Humanities & Social Sciences Communications

ARTICLE

https://doi.org/10.1057/s41599-024-03002-8 OPEN

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Students with special educational needs in regular classrooms and their peer effects on learning achievement

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This study explores the impact of inclusive education on the educational outcomes of students without Special Educational Needs (non-SEN) in Peru, utilizing official Ministry of Education data and implementing cross-sectional regression analyses. Inclusive education is a complex issue that, without appropriate adaptations and comprehensive understanding, can present substantial challenges to the educational community. While prior research from developed nations offers diverse perspectives on the effects of inclusive education on non-SEN students, limited evidence exists regarding its impact in developing countries. Our study addresses this gap by examining inclusive education in Peru and its influence on non-SEN students, thereby contributing to the existing literature. Our findings reveal that, on average, the presence of SEN students in regular classrooms does not significantly affect their non-SEN counterparts. However, we uncover heterogeneous results contingent on the specific type of SEN and students' academic placement. These results emphasize the importance of targeted resources and parental involvement in facilitating successful inclusive education, particularly for specific SEN types. In summary, this study underscores the need for tailored strategies and additional resources to foster the success of inclusive education and calls for further research in this field to expand our understanding and enhance educational policy.

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Introduction

Inclusive education has become a significant policy for improving access to and the quality of education for children with special educational needs (SEN), who often encounter physical and social barriers hindering their access to education and entry into the labor market, which in turn is detrimental to the economic and social progress of a country (Filmer, 2008; Mitra and Sambamoorthi, 2008). Thus, the United Nations has declared "inclusive and equitable quality education" as the fourth 2030 Sustainable Development Goal, which aims to reduce the disability gap in education. Likewise, there exist international declarations like the Salamanca Statement in 1994 (UNESCO, 1994) or the Declaration of the Decade of the Americas for the Rights and Dignity of Persons with Disabilities 2016–2026 (OAS, 2018) that incorporate the principle of inclusive education to guarantee education for all.

There are different education approaches[1] to ensure education for children with SEN, but the inclusive approach, unlike others, promotes equal participation of SEN students in regular schools by attending classes alongside same-aged non-SEN students (Dixon, 2005). Inclusive education goes beyond the placement of pupils; it refers to a unified system that receives all students regardless of their abilities or disabilities (Dixon, 2005). Under the inclusive approach, governments and schools should provide the means (i.e., physical and human resources) to reduce or eliminate physical, academic, and social hurdles faced by SEN students within regular schools (Dixon, 2005). Thus, inclusive education aims for social cohesion and a less discriminatory education approach that helps enhance the human capital acquisition of children with SEN (Kiuppis, 2014).

Despite the efforts for an inclusive education agenda worldwide, children with SEN remain behind in education indicators such as years of education, school attendance, or academic achievement (Filmer, 2008; Rangvid, 2022). This raises concerns about the impact that placement of children with SEN in regular schools may have on the educational achievement of children without SEN since these children are also involved in the inclusive education system (Rangvid, 2019; Ruijs and Peetsma, 2009). In Peru, for instance, some teachers in regular schools as well as some leaders of deaf organizations, do not support inclusive education as they think it is detrimental for both SEN and non-SEN students (Goico, 2019; Peruvian Ombudsman, 2019). Nevertheless, there is little empirical literature focused on the effects of inclusive education not only on SEN students but also on non-SEN students, especially in developing countries that shelter a high percentage of people with disabilities (Olusanya et al., 2022). This paper, therefore, aims to fill that gap by using information from a developing country, namely Peru. It investigates the impact of inclusive education, quantified through the presence of students with SEN in regular classrooms, on the academic performance of their non-SEN counterparts. Analyzing the peer effects of inclusive education is of utmost interest for policymakers aiming to increase the presence of SEN students in regular schools, as policy implications should consider the effects on all children.

The present work provides three main contributions to the existing literature regarding peer effects in the context of inclusive education. First, we provide new evidence using unusual and rich data from a middle-income country. To our knowledge, there is only one study focusing on a developing country. Indeed, Contreras et al. (2020) analyze the Chilean case and find that placement of children with SEN in regular classrooms negatively affects the standardized test scores in mathematics and reading of their non-SEN peers, but it is neutralized when schools receive additional resources and specialized professionals. Nevertheless, Contreras et al. (2020) use panel data for students attending primary schools in two periods, 2007 and 2011, without including types of SEN. In contrast, we study children attending primary and secondary schools using cross-section data between 2011 and 2019 and disaggregate our analysis by types of SEN[2].

Our second contribution is to disaggregate our analysis by type of SEN. We are aware of two studies that use an overall indicator to reflect the presence of SEN students and disaggregate it by type of SEN. On one hand, Hanushek et al. (2002) examine two types of special educational needs: learning or emotional and speech; while, Ruijs (2017) examines four types: visual, hearing, physical or intellectual, and behavioral. In our case, besides evaluating the consequences of placing children with mobility, vision, hearing, and intellectual or learning disabilities in a regular classroom, we also evaluate the repercussions of placing children with autistic spectrum disorder in a regular classroom, which is a much less studied topic.

Finally, our third contribution is to explore the heterogeneous results of inclusive education on the non-SEN student population. Unlike previous studies, we explore the potential different impact of inclusive education between male and female non-SEN students. As most reproductive work has traditionally been done by women (cf. Razavi, 2012), it could be argued that female non-SEN students are more likely to take care of or help SEN students, which in turn may influence their educational achievement. Our heterogeneity analysis also takes into account school characteristics like classroom size as well as mother's characteristics.

In our analysis, we take significant steps to mitigate potential biases stemming from endogenous classroom selection and the sorting of SEN students. We achieve this by focusing on schools with one class per grade level, which provides a more controlled setting for our study. Moreover, our dataset allows us to identify the class composition, which is vital for investigating educational peer effects. The classroom environment is particularly relevant, as classmates have a substantial impact on each other's educational outcomes, given their shared classroom experience throughout the school day (Balestra et al., 2022; Burke and Sass, 2013; Lazear, 2001).

Our findings suggest that the inclusion of students with SEN in regular classrooms, on average, exerts a neutral influence on their non-SEN peers. A nuanced examination reveals varied results contingent upon the specific categories of SEN. This variability is consistent with the fact that SEN encompasses a broad spectrum of support requirements arising from diverse degrees and types of individual abilities, spanning physical, psychological, cognitive, and sensory domains. Hence, the influence of inclusive education would vary according to the distinct profile of the SEN student integrated into a conventional classroom setting. Furthermore, our results underscore the importance of accounting for temporal dynamics and the particular educational phase in gauging the impact of SEN students on their non-SEN counterparts. This observation aligns with the differential results discerned across academic grades.

The rest of the paper is organized as follows. The literature review and institutional setting are presented in the next section, followed by a description of the data and empirical strategy. After that, we discuss our results, and finally, we conclude.

Background

This section starts with a brief literature review and then describes the main features of the Peruvian educational system as well as its public policy approach to inclusive education.

Literature review. The inclusion of students with SEN in regular schools remains a subject of debate due to the mixed findings within the empirical literature. Proponents of inclusive education argue that attending regular schools is not only a fundamental human right for children with SEN (Ainscow and César, 2006; Rangvid, 2022; Ruijs and Peetsma, 2009) but can also yield benefits for non-SEN students, particularly in terms of their learning development. This is attributed to the additional resources allocated to inclusive education (Keslair et al., 2012; Ruijs, 2017). Besides, inclusive education may help children without SEN to develop soft skills like kindness, tolerance, and patience, which are important to living in a diverse society (Contreras et al., 2020; Dixon, 2005). On the other hand, the main concerns regarding inclusive education are related to negative peer effects. The literature on class composition states that students' performance is influenced by their peers' characteristics (Ammermueller and Pischke, 2009; Burke and Sass, 2013; Lavy et al., 2012). Since children with SEN may require more teaching attention and show disruptive behaviors (Ahmed et al., 2021; Contreras et al., 2020; Rangvid, 2019; Ruijs, 2017), they could be considered "bad" students who could interfere with the educational development of their classmates without SEN (Lavy et al., 2012; Lazear, 2001), especially for those who are at the bottom of the ability distribution (Balestra et al., 2022; Lavy et al., 2012).

The quantitative studies that examine the peer effects of inclusive education mainly use data from developed countries. Most of them have found that inclusive education has a negative or null effect on non-SEN students' outcomes. For instance, using data from Switzerland, Balestra et al. (2022) find that placing SEN students in regular classrooms harms not only educational outcomes but also labor market outcomes for non-SEN students. Similarly, studies from the United States (Fletcher, 2010) and Denmark (Kristoffersen et al., 2015; Rangvid, 2019) show that exposure to SEN students decreases reading test scores of non-SEN students. Also, for the United States, Gottfried (2014) and Gottfried et al. (2016) present evidence that inclusive education worsens the non-cognitive skills of non-SEN students. Fletcher (2010), however, points out that the negative effect of inclusive education in the United States disappears for reading when their lagged scores are considered in the analysis. Likewise, studies for Canada (Friesen et al., 2010), England (Keslair et al., 2012), and the Netherlands (Ruijs, 2017) also find that the presence of SEN students does not affect the academic performance of their non-SEN peers; but they point out that this result may be due to additional resources received by regular schools with SEN students. Conversely, other studies have found positive externalities of SEN students on the educational achievement of their non-SEN peers. For instance, Cole et al. (2004) point out that non-SEN students in the United States perform better at reading and mathematics tests since they may benefit from the additional resources allocated to inclusive education. Likewise, Hanushek et al. (2002) find that non-SEN students attending inclusive classrooms in the United States improve their mathematics test scores. Using data from the same country, Gottfried and McGene (2013) go beyond by showing that having a sibling with SEN helps to improve the schooling achievement of those siblings without SEN.

Several meta-analyses and systematic reviews have examined the effects of inclusive education on students with and without SEN. The coincidences lie in the varied impacts of inclusive education on non-SEN students, demonstrating a nuanced and context-dependent picture. While Dell'Anna et al. (2021) hint at positive peer attitudes in inclusive settings, the academic outcomes and the experience of non-SEN students diverge, with high achievers potentially benefiting more than low achievers (Ruijs and Peetsma, 2009). Kart and Kart (2021) and Szumski et al. (2017) contribute to the discussion, highlighting mixed academic effects across different grade levels. The meta-analyses by Oh-Young and Filler (2015) and Krämer et al. (2021) emphasize the overall positive impact of inclusive settings for students with SEN while still acknowledging variations in outcomes. Finally, Van Mieghem et al. (2020) emphasize the pivotal role of teacher professional development in the successful implementation of inclusive education.

Finally, it is worth mentioning that the conflicting results found in the literature may be explained by the differences in the criteria used to identify a SEN student. Most of the previous studies have used an aggregated measure to encompass all SEN students without considering the types of SEN (e.g., Contreras et al., 2020; Rangvid, 2019). On the other hand, some studies have focused on one or two types of special needs; such as emotional disturbances and mental disabilities (e.g., Cole et al., 2004; Fletcher, 2010; Hanushek et al., 2002; Kristoffersen et al., 2015), or learning and behavioral disabilities (e.g., Cole et al., 2004; Friesen et al., 2010; Hanushek et al., 2002). The present paper addresses these limitations found in the literature by taking into account different types of SEN and also by exploring the potential heterogeneous results of inclusive education for non-SEN students.

Institutional setting: The educational system in Peru. Primary and secondary education in Peru is compulsory and provided by the government at no cost and by the private sector with a wide tuition range. Peruvian children between 6- and 11- years old attend primary school and start secondary school by the age of 12 for a period of 5 years. The last National Population Census in 2017 reports that roughly 5.4% and 7.0% of Peruvians who are primary-school and secondary-school-aged, respectively, have at least one disability. However, according to the School Census of the same year, <1% of children attending regular schools are categorized as SEN students, which suggests that inclusive education in Peru is not well developed. Despite this low enrollment rate, the percentage of SEN students grew from 0.26% in 2007 to 0.96% in 2019.

Since primary and secondary schools in Peru must comply with a mandatory national curriculum, the same courses are taken by children who attend the same grade level across different schools. Schools may have more than one class per grade level, which are called *sections*, which students are assigned when they start primary school, which makes it less likely that students are sorted in a non-random fashion. Besides, every section has a specific classroom where students are instructed in most of their courses; thus, students do not need to move among different classrooms throughout the school day. At the primary school, the teacher assigned to a section is usually responsible for the majority of the courses; whereas, at the secondary school, it is often the case that there is a different teacher for each course. Another characteristic of the Peruvian education system is that it allows parents to send their children to any school, public or private, even if that school is outside their district of residence.

According to the last National Population Census in 2017, Peru has achieved almost universal coverage of education, 94.9% of the population aged 12 or over have primary education, and 74.5% aged 17 or over have secondary education. These numbers, however, mask a disability gap. Among adults aged 17 or over, 14.1% of people with at least one disability report having no education, whereas only 3.9% of people with no disabilities report the same. There is also an educational disability gap of 11.9 percentage points (p.p.) among the female population, but it decreases to 7.1 p.p. among the male population. These figures suggest that having a disability poses a larger burden for females than for males.

In this context, the Peruvian National Education Law recognized in 2003 inclusive education as the main approach to providing education to students with SEN, which should be accompanied by supplementary one-to-one attention by specialists (Congreso de la República, 2003). Thus, the Peruvian legal framework advocates an inclusive approach to integrating children and youth with disabilities into society. Aligned with the national inclusive policy, the state, as per the 2012 General Law of Persons with Disabilities (Law 29973), ensures access to quality inclusive education that accommodates individual needs. This entails adjustments in infrastructure, furniture, materials, curriculum, and teaching processes, all aimed at facilitating quality learning and fostering the comprehensive development of each student. It is worth noting, however, that empirical evidence indicates that many regular schools lack the necessary infrastructure, materials, and human resources to accommodate students with disabilities (Cueto et al., 2018; Peruvian Ombudsman, 2011).

The basic education system comprises three modalities: regular basic education (EBR), alternative basic education (EBA), and special basic education (EBE). EBR represents conventional formal education. EBA caters to students who lack access to EBR, emphasizing vocational and entrepreneurial skills. EBE is designated for students with SEN related to disability, talent, or giftedness. EBA and EBR schools, when admitting students with SEN, are termed *inclusive schools*. EBE operates in both inclusive schools and standalone EBE schools. In inclusive schools that accept students with mild disabilities and giftedness, EBE provides support and guidance through programs like Support and Advisory Services for Special Educational Needs (SAANEE). This includes personalized services and support to students, parents, teachers, and school principals through weekly visits of specialized professionals (Congreso de la República, 2006). Nevertheless, the evidence shows that inclusive education in Peru is far from successfully being implemented, and it is combined with an "integration approach" (Peruvian Ombudsman, 2011). On the other hand, dedicated EBE schools directly serve severe and multi-disabled students with needs beyond the scope of EBR or EBA schools. EBR and EBA schools are mandated to reserve at least two slots per classroom during the enrollment period for the inclusion of students with mild or moderate disabilities. However, in practice, this requirement is not systematically fulfilled (Cueto et al., 2018).

Data and methodology

In this study, we use three datasets that are collected by the Peruvian Ministry of Education (MINEDU). First, we utilized the Student Census Evaluation (ECE) as our primary data source, which encompasses the scores achieved by students in the national standardized tests of reading and mathematics[3]. To create our dependent variable, "learning achievement", we transformed these scores into z-scores, standardizing them by grade level and by subject to have a mean of zero and a standard deviation of one for use in our econometric analysis. Furthermore, the ECE dataset includes additional demographic information such as gender and the primary language spoken by the students. The ECE started in 2007, with annual assessments of students in the 2nd grade of primary (2P). Subsequently, it was expanded in 2015 to encompass students in the 2nd grade of secondary (2S). In 2017, however, the ECE was not conducted. Our second dataset is the National School Census (CE) which contains information regarding school characteristics and grade composition. The CE has been yearly collected since 2004, and it covers public and private schools. We use it to measure inclusive education by identifying the presence of SEN students at the section level. These two datasets are merged at the school level through a school identifier; thus, each student is linked to section characteristics in the school he or she is attending. The last dataset is the Information System to Support the Management of the Education Institution (SG), which was implemented in 2003 but has been mandatory only since 2011. The SG contains information that is uploaded every year by teachers or school principals. This includes students' age, mothers' age and education, and number of siblings. The SG is merged with the other datasets by using a student identifier.

For our analysis, we focus on students attending 2P in the period dating from 2011 to 2016 (excluding 2014)[4] and students attending 2S from 2015 to 2019 (excluding 2017).[5] For both grades, 2P and 2S, we account for potential grade advancement and delay.[6] Therefore, in the case of 2P where students are usually 7 years old, we include children aged between 6 and 8 years, and for 2S where students are usually 13 years old, we include children aged between 12 and 14 years. The final number of observations for 2P comprises 55,637 students who took the reading test and 55,614 students who took the mathematics test. And, for 2S, we have 47,491 students who took the reading test and 47,484 students who took the mathematics test.

To evaluate the influence of inclusive education on non-SEN students' learning achievement, we use the CE where the school principal reports the number of SEN students placed in each grade level every year and per type of SEN.[7] This report is based on medical certificates, psycho-pedagogical certificates, and parents' affidavits. Thus, we can identify the presence of SEN students per section to measure inclusive education.[8] Besides, we disaggregate the presence of SEN students per type. Specifically, we distinguish, for each section, the presence of students with mobility, vision, hearing, and intellectual or learning disabilities, as well as those with autistic spectrum disorder (ASD). In the case of intellectual or learning disabilities, the CE includes those students with Down syndrome, brain injury, dyslexia, and developmental aphasia. The other SEN types considered in the CE include students with speech impairment, deaf-blindness, and hospitalized. Although gifted students are identified as SEN students in the CE, we exclude them in our measure of SEN.

There are three main challenges to estimating peer effects, as stated by Manski (1993), that could hinder proper identification of the influence of SEN students on the learning achievement of their non-SEN peers. First, students in the same cohort could face similar environmental factors or have similar unobserved characteristics that may influence their academic outcomes rather than having classmates with SEN. To disentangle the environment from peer effects, we follow the literature by using a large number of observations and fixed effects (Balestra et al., 2022; Burke and Sass, 2013).

Second, there is a potential reflection problem as classmates may influence each other and determine their outcomes simultaneously. Since we focus on SEN characteristics related to physical disabilities, health issues, and injuries determined by specialists, it is less likely that the SEN status of students was determined by the learning achievement of their non-SEN peers.

The third problem is related to self-selection. In the Peruvian school system, parents may choose to send their children to any school regardless of their district of residence; thus, specific school characteristics may attract certain types of students. To address this problem, we restrict the analysis to schools with similar characteristics. We select schools located in urban areas providing mixed-sex education that operate on the main school campus only during the morning shift and with 10–30 students per section. In the case of primary education, we select full-grade schools.[9] Besides, to address a potential sorting problem that could make it difficult to identify whether the learning outcome is due to the presence of SEN students or one's ability, we select schools with one section per grade level. In this way, we avoid the

Table 1 Balancing tests for 2nd grade of primary.

	(1)	(2)	(3)	(4)	(5)
Panel A			***Women***		
At least one SEN student	−0.005	−0.005	−0.009	−0.009	−0.009
	(0.008)	(0.008)	(0.012)	(0.012)	(0.012)
Panel B			***Indigenous language***		
At least one SEN student	0.006	0.006	0.007	0.007	0.007
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Panel C			***Age***		
At least one SEN student	0.001	0.000	0.003	0.003	0.003
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Panel D			***At least one SEN student***		
Women		−0.001	−0.003	−0.003	−0.003
		(0.002)	(0.003)	(0.003)	(0.003)
Indigenous language		0.011	0.012	0.012	0.012
		(0.015)	(0.015)	(0.015)	(0.015)
Age		0.000	0.001	0.001	0.001
		(0.003)	(0.003)	(0.003)	(0.003)
Ho: Women = Indigenous language = Age = 0					
F-stat		0.31	0.50	0.51	0.52
p-value		0.815	0.682	0.675	0.670
Year fixed effects	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes
Student controls		Yes	Yes	Yes	Yes
Cohort controls			Yes	Yes	Yes
School controls				Yes	Yes
Family controls					Yes
Observations	55,605	55,605	55,605	55,605	55,605

Each column represents a separate regression. Student controls include sex, language, and age. Cohort controls include mean age, proportion of male students, proportion of students who speak an indigenous language, and number of students. School controls include the number of students. Family controls include mothers' age and education and number of siblings. Standard errors clustered at the school level are in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

possibility for school administrators to group students into sections based on their characteristics or for parents to choose a section without SEN students. Finally, more than 90% of non-SEN students take the standardized national tests, which suggests that school principals do not select high-performance students to take these tests.

To test the validity of our identification strategy, we perform two balancing checks for 2P and 2S, presented in Tables 1 and 2, respectively. To perform these balancing checks, we use only students who took both reading and mathematics standardized tests, rather than separating them by subject as we do for the econometric analyses. Panels A, B, and C show that the presence of at least one SEN student does not determine the gender, language, or age of non-SEN students, respectively. We observe that coefficients are statistically not significant, and their size is smaller in comparison to those from the main analysis, except for reading test scores in 2S. In addition, panel D shows that individual characteristics do not determine the presence of at least one SEN student in the classroom. These results provide evidence against the likelihood of selection into classrooms.

To examine the impact of inclusive education on standardized test performance of non-SEN students, we estimate the following linear model:

$$\begin{aligned}\mathrm{EDC}_{ist} = \alpha_0 + \alpha_1 \mathrm{SEN}_{st} + \alpha_2 \mathrm{STD}_{ist} + \alpha_3 \mathrm{SEC}_{st} \\ + \alpha_4 \mathrm{SCH}_t + \alpha_5 \mathrm{HH}_{it} + \gamma_s + \gamma_t + \varepsilon_{ist}\end{aligned} \tag{1}$$

Equation (1) is estimated separately for each grade level (2P or 2S) and subject (reading or mathematics) using a linear regression. EDC_{ist} is the learning achievement of student i in section s at year t, measured by the z-score of the standardized test. SEN_{st} is a dichotomous variable capturing the presence of at least one SEN student in section s at year t; thus, α_1 is our parameter of interest. In other specifications below, SEN_{st} will be differentiated by type of SEN. STD_{ist} is a vector of student-level control variables that include age in years and indicators for gender (1 = women) and spoken language (1 = indigenous). The vector SEC_{st} controls for section-level variables without student i. It includes mean age, proportion of male students, proportion of indigenous speakers, and number of students. The vector SCH_t includes number of students at the school level. HH_{it} includes the following household characteristics: mother's age, mother's education, and the number of siblings. We also include school-fixed effects (γ_s)[10] and year-fixed effects (γ_t). Finally, ε_{ist} is an unobserved error term, and we cluster standard errors at the section level as this is the common environment shared by students (Balestra et al., 2022).

To assess potential heterogeneous influences, we follow recent literature[11] and estimate Eq. (1) using split samples by the characteristic of interest (Feigenberg et al., 2023). In particular, we evaluate the gender of the student i. For section characteristics, we evaluate the number of students. Finally, we assess the varying estimates based on the mother's age and the mother's education. In the case of characteristics that are represented by continuous or categorical variables, we convert them into dichotomous variables. For the number of students, we split the sample between sections that have 20 or fewer students and sections with 21 or more students. In the case of the mother's age, we use the mean age to split the sample above and below the mean. The mean age is 41.5 for those mothers with children who attend 2P and 44.8 for those with children who attend 2S. Finally, for mothers' education, we split the sample between those with and without tertiary education.

The descriptive statistics for our final cross-section subpopulations are presented in Table 3. All descriptive and econometric analyses were conducted using Stata 18. In this case, we combine observations that include students who took both

Table 2 Balancing tests for 2nd grade of secondary.

	(1)	(2)	(3)	(4)	(5)
Panel A			***Women***		
At least one SEN student	−0.005	−0.005	−0.009	−0.008	−0.009
	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)
Panel B			***Indigenous language***		
At least one SEN student	−0.002	−0.002	−0.001	−0.001	−0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Panel C			***Age***		
At least one SEN student	0.008	0.008	0.009	0.009	0.005
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Panel D			***At least one SEN student***		
Women		−0.001	−0.002	−0.002	−0.002
		(0.002)	(0.004)	(0.004)	(0.004)
Indigenous language		−0.002	−0.001	−0.001	−0.002
		(0.010)	(0.010)	(0.010)	(0.010)
Age		0.001	0.001	0.001	0.001
		(0.002)	(0.002)	(0.002)	(0.002)
Ho: Women = Indigenous language = Age = 0					
F-stat		0.22	0.28	0.26	0.20
p-value		0.886	0.840	0.855	0.895
Year fixed effects	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes
Student controls		Yes	Yes	Yes	Yes
Cohort controls			Yes	Yes	Yes
School controls				Yes	Yes
Family controls					Yes
Observations	47,479	47,479	47,479	47,479	47,479

Each column represents a separate regression. Student controls include sex, language, and age. Cohort controls include mean age, proportion of male students, proportion of students who speak an indigenous language, and number of students. School controls include the number of students. Family controls include mothers' age and education and number of siblings. Standard errors clustered at the school level are in parentheses
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.10$.

reading and mathematics standardized tests, as the characteristics of the separated subpopulations are similar to each other. According to Table 3, students with SEN generally have lower reading and mathematics scores compared to their peers without SEN across both primary and secondary grades. This trend is more pronounced in 2S compared to 2P. We also observe in Table 3 that the proportions of women and indigenous language speakers are relatively consistent across SEN and non-SEN cohorts. Approximately 48% of the students are female, and the average age is 6.9 in 2P and 12.9 in 2S. However, it is interesting to note that the mean proportion of indigenous language speakers is higher in 2S (~22%) compared to 2P (~12%), indicating a potential demographic shift as students progress through the education system. A similar trend for indigenous language speakers is observed at the section level. Moreover, figures in Table 3 show that the mean age in a section is ~7.2 in 2P and 13.3 in 2S, the sample is balanced between male and female students at the section level, and there are around 20 students per section. Regarding household characteristics, the average age of mothers is 41.5 for those with children in 2P and 44.8 for those with children in 2S, around 6 out of 10 students have mothers with primary or secondary education, and the majority of students have more than two siblings. Finally, students enrolled in primary education typically attend larger schools, characterized by a pupil population exceeding 120, in contrast to those in secondary education, where schools typically accommodate fewer than 100 students.

Empirical results

Regression results from Eq. (1) are shown in Table 4.[12] For column (1), we use ECE and CE datasets, which do not include students' age or household characteristics. For columns (2) through (6), we add the SG dataset to incorporate students' age and household characteristics. Columns (1) through (4) include the proportion of repeaters and the presence of at least one specialized teacher when students were 3 years old, and they were not attending school; thus, the presence of an SEN student should not influence the proportion of repeaters or presence of a specialized teacher. Columns (5) and (6) do not include those variables, and the results remain similar to those obtained in the previous columns. In addition, as a robustness check, we try different subpopulations based on students' age (columns (2) through (4)) and schools with variation in SEN students (column (6)). For all the specifications, our results consistently show that the presence of at least one SEN student as a measure of inclusive education does not have a significant influence on the learning achievement of students who attend 2P or 2S. Our findings align with similar results from other countries such as Canada (Friesen et al., 2010), England (Keslair et al., 2012), and the Netherlands (Ruijs, 2017), indicating that inclusive education does not have a significant impact on the academic achievement of non-SEN students.

Nevertheless, we notice in Table 4 that, after including students' age and household characteristics, the negative relationship between inclusive education and learning achievement (column 1) turned into a positive relationship (columns 2 through 6). Even in the case of students who attend 2S, the magnitude of the positive relationship between inclusive education and mathematics scores increased when student's age and household characteristics were included in the regression. This suggests that the attributes of a student's household, along with individual traits correlated with them, such as motivation, self-discipline, and parental support, may exert a positive influence on their learning environment. This influence could potentially counterbalance any adverse effects of inclusive education. An alternative explanation

Table 3 Descriptive statistics (mean), differentiated by presence of at least one SEN student.

	(1) 2P	(2)	(3) 2S	(4)
	Cohort with SEN	Cohort without SEN	Cohort with SEN	Cohort without SEN
Reading score	−0.119	−0.173	−0.306	−0.394
	(0.874)	(0.894)	(0.859)	(0.863)
Mathematics score	0.027	−0.032	−0.190	−0.291
	(0.925)	(0.960)	(0.899)	(0.863)
Women	0.474	0.480	0.486	0.487
	(0.499)	(0.500)	(0.500)	(0.500)
Indigenous language	0.124	0.121	0.229	0.224
	(0.330)	(0.327)	(0.420)	(0.417)
Age	6.953	6.937	12.957	12.958
	(0.454)	(0.468)	(0.622)	(0.645)
Section: Mean age	7.287	7.245	13.291	13.299
	(0.366)	(0.374)	(0.463)	(0.660)
Section: Prop. of men	0.524	0.518	0.527	0.524
	(0.118)	(0.120)	(0.114)	(0.121)
Section: Prop. of indigenous students	0.108	0.116	0.222	0.204
	(0.280)	(0.301)	(0.353)	(0.363)
Section: number of students	21.003	20.263	21.114	20.346
	(5.487)	(5.506)	(5.426)	(5.524)
School: number of students	126.326	123.009	99.668	95.705
	(39.457)	(38.189)	(32.771)	(30.397)
Mother's age	41.338	41.482	44.547	44.794
	(5.756)	(5.719)	(6.527)	(6.406)
Mother: No education	0.190	0.214	0.276	0.312
	(0.392)	(0.410)	(0.447)	(0.463)
Mother: Primary and secondary	0.723	0.699	0.656	0.639
	(0.447)	(0.459)	(0.475)	(0.480)
Mother: Tertiary	0.087	0.087	0.068	0.049
	(0.282)	(0.283)	(0.251)	(0.215)
Number of siblings	2.385	2.420	2.789	2.884
	(1.512)	(1.538)	(1.926)	(1.923)
Observations	9380	46,225	6757	40,722

Standard deviations are in parentheses.

Table 4 Estimates of the presence of at least one SEN student on their peers' achievement.

	(1)	(2)	(3)	(4)	(5)	(6)
A. 2nd grade of primary						
Dataset	**ECE + CE**	**ECE + CE + SG**				**Restricted**
		6 y–7 y	**7 y–8 y**	**6 y–8 y**	**6 y–8 y**	**6 y–8 y**
Reading	−0.016	0.009	0.012	0.010	0.013	0.010
	(0.018)	(0.023)	(0.024)	(0.023)	(0.023)	(0.023)
Observations	126,112	50,237	46,936	54,624	55,637	31,595
Mathematics	0.004	0.009	0.006	0.010	0.013	0.011
	(0.023)	(0.030)	(0.031)	(0.029)	(0.029)	(0.030)
Observations	126,064	50,218	46,918	54,603	55,614	31,582
B. 2nd grade of secondary						
Dataset	**ECE + CE**	**ECE + CE + SG**				**Restricted**
		12 y–13 y	**13 y–14 y**	**12 y–14 y**	**12 y–14 y**	**12 y–14 y**
Reading	−0.017	0.013	0.016	0.006	0.001	0.001
	(0.016)	(0.021)	(0.020)	(0.019)	(0.018)	(0.018)
Observations	67,254	32,584	30,474	39,676	47,491	18,873
Mathematics	0.011	0.041	0.023	0.031	0.027	0.030
	(0.019)	(0.025)	(0.023)	(0.023)	(0.022)	(0.023)
Observations	67,238	32,577	30,467	39,669	47,484	18,869

Each coefficient represents a separate regression with the presence of at least one SEN student as the independent variable. All the regressions include year and school fixed effect as well as student, cohort, and school controls for columns 1 through 6 and family controls for columns 2 through 6. Student controls include sex and language for columns 1 through 6 and age for columns 2 through 6. Cohort controls include mean age, proportion of male students, proportion of students who speak an indigenous language, and number of students. School controls include the number of students for columns 1 through 6, and presence of at least one specialized teacher, and the proportion of repeaters when students were 3 years old for columns 1 through 4. Family controls include mothers' age and education and number of siblings. The sample used in column 6 excludes schools without variation in SEN students. Standard errors clustered at the school level are in parentheses
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

Table 5 Estimates of the presence of at least one SEN student on their peers' achievement by type of SEN.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. 2nd grade of primary	**Reading**					**Mathematics**				
Mobility disability	−0.060	−0.058	−0.056	−0.056	−0.049	−0.073	−0.072	−0.069	−0.069	−0.064
unadjusted p-value	*(0.307)*	*(0.319)*	*(0.339)*	*(0.334)*	*(0.398)*	*(0.337)*	*(0.346)*	*(0.368)*	*(0.367)*	*(0.405)*
Romano-Wolf p-value	*[0.574]*	*[0.566]*	*[0.618]*	*[0.614]*	*[0.781]*	*[0.638]*	*[0.614]*	*[0.689]*	*[0.697]*	*[0.781]*
Vision disability	0.132	0.129	0.133	0.132	0.135	0.139	0.140	0.151	0.151	0.154
unadjusted p-value	*(0.076)**	*(0.087)**	*(0.079)**	*(0.082)**	*(0.073)**	*(0.114)*	*(0.113)*	*(0.088)**	*(0.088)**	*(0.081)**
Romano-Wolf p-value	*[0.056]**	*[0.052]**	*[0.044]***	*[0.044]***	*[0.040]***	*[0.104]*	*[0.088]**	*[0.048]***	*[0.044]***	*[0.040]***
Hearing disability	0.056	0.059	0.057	0.060	0.066	0.028	0.030	0.028	0.029	0.033
unadjusted p-value	*(0.434)*	*(0.414)*	*(0.433)*	*(0.410)*	*(0.353)*	*(0.763)*	*(0.745)*	*(0.764)*	*(0.759)*	*(0.720)*
Romano-Wolf p-value	*[0.853]*	*[0.785]*	*[0.825]*	*[0.805]*	*[0.705]*	*[0.992]*	*[0.996]*	*[0.996]*	*[0.988]*	*[0.988]*
Cognitive disability	0.008	0.009	0.009	0.009	0.007	0.023	0.023	0.022	0.022	0.021
unadjusted p-value	*(0.755)*	*(0.740)*	*(0.746)*	*(0.731)*	*(0.784)*	*(0.501)*	*(0.504)*	*(0.517)*	*(0.515)*	*(0.543)*
Romano-Wolf p-value	*[0.992]*	*[0.996]*	*[0.996]*	*[0.988]*	*[0.988]*	*[0.936]*	*[0.908]*	*[0.900]*	*[0.900]*	*[0.936]*
Autistic disorder	−0.021	−0.019	−0.016	−0.017	−0.025	−0.133	−0.131	−0.127	−0.127	−0.133
unadjusted p-value	*(0.814)*	*(0.835)*	*(0.861)*	*(0.851)*	*(0.782)*	*(0.184)*	*(0.193)*	*(0.212)*	*(0.211)*	*(0.188)*
Romano-Wolf p-value	*[0.992]*	*[0.996]*	*[0.996]*	*[0.988]*	*[0.988]*	*[0.243]*	*[0.299]*	*[0.379]*	*[0.375]*	*[0.271]*
Other	−0.025	−0.024	−0.024	−0.023	−0.021	−0.028	−0.027	−0.027	−0.027	−0.025
unadjusted p-value	*(0.578)*	*(0.606)*	*(0.597)*	*(0.614)*	*(0.654)*	*(0.630)*	*(0.642)*	*(0.639)*	*(0.642)*	*(0.671)*
Romano-Wolf p-value	*[0.960]*	*[0.960]*	*[0.948]*	*[0.960]*	*[0.956]*	*[0.992]*	*[0.968]*	*[0.968]*	*[0.964]*	*[0.972]*
Observations	55,637	55,637	55,637	55,637	55,637	55,614	55,614	55,614	55,614	55,614
B. 2nd grade of secondary	**Reading**					**Mathematics**				
Mobility disability	0.093	0.092	0.097	0.097	0.099	0.100	0.100	0.101	0.100	0.100
unadjusted p-value	*(0.030)***	*(0.031)***	*(0.022)***	*(0.023)***	*(0.019)***	*(0.062)**	*(0.055)**	*(0.053)**	*(0.055)**	*(0.052)**
Romano-Wolf p-value	*[0.012]***	*[0.012]***	*[0.008]****	*[0.008]****	*[0.004]****	*[0.032]***	*[0.028]***	*[0.032]***	*[0.036]***	*[0.028]***
Vision disability	0.042	0.038	0.039	0.039	0.038	0.007	−0.000	−0.001	−0.002	−0.002
unadjusted p-value	*(0.205)*	*(0.260)*	*(0.250)*	*(0.251)*	*(0.250)*	*(0.854)*	*(0.995)*	*(0.970)*	*(0.968)*	*(0.949)*
Romano-Wolf p-value	*[0.315]*	*[0.458]*	*[0.410]*	*[0.422]*	*[0.478]*	*[0.992]*	*[0.996]*	*[1.000]*	*[1.000]*	*[1.000]*
Hearing disability	−0.006	−0.003	−0.002	−0.002	−0.003	−0.023	−0.021	−0.020	−0.020	−0.023
unadjusted p-value	*(0.919)*	*(0.963)*	*(0.974)*	*(0.970)*	*(0.956)*	*(0.785)*	*(0.800)*	*(0.812)*	*(0.806)*	*(0.782)*
Romano-Wolf p-value	*[0.992]*	*[0.996]*	*[1.000]*	*[1.000]*	*[1.000]*	*[0.992]*	*[0.996]*	*[0.996]*	*[0.988]*	*[0.988]*
Cognitive disability	−0.033	−0.029	−0.026	−0.026	−0.020	0.003	0.008	0.009	0.009	0.013
unadjusted p-value	*(0.140)*	*(0.193)*	*(0.227)*	*(0.226)*	*(0.354)*	*(0.916)*	*(0.772)*	*(0.740)*	*(0.746)*	*(0.613)*
Romano-Wolf p-value	*[0.163]*	*[0.299]*	*[0.410]*	*[0.402]*	*[0.705]*	*[0.992]*	*[0.996]*	*[0.996]*	*[0.988]*	*[0.952]*
Autistic disorder	−0.099	−0.110	−0.110	−0.110	−0.114	0.066	0.046	0.050	0.051	0.046
unadjusted p-value	*(0.463)*	*(0.435)*	*(0.435)*	*(0.438)*	*(0.415)*	*(0.668)*	*(0.762)*	*(0.746)*	*(0.740)*	*(0.764)*
Romano-Wolf p-value	*[0.888]*	*[0.817]*	*[0.825]*	*[0.825]*	*[0.781]*	*[0.992]*	*[0.996]*	*[0.996]*	*[0.988]*	*[0.988]*
Other	0.019	0.025	0.028	0.028	0.030	0.041	0.050	0.049	0.048	0.050
unadjusted p-value	*(0.633)*	*(0.515)*	*(0.477)*	*(0.479)*	*(0.428)*	*(0.501)*	*(0.414)*	*(0.423)*	*(0.425)*	*(0.408)*
Romano-Wolf p-value	*[0.992]*	*[0.908]*	*[0.873]*	*[0.869]*	*[0.801]*	*[0.936]*	*[0.785]*	*[0.817]*	*[0.813]*	*[0.781]*
Observations	47,491	47,491	47,491	47,491	47,491	47,484	47,484	47,484	47,484	47,484
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student controls		Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Cohort controls			Yes	Yes	Yes			Yes	Yes	Yes
School controls				Yes	Yes				Yes	Yes
Family controls					Yes					Yes

Each column represents a separate regression except for the *Romano-Wolf p-value*. The *Romano-Wolf p-value* is estimated by using the command *rwolf2* in Stata 18. Student controls include sex, language, and age. Cohort controls include mean age, proportion of male students, proportion of students who speak an indigenous language, and number of students. School controls include the number of students. Family controls include mothers' age and education and number of siblings. Standard errors clustered at the school level were used to estimate each column.

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$

lies in the interaction effects between inclusive education and these supplementary factors. For instance, older students or those from more privileged households could potentially derive greater benefits from inclusive education due to their increased adaptability to the classroom environment. We further explore these issues in the *Heterogeneity analysis* section.

The main results, however, may mask different outcomes by type of SEN. Table 5 shows the results from Eq. (1) using the presence of at least one student with a certain type of SEN as a measure of inclusive education. Results[13] in Table 5 are estimated by gradually adding control variables in each column. Columns (1) and (6) do not include any control variable. Columns (2) and (7) add student controls. Cohort controls are added in columns (3) and (8), and school controls are added in columns (5) and (9). Finally, family controls are added in columns (5) and (10). As we can see in Table 5, adding variables does not substantially change the estimates. We also notice that the sign of the relationship between inclusive education and learning achievement varies by type of SEN, and only vision disability (panel A) and mobility disability (panel B) have a significant positive relationship with the standardized test scores of students who attend 2P and 2S, respectively. As we can observe in Table 5, even when we use the Romano-Wolf multiple hypothesis correction, the significance of our findings remains similar across different specifications (cf. Clarke, 2021, Clarke et al., 2020). These findings confirm our main results that inclusive education would not harm the learning performance of non-SEN students, regardless of the type of SEN presented by their peers.

Results in Table 5 show that the impact of attending an inclusive classroom with at least one SEN student with a vision disability increases the reading and mathematics scores of students who attend 2P by 0.135 (adjusted p-value < 0.05) (column 5) and by 0.154 (adjusted p-value < 0.05) (column 10) of a standard deviation, respectively. In the case of students who attend 2S, the impact of the presence of at least one student with mobility disability increases the performance on reading and mathematics tests by 0.099 (adjusted p-value < 0.01) (column 5) and by 0.100 (adjusted p-value < 0.05) (column 10) of a standard deviation, respectively. Similar to our results, Ruijs (2017) found that the presence of students with vision disabilities as well as physical and intellectual disabilities in the third level of prevocational secondary education in the Netherlands increases standardized test scores of non-SEN students. Moreover, previous studies pointed out that non-SEN students show more positive attitudes toward their peers with physical disabilities (de Boer et al., 2012), which may explain the positive influence of SEN students with vision and mobility disabilities that we have found on the learning achievement on non-SEN students.

Heterogeneity analysis. We further undertake several analyses to understand the differences in the impact of inclusive education.[14] Clogg's z-test is implemented for testing the statistical significance of the difference between the coefficients estimated separately by splitting Eq. (1) (Clogg et al., 1995).

Estimates of inclusive education by gender of non-SEN students are presented in Table 6. The results show that the influence of inclusive education on learning achievement is not statistically significant for men or women, and there is no statistical difference between them.

To explore the influence of inclusive education by usage of adequate resources, we analyze the influence of the total number of students at the section level. We find that inclusive education is associated with higher scores in reading and mathematics for non-SEN students who attend classrooms with 10–20 students and with lower scores for those who attend classrooms with

Table 6 Estimates of the presence of at least one SEN student on their peers' achievement, by different characteristics.

	2P						2S					
	Reading			Mathematics			Reading			Mathematics		
	Coef.	Std. Err.	Obs.	Coef.	Std. Err.	Obs.	Coef.	Std. Err.	Obs.	Coef.	Std. Err.	Obs.
Student's gender												
Male	0.005	(0.027)	29,003	0.004	(0.033)	28,989	0.013	(0.024)	24,390	0.026	(0.027)	24,384
Female	0.029	(0.027)	26,634	0.029	(0.033)	26,625	−0.010	(0.024)	23,101	0.031	(0.029)	23,100
Clogg's z-test (p-value)	*−0.629 (0.530)*			*−0.536 (0.592)*			*0.678 (0.498)*			*−0.126 (0.900)*		
Mother's age												
Mean age or younger	−0.009	(0.027)	28,486	−0.017	(0.033)	28,471	0.011	(0.023)	24,526	0.048*	(0.027)	24,519
Over than mean age	0.039	(0.026)	27,151	0.043	(0.034)	27,143	−0.017	(0.024)	22,965	0.003	(0.028)	22,965
Clogg's z-test (p-value)	*−1.281 (0.200)*			*−1.266 (0.205)*			*0.842 (0.400)*			*1.157 (0.247)*		
Mother's education												
No tertiary education	0.017	(0.023)	50,775	0.022	(0.030)	50,755	0.005	(0.018)	45,052	0.031	(0.022)	45,046
Tertiary education	0.014	(0.077)	4862	−0.061	(0.075)	4859	−0.095	(0.102)	2439	−0.043	(0.106)	2438
Clogg's z-test (p-value)	*0.037 (0.970)*			*1.028 (0.304)*			*0.965 (0.334)*			*0.684 (0.494)*		
Cohort size												
Between 10 - 20 students	0.022	(0.038)	28,174	0.029	(0.048)	28,161	0.043	(0.029)	23,862	0.052	(0.034)	23,858
Between 21 - 30 students	−0.023	(0.035)	27,463	−0.035	(0.045)	27,453	−0.034	(0.029)	23,629	0.010	(0.037)	23,626
Clogg's z-test (p-value)	*0.871 (0.384)*			*0.973 (0.331)*			*1.877 (0.060)**			*0.836 (0.403)*		

Each coefficient represents a separate regression. The median age in 2P is 41.5 years and in 2S is 44.8 years. All the regressions include year and school fixed effect as well as student, cohort, school, and family controls. Student controls include sex, language, and age. Cohort controls include mean age, proportion of male students, proportion of students who speak an indigenous language, and number of students. School controls include the number of students. Family controls include mothers' age and education and number of siblings. Standard errors clustered at the school level were used to estimate each coefficient.
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

21–30 students, regardless the student attends 2P or 2S. This result may reflect that small groups foster a closer interaction between students and teacher which in turn may allow the teacher to develop better teaching strategies since they know each student better. The result of inclusive education by section size, however, is statistically different only for the reading score obtained by non-SEN students who attend 2S. This result underscores the complexity of inclusive education's effects and the importance of context-specific considerations. Authorities should pay special attention to the number of students assigned to an inclusive classroom.

To analyze the household's characteristics, we use the mother's age and education. In the case of reading and mathematics in 2P, it seems that older mothers help to improve the scores of non-SEN students who attend an inclusive classroom; but there is not a clear pattern in the case of 2S. The differences in the test scores by mother's age, however, are not statistically significant in any case, 2P or 2S. We have to take this result with caution as it is possible that other family characteristics rather than the mother's age act as a moderator that could influence the effect of inclusive education on children's outcomes in school (Leigh and Gong, 2010; López Turley, 2003).

We also present in Table 6 the estimates of inclusive education on test scores of non-SEN students by mother's education. We observe that the difference in inclusive education's influence on test scores in reading and mathematics is not statistically different regardless mother's education. Although the difference is small and not significant, we observe that among non-SEN students in 2P and 2S with well-educated mothers (i.e., tertiary education), inclusive education is associated with lower scores in reading and mathematics. This finding may suggest that well-educated mothers may dedicate fewer hours to helping their children as they are more likely to work outside the home in comparison to less-educated mothers.

Conclusion

The current study focused on the learning achievement of non-SEN students in Peru who attend an inclusive classroom. We use three rich administrative datasets that allow us to measure inclusive education by the presence of at least one SEN student in the classroom, which is the appropriate setting as students spend their school day mostly within the classroom. Thus, we are able to capture the influence of inclusive education on the test scores of non-SEN students on national standardized tests in reading and mathematics.

Inclusive strategies in regular classrooms are undeniably crucial, but without appropriate adaptations and a comprehensive understanding by all involved, inclusive education can pose considerable challenges for the entire educational community, including non-SEN students (Edwards et al., 2019; Nilsen, 2020). While some studies for developed countries show that the learning achievement of non-SEN students is improved by attending inclusive classrooms and others point to negative effects, there is limited evidence regarding the impact of inclusive education for developing countries. From this perspective, our study contributes to the literature by examining the case of inclusive education in Peru and its consequences on non-SEN students. To the best of our knowledge, this topic has not been previously analyzed in the Peruvian context. Further, we explore the influence of inclusive education by type of SEN and undertake a heterogeneity analysis.

Overall, this study has found that the inclusion of SEN students in regular classrooms, on average, yields no substantial implications for their non-SEN counterparts. Our results have shown consistency among the different model specifications estimated using several subpopulations with different age ranges as well as an additional sub-population restricted to schools with variation in the presence of SEN students. Nevertheless, it is worth noticing that there is a negative relationship between inclusive education and learning achievement of non-SEN students that turns into a positive relationship when the mother's characteristics are included in the analysis. This may present an opportunity for school authorities to involve parents in the learning process of their kids to enhance inclusive education programs, as the literature suggests that the way inclusive education is implemented may lead to positive results on the academic performance of non-SEN students (Szumski et al., 2017).

We also found that the implications of inclusive education are contingent upon the specific type of SEN. In particular, non-SEN students benefit from attending classrooms with at least one student with a vision disability in 2P and a mobility disability in 2S. This finding underscores differential effects between lower and later grades, a phenomenon previously noted in the literature (Kart and Kart, 2021). Also, this result should draw attention from policymakers interested in inclusive education as schools may be more suitable to assist this type of SEN students, whereas the potential lack of resources to support other types of SEN might detrimentally affect SEN and non-SEN students (Edwards et al., 2019). In addition, we find that the influence of inclusive education is heterogeneous. We find that the small size of the classroom (20 or fewer students) helps to improve learning achievement in reading for non-SEN students who attend an inclusive classroom in 2S. Similar to previous literature (e.g., Szumski et al., 2017), this finding points to the need for educational policymakers to increase the budget for inclusive education, targeting to hire more and adequate resources. Finally, the mother's characteristics are not relevant to explain differences in the estimates of inclusive education on academic achievement of non-SEN students.

Despite the contributions made by this study, some potential limitations could be addressed by future research. First, due to a lack of data, we are not able to incorporate a measure that reflects the diverse intensity of a disability (Oh-Young and Filler, 2015) that could be associated with different costs (Nicoriciu and Elliot, 2023). Second, the datasets employed in this analysis are unavailable for certain years, precluding our use of data from ECE before 2011. Additionally, the variable indicating the language spoken in 2S was not present in the same dataset (CE) for the years 2018 and 2019. Finally, despite our efforts to mitigate concerns related to omitted variable bias, we concede the possibility of residual biases. Specifically, we omitted socioeconomic status from our analysis due to substantial rates of missing data.

Data availability

The datasets used in this study are available from the Peruvian Ministry of Education repository upon request.

Received: 9 November 2023; Accepted: 27 March 2024;
Published online: 17 April 2024

Notes

1 In the literature, there are three main approaches: (i) segregation, (ii) integration, and (iii) inclusive (see e.g., Dixon, 2005; Kiuppis, 2014; Madhesh, 2023).

2 It is worth noting that results from countries like Peru are not directly comparable to those previously presented by Contreras et al. (2020). Indeed, academic performance in Peru is poorer relative to Chile, as reported by the Program for International Student Assessment (PISA) and it does not receive monetary incentives to enroll children with SEN. Furthermore, Chile displays a particular institutional framework

worldwide since state-subsidized private schools (voucher schools) have around 50% of total enrollment (CEM, 2019). Thus, insights from the Peruvian case are valuable for other comparable countries.

3 Although the ECE evaluates other subjects, only mathematics and reading were evaluated in every ECE. Students attending 2nd grade of primary were evaluated from 2007 to 2016 on mathematics and reading. In the case of students attending 2nd grade of secondary, they were evaluated on mathematics and reading from 2015 to 2019 (except 2017), social sciences in 2016 and 2018, and science and technology in 2018 and 2019.

4 Unfortunately, information for SG was not available before 2011, and the MINEDU did not provide information for 2014.

5 The ECE was not conducted in 2017.

6 Advancement and delay in 2P (2S) are determined based on the chronological age of the students as of March 31. If a student is one year younger than the standard age of 7 (13), it would be considered advancement. Conversely, if a student is one year older than the standard age, that is, age of 8 (14), it would be considered within a delay.

7 Since we only include schools with one section per grade, the number of SEN students reported by grade is used to account for the presence of SEN students at the section level.

8 A cohort refers to the students within the same section for each grade level and year.

9 Full-grade refers to primary schools where teachers do not teach more than one grade in the same classroom.

10 Since we work with schools that have only one section, school-fixed effects can also be understood as section-fixed effects.

11 Feigenberg et al. (2023) state that using a split-sample approach is equivalent to a fully interacted model but avoids losing statistical power. Likewise, they state that, unlike a model with only one interaction, the split-sample approach reduces bias due to omitted variables.

12 Results, including all control variables, are presented in the Supplementary Information. Tables S1 and S2 for reading and mathematics in 2P, respectively. Tables S3 and S4 for reading and mathematics in 2S, respectively.

13 Results, including all control variables, are presented in Supplementary Information Table S5.

14 Results, including all control variables, are presented in Supplementary Information from Table S6 to Table S10.

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Acknowledgements

This paper was supported by the Peruvian Economic and Social Research Consortium (grant No. A1-PB03, CIES 2022). The authors express their gratitude to the participants of the XXXIV Annual Research Seminar 2023 hosted by the Economic and Social Research Consortium (CIES), as well as to two anonymous referees for their invaluable feedback, which contributed to the improvement of this manuscript. Special thanks to Juan Castañeda and Jonatan Amaya for their outstanding research assistance in earlier versions of this study. All remaining errors are our own.

Author contributions

All the authors contributed equally to this work.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information

Supplementary information The online version contains supplementary material available at https://doi.org/10.1057/s41599-024-03002-8.

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