports.

3.2.4. WP3. Valorization

Recognizing that science communication is urgently needed, this WP ensures practical relevance and societal impact of the project through tailored outreach and dissemination efforts targeting schools and adolescents, while also providing ready-to-use deliverables for direct application in schools. First, to foster continued engagement, we will organize **three outreach lectures** for participating schools on broader educational themes (student motivation, teaching styles). These sessions will not reference the ongoing study directly, in order to preserve the naturalistic character of the study while still offering immediate value to school staff. Second, participating school will receive a **school-specific feedback report**, summarizing key findings related to the student population–such as motivational profiles and policy adherence. These reports are intended to support school teams in reflecting on their smartphone policy and in developing or refining their broader media and digital literacy strategies. Third, at the conclusion of the data collection, we will host a **dissemination event** for all participating schools and students. The morning session will present the project's key findings; the afternoon will offer interactive workshops to stimulate dialogue and practical application. Our research group has extensive experience organizing such large-scale, practice-oriented events[12], [25], [26]. Finally, drawing on the study's findings and input from the dissemination event, we will develop a **ready-to-use educational tool**–for example, a PowerPoint presentation or lesson plan–that teachers can implement in their classrooms. This tool will help foster critical reflection and responsible smartphone use, contributing to students' digital literacy. By equipping educators with empirically grounded, context-sensitive materials and strategies, this WP aims to bridge the gap between science and practice, and to empower schools in guiding adolescents toward sustainable and self-regulated digital habits.

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