

Digital Technology in Brazilian Schools after COVID-19: Distraction, School Climate, and Equity in PISA 2022

Fábio Sant'Anna Linhares¹ and Fabiane da Silva Queiroz² and Jean Cristian Ferreira Machado³

¹ Instituto de Computação, Universidade Federal de Alagoas, Maceió, AL, Brazil

² Centro de Ciências Agrárias, Universidade Federal de Alagoas, Maceió, AL, Brazil

³ Instituto Infnet, Rio de Janeiro, RJ, Brazil

fl@ic.ufal.br, fabiane.queiroz@ceca.ufal.br,

jean.machado@prof.infnet.edu.br

Abstract. This short paper critically synthesizes PISA 2022 and recent literature on device-related distraction, school climate, and educational equity in Brazil. In mathematics lessons, 45% of Brazilian students reported distraction by their own devices and 40% by classmates' use, compared with OECD averages of 30% and 25%. Because the study does not re-estimate PISA microdata, its claims are associative rather than causal. The synthesis distinguishes digital distraction from school climate and proposes four governance domains: pedagogical purpose, conditions of use, equity safeguards, and evidence-based monitoring. It also discusses Brazil's device regulation and generative AI.

Keywords— digital technology, digital distraction, school climate, educational equity, PISA 2022, educational governance

1. Introduction

The COVID-19 pandemic exposed technology as essential educational infrastructure and, simultaneously, as a mechanism through which existing inequalities could widen. During school closures, unequal access to connectivity, devices, adult support, and suitable study environments contributed to heterogeneous learning losses, with greater harm among socially disadvantaged students [Lichand et al. 2022; Schady et al. 2023]. After the return to in-person schooling, a different problem became visible: devices that could support learning also competed with instruction for students' attention. This article treats that configuration as a post-pandemic digital tension, rather than as a logical paradox or a universal effect of technology.

PISA 2022 illustrates the scale of the problem. In Brazil, 45% of students reported being distracted by their own digital devices and 40% by classmates' use in most or every mathematics lesson; the corresponding OECD averages were 30% and 25% [OECD 2023b]. Across OECD countries, students reporting distraction caused by classmates in at least some mathematics lessons scored 15 points lower after adjustment for socioeconomic profile [OECD 2023a; OECD 2023b]. These results do not establish that devices alone caused the score difference, but they indicate that attention has become an institutional variable rather than a merely individual habit.

The objective of this short paper is to critically synthesize evidence on device-related distraction, school climate, and educational equity in Brazil. Its contribution is threefold: it separates constructs that are often conflated; clarifies what PISA evidence

can and cannot support; and proposes four domains for translating the synthesis into educational governance. The argument rejects both technological determinism and an undifferentiated anti-technology response. The relevant question is not simply whether devices enter school, but under which purposes, rules, protections, and evaluative procedures they are used.

2. Method, Evidence Hierarchy, and Limitations

This is a documentary, theoretical-analytical study. Its corpus comprises official OECD reports and technical documentation on PISA 2022, peer-reviewed studies on post-pandemic learning and digital inequality, and recent Brazilian literature on school climate. Official OECD publications are treated as the primary sources for descriptive claims about achievement, distraction, equity, and assessment design. The preprint by Cito and Marôco (2025) is retained only as an illustrative Brazilian case and is not treated as definitive evidence.

PISA requires procedures that are easily mishandled. Student proficiency is represented through ten plausible values, which should not be collapsed into a single average before estimation. Sampling variance must reflect the complex design through replicate weights and Balanced Repeated Replication with Fay adjustment. Multilevel analyses must also respect the nesting of students within schools and, where applicable, territories [Huang 2024; Karakolidis et al. 2022; Mang et al. 2021; OECD 2024]. Ignoring these features can produce apparently precise results with incorrect standard errors and overstated inference.

The study does not re-estimate the Brazilian microdata and therefore cannot independently test alternative specifications, subgroup interactions, mediation mechanisms, or robustness to missing-data decisions. The distraction indicators are self-reported, cross-sectional, and focused mainly on mathematics lessons. They may be affected by measurement differences, residual confounding, school composition, and reverse interpretation. International comparisons are descriptive and cannot isolate cultural, regulatory, or institutional causes. Accordingly, the paper identifies patterns and governance implications but does not estimate causal effects of device use, school climate, or specific policies.

3. Critical Synthesis and Discussion

3.1. From Access to Conditions of Use

Digital inequality cannot be reduced to possession of hardware. The literature distinguishes inequalities in access, skills, types of use, support, and outcomes [Robinson et al. 2015]. This is important for Brazil because expanding device availability may reduce one barrier while leaving students unequally equipped to convert access into learning. A device used within a structured task, with teacher guidance and a defined endpoint, differs pedagogically from the same device used without boundaries while instruction competes with notifications, entertainment, and peer communication.

PISA 2022 suggests a non-linear relationship. Moderate use of digital resources for learning at school was associated with better performance than no use, whereas intensive or leisure-oriented use was associated with worse outcomes [OECD 2023b].

Brazil's reported classroom distraction was substantially above the OECD average. The contrast is not uniquely Brazilian: the proportion distracted by their own devices exceeded 50% in Argentina, Uruguay, and Chile, while it was below 10% in Japan and Korea [OECD 2023b]. These differences are useful for comparison but should not be converted into rankings of regulatory success, because school norms, device availability, reporting practices, and student composition also vary.

The practical implication is that access and restriction are incomplete when treated separately. Access without pedagogical integration can increase exposure without improving learning; restriction without alternatives can remove tools that support accessibility, feedback, research, and differentiated instruction. A defensible policy must specify what counts as educational use, when devices may be activated, how attention is protected, and what evidence will be used to revise the rule.

3.2. Digital Distraction and School Climate

Digital distraction and school climate are related but non-equivalent constructs. PISA measures distraction through students' reports about device use in mathematics lessons. School-climate instruments generally address broader dimensions such as safety, belonging, relationships, discipline, aggression, and institutional organization, often combining information from students, teachers, or principals [Moro et al. 2019; Xavier 2024]. Conflating the constructs obscures both mechanism and intervention.

The distinction has direct policy value. Device-related distraction calls for classroom protocols, teacher mediation, notification management, temporal boundaries, and development of self-regulation. A deteriorated school climate requires a broader agenda involving leadership, safety, peer relations, conflict management, and trust. A school can restrict phones and still have a poor climate; it can improve climate and still leave digital interference unmanaged. These problems may reinforce one another, but one should not be used as an automatic proxy for the other.

The preprint by Cito and Marôco (2025) is useful mainly as a methodological warning. Its discussion of variable exclusion, hierarchical specification, and the atypical Roraima sample shows why a large international database does not eliminate problems of representativeness and model dependence. Because the source has not completed peer review and the present study does not reproduce its estimates, it has been reduced from a structural basis of the argument to a limited illustrative example.

3.3. Equity Is About Outcomes, Not Only Access

Equity becomes concrete when the distribution of outcomes is examined. In Brazil, students in the highest national socioeconomic quartile outperformed those in the lowest quartile by 77 mathematics points, and socioeconomic status accounted for 15% of performance variation [OECD 2023a]. These figures do not show that digital use produced the gap. They show that any device policy operates inside an already stratified system.

Uniform rules can therefore have unequal consequences. Students may differ in home connectivity, digital skills, access to school-provided equipment, need for assistive technology, and availability of adult or teacher support. Governance should assess not only average effects but also whether a rule creates avoidable barriers or transfers educational costs to groups with fewer alternatives. Detailed claims about

regional, racial, or school-sector differences require disaggregated analyses that this synthesis does not perform and should remain an explicit research agenda.

3.4. Four Domains for Educational Technology Governance

The synthesis supports a compact framework with four connected domains. First, pedagogical purpose: each use should be linked to a learning objective that cannot be achieved as effectively by a simpler alternative. Second, conditions of use: schools should define timing, duration, permitted applications, teacher authority, storage, and procedures for interruptions. Third, equity and protection: rules should address accessibility, privacy, age appropriateness, safety, and unequal access to institutional resources. Fourth, evidence and revision: implementation should be monitored through indicators of attention, participation, learning, climate, and subgroup effects, with predefined criteria for adjusting or suspending practices.

Brazil's recent regulation illustrates this move from abstract debate to institutional rules. Law No. 15,100/2025 restricts students' use of personal portable devices during classes, recess, and intervals, while preserving pedagogical use and exceptions related to accessibility, inclusion, health, and fundamental rights [Brazil 2025b]. Decree No. 12,385/2025 assigns implementation to education systems and schools, requires adaptation to local contexts, and reinforces guidance, training, and community participation [Brazil 2025a]. The framework is therefore not equivalent to an analogue-only school: it distinguishes personal disruptive use from supervised educational use.

This distinction should guide evaluation. Success cannot be measured merely by the number of confiscated phones or devices distributed. Relevant indicators include instructional time recovered, frequency of reported distraction, participation in device-supported activities, accessibility effects, school-climate measures, and differences across socioeconomic groups. Data infrastructures should connect large-scale assessments with school census information and more proximal school-level evidence without treating any single indicator as causal proof [OECD 2024; Queiroga et al. 2024].

3.5. Generative AI Intensifies the Governance Problem

PISA 2022 predates the widespread classroom adoption of generative AI and cannot establish its effects. GenAI nevertheless intensifies the same governance problem because it can function as tutor, feedback mechanism, accessibility resource, or cognitive partner, while also enabling task completion without corresponding learning. Recent OECD synthesis indicates that benefits are more plausible when tools are guided by explicit teaching principles and designed around learning goals [OECD 2026].

The policy question is therefore broader than screen presence. Schools must decide when AI assistance is legitimate, what reasoning students must make visible, how outputs are verified, which data may be processed, and how dependence or cognitive outsourcing will be detected. Future research should combine interaction traces with process measures, subgroup analysis, and longitudinal or quasi-experimental designs. It should distinguish improved product quality from durable learning, because the two outcomes are not interchangeable.

4. Conclusion

PISA 2022 shows that classroom digital distraction is widespread in Brazil: 45% of students reported distraction by their own devices and 40% by classmates' use, both above OECD averages [OECD 2023b]. At the same time, evidence does not support a simple conclusion that technology is intrinsically harmful. Effects vary with purpose, intensity, pedagogy, institutional norms, and the social conditions under which students use digital resources.

The central analytical result is that digital distraction, school climate, and educational inequity should not be collapsed into one explanation. They interact, but they are measured differently and require distinct interventions. The proposed governance framework - pedagogical purpose, conditions of use, equity safeguards, and evidence-based revision - converts this distinction into an operational contribution.

The conclusions remain bounded by the study's design. This is a critical synthesis of secondary evidence, not an original estimation of PISA microdata, and it does not identify causal effects. Its policy implication is correspondingly disciplined: neither unrestricted digitalization nor prohibition alone is sufficient. Educational systems need rules that subordinate devices and generative AI to learning objectives, protect attention and rights, and remain open to revision when credible evidence indicates unequal or ineffective outcomes.

References

- Brazil (2025a) “Decree No. 12,385, of 18 February 2025”, Regulates Law No. 15,100/2025 on personal portable electronic devices in basic education.
- Brazil (2025b) “Law No. 15,100, of 13 January 2025”, Regulates students' use of personal portable electronic devices in public and private basic-education institutions.
- Cito, L. and Marôco, J. (2025) “Beyond the Average: Mapping Educational Inequality in Brazil with PISA 2022”, Research Square, preprint. DOI: 10.21203/rs.3.rs-7273143/v1.
- Huang, F. L. (2024) “Using Plausible Values When Fitting Multilevel Models with Large-Scale Assessment Data Using R”, *Large-scale Assessments in Education*, v. 12, 7. DOI: 10.1186/s40536-024-00192-1.
- Karakolidis, A., Pitsia, V. and Cosgrove, J. (2022) “Multilevel Modelling of International Large-Scale Assessment Data”, In: Khine, M. S. (ed.) *Methodology for Multilevel Modeling in Educational Research*, Springer, Singapore, p. 141-159. DOI: 10.1007/978-981-16-9142-3_8.
- Lichand, G. et al. (2022) “The Impacts of Remote Learning in Secondary Education During the Pandemic in Brazil”, *Nature Human Behaviour*, v. 6, n. 8, p. 1079-1086. DOI: 10.1038/s41562-022-01350-3.
- Mang, J., Küchenhoff, H., Meinck, S. and Prenzel, M. (2021) “Sampling Weights in Multilevel Modelling: An Investigation Using PISA Sampling Structures”, *Large-scale Assessments in Education*, v. 9, 6. DOI: 10.1186/s40536-021-00099-0.

XXI Latin-American Conference on Learning Technologies (LACLO 2026)

- Moro, A., Vinha, T. P. and Morais, A. (2019) “Avaliação do Clima Escolar: Construção e Validação de Instrumentos de Medida”, *Cadernos de Pesquisa*, v. 49, n. 172, p. 312-335. DOI: 10.1590/198053145305.
- OECD (2023a) PISA 2022 Results (Volume I): The State of Learning and Equity in Education, OECD Publishing, Paris. DOI: 10.1787/53f23881-en.
- OECD (2023b) PISA 2022 Results (Volume II): Learning During - and From - Disruption, OECD Publishing, Paris. DOI: 10.1787/a97db61c-en.
- OECD (2024) PISA 2022 Technical Report, OECD Publishing, Paris. DOI: 10.1787/01820d6d-en.
- OECD (2026) OECD Digital Education Outlook 2026: Exploring Effective Uses of Generative AI in Education, OECD Publishing, Paris. DOI: 10.1787/062a7394-en.
- Queiroga, E. M. et al. (2024) “Data-Driven Strategies for Achieving School Equity: Insights From Brazil and Policy Recommendations”, *IEEE Access*, v. 12. DOI: 10.1109/ACCESS.2024.3422822.
- Robinson, L. et al. (2015) “Digital Inequalities and Why They Matter”, *Information, Communication & Society*, v. 18, n. 5, p. 569-582. DOI: 10.1080/1369118X.2015.1012532.
- Schady, N. et al. (2023) *Collapse and Recovery: How the COVID-19 Pandemic Eroded Human Capital and What to Do About It*, World Bank, Washington, DC. DOI: 10.1596/978-1-4648-1901-8.
- Xavier, F. P. (coord.) (2024) *Gestão das Redes de Ensino e Clima Escolar: Mapeamento das Ações e Uma Proposta de Matriz Avaliativa Sensível à Equidade*, Centro Lemann; Nupede/UFGM, Belo Horizonte.