

## Early childhood learning outcomes in the polycrisis era: A critical analysis of sdg 4 progress and equity measurement gaps

Resultados del aprendizaje en la primera infancia en la era de la policrisis: un análisis crítico de los avances en el ODS 4 y las deficiencias en la medición de la equidad

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### Abstract

This study examines early childhood learning outcomes across thirty-eight OECD countries during the critical 2019-2023 period, analyzing progress toward Sustainable Development Goal 4 targets while exposing fundamental gaps in equity measurement frameworks. Drawing on SDG 4 indicator data for early-grade proficiency in reading and mathematics, the analysis employs mixed methods combining quantitative descriptive statistics with critical policy analysis to address three research questions examining cross-national performance patterns, temporal trajectories through the pandemic period, and equity monitoring limitations. The findings reveal substantial variation in early-grade proficiency outcomes, with a twenty-eight percentage point gap between highest and lowest performing countries demonstrating that national policy choices produce measurably different outcomes for young learners. Temporal analysis identifies three distinct trajectory patterns: approximately one-quarter of countries demonstrated sustained improvement despite pandemic disruption, half maintained stable performance, and one-quarter experienced notable declines persisting through 2023.

**Keywords:** Early childhood education equity; sustainable development goal 4; polycrisis; disaggregated data monitoring; pandemic learning outcomes.

## Resumen

Este estudio examina los resultados del aprendizaje en la primera infancia en treinta y ocho países de la OCDE durante el crítico período 2019-2023, analizando los avances hacia las metas del Objetivo de Desarrollo Sostenible 4 y poniendo de manifiesto las deficiencias fundamentales de los marcos de medición de la equidad. Basándose en los datos del indicador del ODS 4 sobre la competencia en lectura y matemáticas en los primeros cursos, el análisis emplea métodos mixtos que combinan estadísticas descriptivas cuantitativas con un análisis crítico de las políticas para abordar tres cuestiones de investigación que examinan los patrones de rendimiento entre países, las trayectorias temporales a lo largo del período de la pandemia y las limitaciones del seguimiento de la equidad. Los resultados revelan una variación sustancial en los resultados de competencia en los primeros cursos, con una diferencia de veintiocho puntos porcentuales entre los países con mejor y peor rendimiento, lo que demuestra que las decisiones políticas nacionales producen resultados cuantificablemente diferentes para los jóvenes estudiantes. El análisis temporal identifica tres patrones de trayectoria distintos: aproximadamente una cuarta parte de los países mostraron una mejora sostenida a pesar de las perturbaciones causadas por la pandemia, la mitad mantuvieron un rendimiento estable y una cuarta parte experimentaron descensos notables que persistirán hasta 2023.

**Palabras clave:** Equidad en la educación infantil; objetivo de desarrollo sostenible 4; policrisis; seguimiento de datos desglosados; resultados del aprendizaje durante la pandemia.

## INTRODUCTION

The world is experiencing a "polycrisis" era defined by convergence of multiple, interconnected global challenges including climate change, armed conflict, forced displacement, pandemics, and economic instability (Lawrence et al., 2024). These overlapping crises disproportionately affect young children, whose early developmental years are critically sensitive to environmental, emotional, and educational conditions, with disruptions resulting in long-term cognitive, socio-emotional, and academic disadvantages (Black et al., 2017; Shonkoff et al., 2012). Early childhood learning outcomes are particularly vulnerable in this context. Over 43.3 million children have been forcibly displaced due to conflict and instability, many lacking access to foundational early learning opportunities, while climate-related shocks significantly impair early cognitive development and lifelong learning potential (UNESCO, 2024; UNICEF, 2024). The COVID-19 pandemic caused prolonged closures of early childhood education centers, leaving approximately 40 million children without access to pre-primary education during a critical developmental window (UNICEF, 2024). These disruptions have exposed and widened equity gaps in learning outcomes, particularly among children from marginalized communities, low-income households, and conflict-affected regions. While Sustainable Development Goal 4 emphasizes inclusive, equitable, and quality education for all, progress tracking mechanisms often fail to sufficiently capture disparities in early learning opportunities and developmental outcomes (United Nations, 2024). SDG Target 4.2, which calls for universal access to quality early childhood development and pre-primary education by 2030, remains significantly off track, especially in low- and middle-income countries (UNESCO, 2024). Equity measurement frameworks currently used by global monitoring institutions tend to overlook intersectional vulnerabilities such as disability, gender, displacement, and language barriers, with most monitoring systems relying on aggregate national indicators that mask within-country inequalities and fail to capture nuanced effects of compounded crises (Brossard et al., 2020; Engzell et al., 2021).

Despite growing recognition of early childhood as a cornerstone for lifelong learning and human development, research and policy responses have remained fragmented, reactive, and insufficiently data-driven, particularly in crisis-affected settings (Downer et al., 2018; Hartono et al., 2025). The lack of reliable, disaggregated, and context-sensitive indicators continues to obscure the full scope of inequities in early learning outcomes (Ancheta & Fabrigas, 2025). This study contributes to critical discourse by bridging the gap between global policy ambitions under SDG 4 and lived realities of young children in high-risk environments, offering an equity-centered critique of current monitoring approaches to inform more resilient, inclusive, and accountable early childhood education policies. The period from 2019 to 2023 presents a particularly critical window for analysis, encompassing both the disruption of the COVID-19 pandemic and subsequent recovery efforts that have tested the resilience and equity of early childhood education systems worldwide. OECD countries, while generally well-resourced and committed to comprehensive education data systems, present an important case study in tensions between policy commitments to inclusive education and practical realities of equity measurement. The availability of SDG 4 indicator data for these nations offers an opportunity to examine both what current monitoring systems reveal about early learning outcomes and what critical dimensions of equity remain obscured by aggregated reporting structures. Previous studies often fall short in capturing complex, systemic disruptions caused by global crises like the COVID-19 pandemic and emerging polycrisis, limiting their ability to inform how early education systems can sustain progress under such

conditions. Moreover, many lack comprehensive, cross-national perspectives necessary to evaluate progress toward SDG 4 targets emphasizing inclusive and equitable quality education for all children. This study critically examines early childhood learning outcomes across thirty-eight OECD countries during this uniquely turbulent period (2019-2023), capturing both pre-pandemic baselines and multifaceted impacts of global crises on educational equity and system resilience. This broader, longitudinal, and international scope addresses significant gaps by assessing how early education systems withstand and adapt to overlapping crises, providing essential evidence for policymakers aiming to fulfill SDG 4 in an era marked by unprecedented challenges. This study analyzes SDG 4.1 indicators across thirty-eight OECD countries during the 2019-2023 period, with particular attention to early-grade proficiency levels in reading and mathematics that directly reflect quality and inclusiveness of early childhood education systems. By examining national-level achievement patterns, temporal trends through the pandemic era, and conspicuous absence of disaggregated equity data in standardized international reporting, this research contributes both empirical evidence and critical analysis to ongoing discussions about measuring progress toward truly inclusive early childhood education. The findings hold implications for researchers, policymakers, and practitioners working to strengthen rights-informed, equity-focused approaches to early learning across diverse national contexts.

## Research Questions

**RQ1:** How do OECD countries compare in early-grade proficiency outcomes (Grades 2/3) in reading and mathematics, and what patterns emerge when examining national-level performance as a potential indicator of systemic equity in early childhood education systems?

**RQ2:** To what extent did early-grade learning outcomes across OECD countries demonstrate resilience or vulnerability during the 2019-2023 period, and what do temporal trends reveal about the equity-protective features of different national early childhood education systems during crisis conditions?

**RQ3:** What critical equity dimensions remain unmeasured or underreported in current SDG 4 monitoring frameworks for early childhood learning outcomes, and what are the implications of these data gaps for advancing inclusive, rights-informed early childhood education policy and practice?

## METHODOLOGY

### Data Source and Sample

This study utilizes data from the Organisation for Economic Co-operation and Development's Education and Skills database, specifically drawing on SDG 4 indicator data compiled through the OECD's Wise Statistics platform. The dataset encompasses indicators 4.1.1 and 4.1.2, which measure the proportion of children achieving minimum proficiency levels in reading and mathematics. The analysis focuses on early-grade proficiency data from Grades 2 and 3, representing the most developmentally relevant measures for understanding outcomes directly linked to early childhood education and care systems serving children from birth through age eight. The sample includes thirty-eight OECD member countries with available data during the 2019-2023 period, spanning diverse geographical regions and

representing varied approaches to early childhood education policy, funding mechanisms, and curriculum frameworks. The temporal scope captures pre-pandemic baseline conditions in 2019, acute disruption phase of the COVID-19 pandemic in 2020-2021, and subsequent recovery and adaptation period through 2023, enabling examination of both stable baseline performance and system resilience under crisis conditions. The dataset contains 620 observations across the study period, with proficiency levels reported as percentages of students achieving minimum competency standards in reading and mathematics. All data reflect nationally representative assessments conducted according to international standards for educational measurement, ensuring comparability across national contexts.

## Analytical Approach

The analysis employs a mixed-methods approach combining quantitative descriptive statistics with critical policy analysis to address the three research questions. For Research Question 1, comparative analysis of national-level early-grade proficiency outcomes was conducted using descriptive statistics to identify patterns in reading and mathematics achievement across the OECD sample. Countries were ranked according to their most recent proficiency rates to establish performance distribution and identify high-performing, middle-performing, and lower-performing groups. This categorization serves as a preliminary indicator of systemic equity, operating under the theoretical framework that countries achieving universally high proficiency rates at the early-grade level likely possess more equitable foundational education systems. The analysis recognizes that aggregate national performance cannot definitively establish within-country equity without disaggregated data, though cross-national comparison offers valuable insights into which national systems achieve broadly inclusive outcomes at the population level. For Research Question 2, temporal trend analysis examined changes in early-grade proficiency outcomes across the 2019-2023 period, calculating year-over-year changes in proficiency rates for countries with continuous data availability and identifying patterns of improvement, decline, or stability. Particular attention was directed toward performance trajectories during the 2020-2021 period, when COVID-19-related school closures and educational disruptions were most acute, and the subsequent 2022-2023 recovery phase. Countries were categorized according to their pandemic-period resilience, with resilient systems defined as those maintaining or improving proficiency rates despite disruption, and vulnerable systems defined as those experiencing sustained declines. The temporal analysis incorporates consideration of pre-existing performance levels, recognizing that countries beginning the period with lower baseline proficiency may face different challenges compared to high-baseline countries, and considers whether performance changes were distributed equally across reading and mathematics domains.

For Research Question 3, systematic data gap analysis was conducted by examining the structure and content of available SDG 4 indicator data against disaggregation requirements specified in the SDG framework and established principles of equity monitoring in early childhood education. This analysis documented which demographic dimensions are absent from the dataset, including sex-disaggregated outcomes, socioeconomic status indicators, geographic location comparisons, immigrant and language minority status, and disability or special educational needs categories. The implications of these data gaps were analyzed through the lens of rights-informed early childhood education theory, which emphasizes the necessity of visibility for marginalized populations in accountability systems. This component

incorporates document analysis of OECD reporting frameworks and SDG monitoring guidelines to understand whether data gaps reflect collection limitations, reporting choices, or privacy and ethical considerations in international data sharing.

## RESULTS

The analysis of SDG 4 indicator data across thirty-eight OECD countries during the 2019-2023 period reveals significant variation in early-grade learning outcomes, temporal patterns reflecting pandemic impacts, and critical gaps in equity monitoring capacity. Results are organized according to the three research questions.

### **Research Question 1: Cross-National Patterns in Early-Grade Proficiency**

The data reveal substantial variation across countries, with reading proficiency rates ranging from 87.2 percent (Ireland) to 58.4 percent (Colombia), representing a twenty-eight percentage point gap. Mathematics proficiency demonstrates a similar pattern, with some countries showing relative strength in one domain compared to the other.

The distribution reveals three broad performance tiers. High-performing countries, concentrated primarily in Northern and Western Europe and East Asia, achieve proficiency rates above 80 percent for both reading and mathematics, demonstrating feasibility within diverse policy contexts. These top-performing countries share common characteristics including substantial public investment exceeding one percent of GDP, near-universal pre-primary access exceeding 95 percent, comprehensive teacher training requirements, and low child poverty rates below 15 percent. Middle-performing countries show variable investment patterns and mixed pre-primary participation rates between 65 and 85 percent. Lower-performing countries demonstrate limited early childhood education and care investment below 0.5 percent of GDP, lower pre-primary participation below 70 percent, and higher child poverty rates exceeding 20 percent, often facing significant resource constraints.

The reading-mathematics correlation across countries is moderately strong with a Pearson correlation coefficient of approximately 0.78, suggesting that countries performing well in one domain tend to perform well in the other, though important exceptions exist reflecting differences in curriculum emphasis, instructional approaches, or assessment characteristics across national contexts.

### **Research Question 2: Temporal Trends and System Resilience**

Analysis of changes in early-grade proficiency between 2019 and 2023 reveals diverse trajectories across OECD countries, with the COVID-19 pandemic serving as a natural experiment in education system resilience.

Three distinct trajectory patterns emerge. Approximately one-quarter of countries demonstrated improvement in early-grade proficiency across the study period, with gains ranging from modest to substantial. These improving countries include both those starting from relatively lower baselines making catch-up progress and high performers further extending their advantage, suggesting improvement is possible across the performance spectrum. Roughly half of countries maintained relatively stable proficiency levels, with changes of less than two percentage points in either direction. This stability through

significant disruption suggests moderate resilience, though aggregate data cannot reveal whether national-level stability masked widening internal disparities between advantaged and disadvantaged populations. The remaining quarter experienced notable declines between 2019 and 2023, with losses exceeding two percentage points and in some cases surpassing five percentage points. These declining trajectories raise concerns about pandemic-related learning loss that has not been recovered by 2023, potentially indicating inadequate remediation efforts, resource constraints, or challenges in re-engaging students and families after prolonged disruption.

Examining pandemic-period performance more specifically, comparing 2019 baseline with 2021 outcomes during peak disruption and 2023 recovery reveals differential patterns. Highly resilient countries including Poland, Ireland, Estonia, Korea, Slovenia, Portugal, and Chile maintained or improved performance throughout, suggesting robust distance learning infrastructure, effective family support systems, and successful rapid adaptation. Countries showing moderate impact with recovery experienced temporary declines followed by improvement as in-person learning resumed and remediation efforts took effect. Countries with severe impact showing only partial recovery by 2023, including Sweden, United States, France, Belgium, and New Zealand, suggest that while significant progress has been made, complete restoration of pre-pandemic trajectories may require sustained effort and resource investment. Countries experiencing sustained vulnerability, unable to recover pre-pandemic performance levels by 2023, may be experiencing compounding disadvantage where initial crisis impacts combined with inadequate recovery resources create persistent achievement gaps.

### **Research Question 3: Equity Data Gaps and Monitoring Limitations**

Systematic examination of the SDG 4 indicator dataset reveals significant limitations in equity monitoring capacity despite comprehensiveness of aggregate national reporting.

The complete absence of disaggregated data across all equity dimensions represents a critical gap in current SDG 4 monitoring capacity for early childhood education outcomes. Despite explicit requirements in SDG monitoring guidelines for disaggregation by sex, wealth, and location at minimum, standardized international reporting provides only national aggregates. This limitation means progress toward SDG Target 4.1 is being assessed without visibility into whether improvements or declines are shared equally across populations or concentrated among already advantaged groups.

The gender data gap proves particularly notable given that sex-disaggregated data typically presents minimal technical or privacy challenges. The absence from standardized international datasets suggests either that disaggregated international reporting mechanisms lag behind national capacity, or that data sharing agreements and privacy considerations limit what can be included in publicly accessible international databases. The socioeconomic status gap presents more complex challenges, as wealth and income measures vary substantially across national contexts and may involve greater privacy sensitivities. However, proxy measures such as parental education level or school-level socioeconomic composition could potentially enhance equity monitoring without requiring individual-level income or wealth data. The absence of data on children with disabilities, immigrant and language minority children, and Indigenous populations means that educational experiences of groups most vulnerable to exclusion and marginalization cannot be monitored through current SDG indicator frameworks.

The implications of these data gaps extend beyond academic research to policy accountability and resource allocation. Without disaggregated data, holding education systems accountable for providing equitable opportunities to all children becomes difficult, as does targeting interventions and resources to populations experiencing greatest need. The invisibility of marginalized groups in monitoring systems risks perpetuating their marginalization by directing policy attention and resources toward improving aggregate national statistics without ensuring improvements reach all children. This dynamic contradicts the fundamental SDG principle of "leaving no one behind" and undermines commitments to supporting opportunities for all young children to access quality early childhood education.

## DISCUSSION

The findings reveal substantial variation in early childhood learning outcomes across OECD countries during unprecedented global disruption, with divergent pandemic trajectories and critical equity monitoring gaps illuminating both progress and persistent challenges in advancing toward Sustainable Development Goal 4.

The twenty-eight percentage point gap in reading proficiency demonstrates that national policy choices produce measurably different outcomes. Top-performing countries share common characteristics including substantial public investment exceeding one percent of GDP, near-universal pre-primary access, comprehensive teacher preparation, and robust social support structures mitigating child poverty, aligning with research emphasizing integrated policy approaches (Britto et al., 2017; Engle et al., 2011). However, aggregate national performance provides only partial insight into within-country equity. High proficiency rates suggest broadly inclusive systems but cannot reveal whether all children participate equally or whether certain groups remain systematically disadvantaged. This limitation reflects the critical data gap identified in Research Question 3, where aggregate indicators risk perpetuating epistemic violence by rendering marginalized populations invisible in accountability systems (Santos, 2014; Smith, 2012).

The temporal analysis reveals varying resilience to pandemic disruption. Highly resilient countries like Poland and Ireland maintained or improved performance despite widespread school closures through investments in digital infrastructure and family support systems enabling learning continuity (UNICEF, 2024). Conversely, Sweden's notable decline represents a reversal of strong performance, generating policy debate about support adequacy for immigrant and language minority children (UNESCO, 2024), while the United States' declining trajectory reflects longstanding challenges in providing equitable opportunities, with pandemic disruptions exposing and exacerbating pre-existing inequalities (Dorn et al., 2021). These patterns align with the polycrisis framework where overlapping challenges compound risks for vulnerable populations and strain systems' capacity to maintain quality and equity simultaneously (Lawrence et al., 2024).

Most critically, this study documents complete absence of disaggregated data across all equity dimensions in standardized international SDG 4 reporting. Despite explicit requirements for disaggregation by sex, wealth, and location, the dataset provides only national aggregates, representing fundamental failure to operationalize the "leave no one behind" principle (United Nations, 2024). The absence of sex-disaggregated data proves particularly puzzling given that gender breakdowns present minimal technical or privacy challenges. International assessments routinely collect such information, suggesting

standardized international reporting mechanisms lag substantially behind national data collection capacity (Zhao et al., 2022). The invisibility of socioeconomic disparities, children with disabilities, immigrant and language minority children, and Indigenous populations means groups most vulnerable to exclusion remain completely invisible in international monitoring systems, limiting ability to design targeted interventions (Campbell Barr & Bogatić, 2017). The neoliberal measurement paradigm manifests clearly here, as emphasis on efficiency and standardized accountability produces monitoring systems privileging easily quantifiable aggregate outcomes over documenting how different groups experience education systems (Ball, 2012; Hastings, 2019).

## CONCLUSION

This study examined early childhood learning outcomes across thirty-eight OECD countries during the 2019-2023 period, revealing substantial variation in early-grade proficiency, divergent pandemic trajectories, and critical equity monitoring gaps. The twenty-eight percentage point gap in reading proficiency underscores that national policy choices produce measurably different outcomes, with top-performing countries sharing characteristics including substantial public investment, near-universal pre-primary access, and strong social support structures. However, aggregate national performance provides only partial insight into equity, as high average outcomes may mask persistent disadvantages faced by marginalized populations whose experiences remain invisible without disaggregated data. Temporal analysis reveals that approximately one-quarter of countries improved proficiency despite pandemic disruption, half maintained stable performance, and one-quarter experienced declines persisting through 2023, suggesting certain structural features provide protective effects during crises. Most critically, this study documents complete absence of disaggregated data across all equity dimensions in standardized international SDG 4 reporting. Despite explicit requirements for disaggregation by sex, wealth, and location, current monitoring systems provide only national aggregates that obscure within-country inequalities. This gap represents fundamental failure to operationalize the "leave no one behind" principle. The invisibility of children with disabilities, immigrant and language minority children, Indigenous populations, and those from low-income families constitutes structural violence that denies these children recognition in accountability processes. Addressing these gaps requires substantial strengthening of international monitoring architecture with attention to critical perspectives questioning whose knowledge counts and how to balance standardization with cultural responsiveness. Participatory approaches engaging communities in defining relevant outcomes offer promise for developing inclusive monitoring frameworks that honor multiple epistemologies while maintaining accountability for children's rights. The polycrisis context adds urgency to these reform imperatives, as robust equity monitoring becomes essential for identifying where disruptions hit hardest and evaluating whether emergency responses protect vulnerable children or widen opportunity gaps. For the global early childhood education community working toward SDG 4, the findings demonstrate that universal high-quality early childhood education demands more than expanding aggregate access. It requires systematic attention to reaching marginalized populations, monitoring outcomes across multiple equity dimensions, and holding systems accountable for serving all children rather than privileging those easiest to reach.

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