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Organizational ambidexterity and student achievement: Do knowledge exploration and exploitation in schools make a difference?

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ABSTRACT

While studies on ambidexterity and its impact on outcomes have been ubiquitous in organizational research, the literature regarding its nature in schools has been scarce and has lacked information about its impact on student achievement. To address this research gap, this study examined the interactive role of the two dimensions of ambidexterity—exploration and exploitation—in accounting for variations in school-level average student achievement in language and math. Additionally, we investigated the moderating role of several school-context variables (school size, school location [rural or urban], student poverty, and school type). We used data from a random sample of 295 schools in Chile, estimated structural equation models, applied response surface analysis, and employed machine learning. The results showed that a high integration of exploration and exploitation, and hence ambidexterity, was significantly related to student achievement. In high-poverty schools, a focus on acquiring new knowledge and exploring innovations can function as a catalyst for reducing the achievement gap. We conclude that the integration of exploration and exploitation in schools could help schools increase student achievement and reduce educational inequalities.

Introduction

Improving student achievement, particularly for those who grew up in poverty, has consistently been of paramount concern for educational policymakers, practitioners, and researchers (Cookson & Darling-Hammond, 2022). To address this issue, policymakers have introduced various school reforms to help high-poverty school recover (Baker & Cooper, 2005; Elmore, 2004). In addition, educational scholars have developed a keen interest in these reforms, aiming to understand how they shape school organizational elements that could support student achievement (Bryk, 2010). In the context of school reform, schools often find themselves in a position where they need to implement innovative practices and hone current practices with existing resources simultaneously (Bingham & Burch, 2019). Reforms should enable schools to change and innovate their organizational structure, functioning, and processes (Darling-Hammond et al., 2016), which entail innovative settings and practices (Darling-Hammond & Friedlaender, 2008) as well as effective utilization of existing resources and human capacity (Grubb, 2009). An emerging concept in this regard is organizational ambidexterity (Birkinshaw & Gupta, 2013; O'Reilly & Tushman, 2008).

The concept of organizational ambidexterity suggests that an organization's long-term success is contingent upon its capacity to exploit existing capabilities for immediate efficiency while concurrently exploring the fundamental competencies necessary for achieving prospective, more distal, and rather insecure (Raisch et al., 2009) futures (Papachroni et al., 2016) and outcomes (Tushman & O'Reilly, 1996). As such, it incorporates the principles of exploration and exploitation, representing a dynamic capability that necessitates the integration of both existing (exploitation) and novel (exploration) assets and knowledge to facilitate change and ensure continuous improvement (March, 1991; O'Reilly & Tushman, 2008). In this context, Levinthal and March

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(1993) put forth the proposition that the primary challenge facing an organization is to achieve a balance between adequate exploitation to secure its present viability and sufficient exploration to sustain its future viability. In line with this perspective (Smith et al., 2016), exploration and exploitation are regarded as interdependent polarities (Papachroni & Heracleous, 2020) representing inherently opposing organizational learning modes (Cao et al., 2009) that compete for limited resources (Gupta et al., 2006). Consequently, persistent tension exists between these two modes (Andriopoulos & Lewis, 2009; Lavie et al., 2010), which requires ongoing active management (Birkinshaw & Gupta, 2013). The term "ambidexterity" is used to describe the active management of exploitation and exploration and the navigation of the inherent tension between these two forms of organizational learning.

Despite decades of research on the subject, researchers have argued that how ambidexterity can be achieved in public organizations or the conditions that support its emergence is not fully understood. In particular, little attention has been devoted to how public organizations might achieve ambidexterity to balance efficiency and innovation simultaneously (Cannaerts et al., 2020). While research on ambidexterity in the public sector is growing, the knowledge base is still limited since this line of research depends heavily on ideas borrowed from private organizations (Gieske et al., 2020; Favoreu et al., 2024). The dearth of research is even more serious in the education sector, which is under significant pressure to change and innovate (Oke & Fernandes, 2020). Despite this, the issue has not received any substantial attention until recent years, when a few articles on ambidexterity in schools were produced (Bingham & Burch, 2019; Da'as, 2023; Dedering & Pietsch, 2023; Özdemir et al., 2024; Pietsch et al., 2022, 2023). Similarly, while a positive association between ambidexterity and performance is evident in organizational research (He & Wong, 2004; Junni et al., 2013; Peng et al., 2019), how ambidexterity is related to student learning and achievement, which are the main outcomes of schools (Kyriakides et al., 2018), has yet to be discovered. Finally, organizational researchers have provided evidence that the extent to which ambidexterity can lead to improved organizational performance is contingent on contextual factors (Fourné et al., 2019). More empirical research is needed, particularly in education, to unveil the interactive effect of ambidexterity and school-context elements on school outcomes.

Against this background, this article focuses on ambidexterity in schools and examines whether it is associated with student achievement, since in the context of school effectiveness research, performance can be defined as a given school's output, which is measured in terms of the school-average achievement of students (Scheerens, 2000) based on standardized test measures (Leitner, 1994). In light of this, schools must address the following key dimensions (Kyriakides et al., 2018; Kyriakides & Creemers, 2011): (1) quality, to enable optimal learning outcomes, and (2) equity, to reduce educational disparities and ensure equal opportunities for all students. Following this understanding, the article aims to provide insight into whether the two components of ambidexterity (exploration and exploitation) predict school-average student achievement on a high-stakes standardized assessment. It goes beyond this by investigating how congruence and incongruence between exploration and exploitation might explain variations in student achievement results. Finally, it examines the influence of contextual factors (administration, student socioeconomic status, school type, etc.) and their interactions with ambidexterity to examine their combined and relative predictive power for student achievement. To achieve these purposes, we used a random sample of N = 295 schools and secondary data provided by the Chilean Education Quality Agency and the Ministry of Education. We employed various analytical techniques, including structural equation modeling (SEM), response surface analysis (RSA), and machine learning approaches, such as classification and regression trees (CART). Aligned with the purposes and methods, the following research questions guided the study:

RQ1. Are exploration, exploitation, and organizational ambidexterity related to student achievement?
RQ2. How is the interaction between exploration and exploitation associated with student achievement?
RQ3. Do the effects of exploration and exploitation activities on student achievement interact with a school's contextual factors?

Theoretical background

Organizational ambidexterity

Almost all organizations, including schools, have faced increasing pressure for change because of multifaceted elements, such as technological advancements, customer demands, competitive pressures, regulatory requirements, or internal inefficiencies and challenges (Clauss et al., 2021; Saleh et al., 2023). However, the change should ensure both effectiveness and efficiency at the same time, which entails a dynamic capability to develop new ideas and practices and to utilize existing assets to address the issues associated with a rapidly changing environment, referring to organizational ambidexterity (O'Reilly & Tushman, 2008). Ambidexterity is the organization's capacity to motivate members to utilize existing capabilities and navigate constraints effectively while fostering innovative practices to optimize efficiency (Bingham & Burch, 2019). It refers to the ability of an organization to engage in both explorative and exploitative activities (O'Reilly & Tushman, 2008). Exploitation allows organizations to maintain existing practices, often with minor changes, and increase resource efficiency, while exploration requires radical innovations in products, practices, and technologies (Clauss et al., 2021). Moreover, exploitation is concerned with increasing productivity and efficiency via enhanced execution and stabilization, whereas exploration is associated with experimenting, searching for new knowledge and solutions, and risk taking (March, 1991). At the organizational level, exploration is related to "the refinement and extension of existing competencies, technologies, and paradigms," and exploration is more about "experimentation with new alternatives" (March, 1991, p. 85).

Consequently, as noted by Gupta et al. (2006), both exploitation and exploration entail some degree of learning, which in turn drives organizational change. However, the specific type and extent of learning involved differ between the two, resulting in friction that requires active management (Dedering & Pietsch, 2023; O'Reilly & Tushman, 2008). Researchers have thus indicated that integrating and balancing both exploration and exploitation are essential for organizational success in addressing a changing environment (Fourné et al., 2019). However, it is important to point out that the notion of balancing or integrating two components of ambidexterity poses paradoxes because the two concepts—exploration and exploitation—which sound logical when considered separately turn out to be irrational when integrated, because of their contradictory nature (Clauss et al., 2021). Therefore, the term "ambidexterity" refers specifically to the active management of these two contradictory organizational operating and learning modes (Birkinshaw & Gupta, 2013). Following O'Reilly and Tushman (2013), Fourné et al. (2019) propose two managerial solutions to these paradoxical challenges: structural versus contextual approaches. Structural ambidexterity suggests "structurally separating exploration from exploitation across different, spatially separate units" (p. 565). In this approach, exploring and exploiting activities occur through different competencies, cultures, processes, and structures within an organization managed by leaders (O'Reilly & Tushman, 2011). This facilitates purpose-fit systems, clear objectives, processes, and incentives, all aimed at promoting specialization within the organization's units (Fourné et al., 2019).

On the other hand, the contextual approach to ambidexterity allows each individual within an organization to alternate between and demonstrate both exploitation and exploration (Fourné, et al., 2019). In other words, it supports the integration of exploration and exploitation

activities within a unit or organization at large but also enables the differentiated utilization of both activities by members (Wang & Rafiq, 2014). This is more about the human and individual aspects of the organization such as social support and trust that enable organizational members to handle multiple roles and allocate their time between competing demands (Gibson & Birkinshaw, 2004). In addition to the aforementioned two simultaneous approaches to organizational ambidexterity, a third focuses on a sequential or punctuated balance of exploration and exploitation (Gupta et al., 2006), whereby sequential separation dynamically occurs between long periods of exploitation and short bursts of exploration.

The modeling of organizational ambidexterity, based on exploitation and exploration, is thus correspondingly heterogeneous in the studies available to date, with three definitions identified (Cao et al., 2009; Fourné, et al. 2019; Gibson & Birkinshaw, 2004; Junni et al., 2013; Pietsch et al., 2022; Rosing & Zacher, 2017). First (*sum*), ambidexterity combines the exploitation and exploration dimensions, suggesting a compensatory balance between exploration and exploitation. Although higher degrees of both dimensions are necessary for high ambidexterity, a relatively stronger dimension could compensate for a weaker one (Rosing & Zacher, 2017). The second conceptualization (*multiplication*) considers ambidexterity a product or interaction of exploitation and exploration and assumes that the two dimensions are independent yet the effect of one will depend on the other. For example, for a school to be highly ambidextrous, it should engage in higher levels in both dimensions rather than lower levels of one or both (Gibson & Birkinshaw, 2004; Mom et al., 2019)—this is the prevailing approach in studies on ambidexterity (Junni et al., 2013). Finally (*subtraction*), ambidexterity can also be understood as the im(balance) between exploitation and exploration. In other words, it is about the extent to which both move together (Fourné, et al., 2019). This means that ambidexterity would be much stronger when exploration and exploitation are at the same or similar levels relative to each other regardless of the level of im(balance) (Cao et al., 2009). This, for instance, means that a school demonstrating low levels of both exploration and exploitation might be regarded as being as ambidextrous as one that exhibits high levels in both areas (Rosing & Zacher, 2017).

The impact of ambidexterity on organizational outcomes

Many studies on ambidexterity have examined how it might affect organizational performance (Junni et al., 2013), indicating that ambidexterity can be highly beneficial for many organizations and can support the improvement of outcomes (Dranev et al., 2020; Junni et al., 2013). From a methodological perspective, researchers favored the interaction between explorative and exploitative behaviors (Caniëls & Veld, 2019; He & Wong, 2004; Rosing & Zacher, 2017), yet the results are still inconsistent when examining the impact of (im)balance between the two dimensions. For example, He and Wong (2004) tested two ambidexterity hypotheses by investigating the combined impact of exploration and exploitation on firms' objective performance. Their results found a positive relationship between the interaction of explorative and exploitative strategies and the sales growth rate and a negative one for the relative imbalance of these strategies.

Again, focusing on objective performance (sales growth rate), Derbyshire (2014) concluded that in some contexts, firms that are stronger in both exploitation and exploration are more beneficial, whereas in others, an optimal mix of exploitation and exploration is needed for enhanced outcomes. The mix strategy might focus more on exploitation, as moderated by exploration, in organizations where innovation is more related to a new product, or on the reverse when innovation is less about the development of a new product. Caniëls and Veld (2019) examined the effect of ambidexterity on innovation performance as perceived by employees and found that a combination of high levels of exploitation and exploration activities was positively and significantly associated with employees' innovative work behavior. Examining the relationship between ambidexterity and perceived innovative employee performance, Rosing and Zacher (2017) discovered that individuals showed higher innovative performance when they exhibited high levels of exploration and exploitation and when the two dimensions of ambidexterity were at approximately the same level.

Highlighting the contradictory nature of the findings, Kassotaki (2022) asserted that while some research supported the use of explorative practices suggesting the benefits of exploration over exploitation (Raisch & Birkinshaw, 2008), another line of research reported the importance of simultaneous utilization of both dimensions for organizational performance (Caniëls & Veld, 2019). In a meta-analysis of organizational ambidexterity, Junni et al. (2013) demonstrated that the primary effect of organizational ambidexterity on organizational performance is $r = .06$, with effects on objective performance measures being $r = .04$ and $r = .30$ for perceptual performance measures. The results of this study indicate that the specific effects of exploitation and exploration are each $r = .22$. Furthermore, the correlation of these two strategies with objective outcomes is $r = .06$ and $r = .07$, respectively, and with perceptual outcomes, it is $r = .26$ in each case.

Organizational antecedents and moderators

Little is known about the contexts and conditions that may affect and moderate the relationship between ambidexterity and performance (Caniëls & Veld, 2019; Junni et al., 2013). Research posits that the optimal levels of exploration and exploitation are contingent upon the context of the organization (Lavie et al., 2010) and its environment (Birkinshaw & Gupta, 2013); therefore, researchers should be careful when applying the results of a study conducted in a particular context to a different context (Junni et al., 2013).

Leadership and management are considered to be highly relevant antecedents of organizational ambidexterity (Lavie et al., 2010). In addition, the experience of the organization, its management team, and its employees must also be taken into account (Raisch & Birkinshaw, 2008). The organizational structure itself also holds considerable importance. This can be reflected in a hierarchical arrangement with distinct subunits or departments, each tasked with specific responsibilities (Kassotaki, 2022). Other relevant factors that impact organizational ambidexterity include the age and size of the organization as well as the availability of resources (Lavie et al., 2010). For instance, Cao et al. (2009) concluded that balancing dimensions is more beneficial to firms with constrained resources while the combined magnitude of exploration and exploitation is more profitable for firms with larger resources. Ceptureanu et al. (2022) reported that the impact of ambidexterity on performance is much stronger in relatively new companies than in old ones. Focusing on the moderating role of firm size, Wenke et al. (2021) noted that small firms benefit more from either exploration or exploitation than from ambidexterity.

Furthermore, a multitude of external and internal organizational factors may contribute to discrepancies in the impact of ambidexterity (Kassotaki, 2022). Moderators can be classified into two principal categories: environmental and other factors (Kassotaki, 2022; Raisch & Birkinshaw, 2008). The framework developed by Raisch and Birkinshaw (2008) proposes that key environmental factors, such as environmental dynamism and competitive dynamics, play a pivotal role in determining the manner and extent to which ambidexterity is managed and becomes effective. For example, organizational ambidexterity exerts a pronounced influence in dynamic and uncertain contexts, where the occurrence of a disruptive change that renders current methods or products obsolete is more likely to occur (Tushman & O'Reilly, 1996). In line with this assumption, Tamayo-Torres et al. (2017) found that the balanced approach to ambidexterity will benefit manufacturing firms in both static and dynamic environments but that the association between ambidexterity and performance is less significant in static environments.

Other relevant moderating factors, in turn, primarily relate to interactions with the environment and social aspects (Kassotaki, 2022).

However, additional moderators, particularly internal organizational factors, also exert an influence (Raisch & Birkinshaw, 2008). This incorporates elements such as resource endowment, firm scope, and market orientation (Raisch & Birkinshaw, 2008). Furthermore, an organization's ability to recognize the value of external knowledge—with its absorptive capacity (Cohen & Levinthal, 1990)—and internalize and apply it significantly impacts how ambidexterity is managed and made effective (Lavie et al., 2010). Beyond that, it is evident that organizational culture plays a crucial role in this context, as achieving ambidexterity requires an organizational "context characterized by a combination of stretch, discipline, support, and trust" (Gibson & Birkinshaw, 2004, p. 209).

Fig. 1 presents a condensed model for understanding ambidexterity in schools, which is based on the theoretical frameworks proposed by Raisch and Birkinshaw (2008), Lavie et al. (2010), and Kassotaki (2022).

While there is no research on the interactive impact of ambidexterity and school context variables on achievement in education, scholars have discussed the importance of several school-level factors, including student poverty and school size, location, and type, which might have both a direct impact on student learning and an interactive effect with other key school components, such as leadership and professional development, to influence student achievement (Gümüş et al., 2022; Breger, 2017; Tan, 2018; Tayyaba, 2012; Young, 1998). For instance, research has found that students in impoverished schools are less likely to meet achievement standards (Breger, 2017). Poverty has also led to variations in the impact of school on student achievement (Tan, 2018). In Chile, for example, the socioeconomic achievement gap is high. The difference in average performance between students in the poorest quintile and students in the wealthiest quintile is equivalent to almost 3 years less of schooling (Bellei & Muñoz, 2021). As demonstrated by Valenzuela et al. (2014), students from low socioeconomic backgrounds in Chile are more likely to attend public schools. Nevertheless, students from lower socioeconomic backgrounds are less segregated in public schools than in private schools (Valenzuela & Allende, 2023; Valenzuela et al., 2014). As shown, the observed poverty-related segregation in schools can be attributed to various structural aspects of Chilean society, including residential segregation, as well as to features of the educational system, such as school choice and student selection processes, illustrating the intricate interrelationship between multiple factors that contribute to educational inequality in Chilean education (Valenzuela & Allende, 2023). The context of rural versus urban might differ across different countries, and so does its impact on achievement. For example, a study in Pakistan showed that while rural students outperformed their urban counterparts in one region, urban students performed significantly better in another (Tayyaba, 2012). In Australia, students attending rural schools do not perform as well as those attending urban schools (Young, 1998). Breger (2017) found a positive correlation between school size and student test scores, meaning that students in crowded school populations had higher overall achievement. As for school type, there is evidence that the voucher system increased overall student test scores (Wolf et al., 2013) and that private schools performed better than public schools (Peterson & Llaudet, 2006).

With respect to the concept of individual ambidexterity in schools, Pietsch et al. (2022) finally demonstrated that the ambidexterity of school leaders is positively correlated with the competitive dynamics between schools within the local schooling market. Moreover, in a longitudinal study (Pietsch et al., 2023b), the researchers found that school leaders in dynamic contexts, such as the COVID-19 pandemic, are more likely to employ sequential ambidexterity, shifting their focus from exploitation to exploration. Considering the assertion that organizational ambidexterity is based on micro-foundations (Tarba et al., 2020) and thus, for schools, on the individual ambidexterity of teachers (Özdemir et al., 2024) and school leaders (Da'as, 2023; Dedering & Pietsch, 2023), it can be postulated that contextual characteristics may also exert an influence on the ambidexterity of schools and the interrelationship between outcomes, particularly student achievement.

Methods

Context

The data for this study were collected in Chile. The Chilean education system, with 13 years of mandatory schooling, is coordinated by the Ministry of Education. Mandatory schooling covers one kindergarten and eight primary and four secondary schools. As of 2023, there were 11,123 schools in Chile, serving 3.63 million students enrolled in

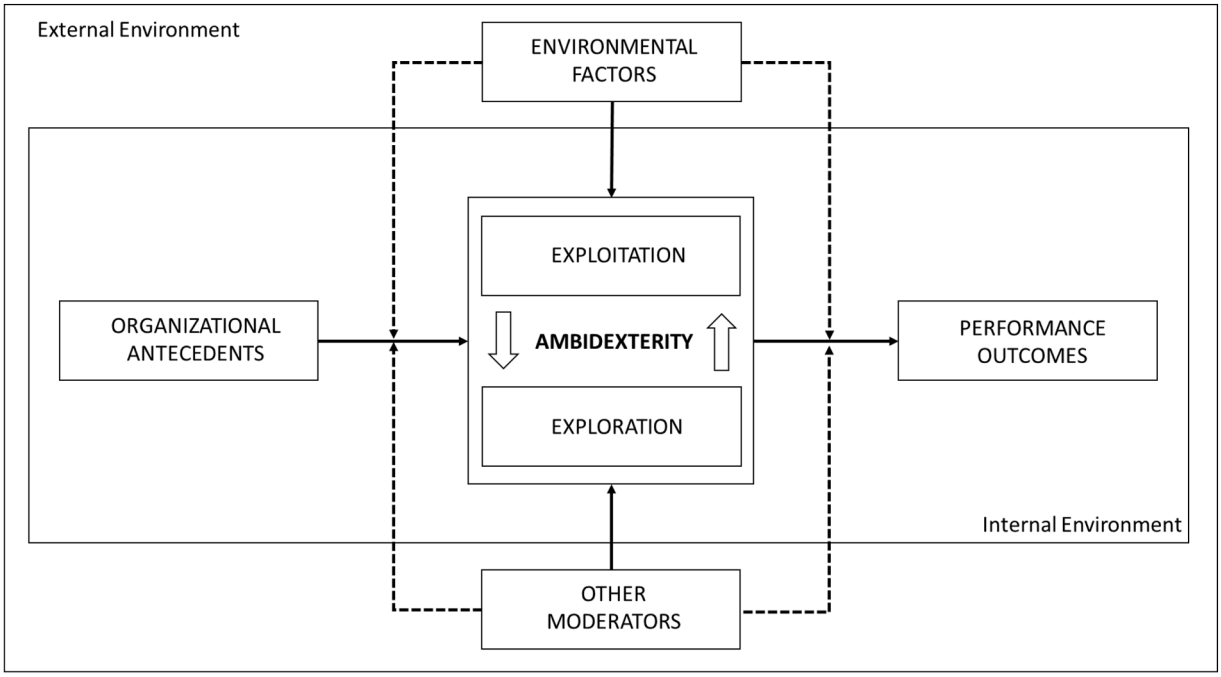

Fig. 1. A model for understanding ambidexterity in schools.

kindergarten through the 12th grade. These schools are divided into groups, depending on their administrative status: public schools (44.5 percent of all schools and 35.4 percent of all students), private subsidized schools (49.8 percent of schools and 55.2 percent of students), and paid private schools (5.4 percent of schools and 9.3 percent of students). Public schools are managed by local governments (municipalities) or Local Education Services and funded by the state through an attendance-based voucher. Private subsidized schools are managed by private entities and funded by the state; these schools can be free of charge or have shared funding, with families paying a part of the cost. Private schools are managed by private entities and funded exclusively by families (Ministry of Education, 2024). As this is a high-stakes education system, Chile's Education Quality Agency (ACE) administers the SIMCE testing program, an annual high-stakes census assessment in grades 4 and 10, and on alternate years in grades 6 and 8. Each year, the tested subjects include mathematics and Spanish language and, in alternate years, natural sciences or social sciences in grades 6, 8, and 10. These results, adjusted according to students' and schools' intake and locality, are used by ACE to assign schools to one of four performance categories: high (students perform above what was expected), medium (students perform as expected), medium-low (students perform below expectations), and insufficient (students perform significantly below expectations) (Munoz-Chereau et al., 2020).

Table 1
Distribution of sampled schools by administration and control variables.

	School administration			
	Public (n = 141)	Private, state (n = 136)	Private, parental (n = 18)	Full sample (N = 295)
Average School Size				
Average Number of Students per School	378	750	736	572
Percentage of Students in Poverty				
Students from <40% Income Distribution	68.32	53.37	5.66	57.61
Percentage Rural vs. Urban Schools				
Rural/Urban	20.57/79.43	8.09/91.91	0.00/100.00	13.60/86.40
Percentage Distribution of SIMCE Performance				
High	4.26	13.97	27.78	10.20
Medium	48.81	58.82	66.67	53.60
Medium-low	39.91	21.32	5.56	25.40
Insufficient	17.02	5.88	0.00	10.80

Sample and data collection

In 2023, a stratified random sample of 2500 elementary and secondary schools was selected from an open database compiled by the Ministry of Education. Stratification variables included grade levels and secondary educational programs, ACE performance categorization, and type of administration (public, private- and state-funded, and privately paid by parents). The sampling was based on the distribution in the Chilean school system. Of the 2,500 schools randomly selected, 47.7% (n = 1,192) were public schools, 45.5% (n = 1,137) were private schools that were state funded, and 6.8% (n = 171) were private schools paid by parents. The Ministry of Education's Center for Studies distributed an email to principals from the randomly selected schools. The email contained a link to an online survey using SurveyMonkey software and an invitation to participate voluntarily in the study. Three follow-up emails were sent after the initial invitation. The completion rate across all invited schools was 14.2% (N = 355). Additional data—that is, 4th grade SIMCE scores and control variables—were drawn from open databases compiled by the Education Quality Agency (ACE), which administers SIMCE, and from the National Directory of Schools of the Ministry of Education. Student achievement data for grade 4 were available for 295 of the schools that participated in the study. The distribution of the 295 participating schools corresponds with that of the underlying population and the total sample. Of the schools included in the study, 47.8% (n = 141) were public schools, 46.1% (n = 136) were state-funded private schools, and 6.1% (n = 18) were private schools paid by parents. The average number of students per school was not small: 572 for the full sample and 378, 750, and 736 for the public, state-funded private, and private schools, respectively. Once the data collection closed, the Ministry shared with the researchers an SPSS file containing the data. Table 1 presents an overview of the characteristics of the school sample.

Measures

Student achievement. For each school, the 4th-grade SIMCE language and mathematics subtest scores achieved in 2018 were obtained from an open database compiled by the Ministry of Education (Agencia Calidad de la Educación, 2024). Because of social unrest and COVID-19 school closures, SIMCE was not administered from 2019 to 2021 but was partially administered in 2022. These tests were administered in 2023, but the school-level results were not published at the time this manuscript was prepared. Accordingly, we used the most recent student performance data currently available from the participating schools, in which the achievement scores were at the school level, computed as the observed average of student achievement scores. A substantial body of research indicates that student achievement at the school level tends to remain stable over extended periods (Marks, 2017, 2023), especially with regard to basic skill areas in primary education (Dumay et al., 2014; Teddlie & Reynolds, 2000), and when raw scores, such as SIMCE, are used (Dumay et al., 2014; Thomas et al., 2007). As Dumay et al. (2014) observed, the correlations identified at the school level over a five- to ten-year period for such data typically fall within the range of $r = .90$ to $r = .99$. Considering the available evidence, it seemed reasonable to conclude that using these data was appropriate.

Ambidexterity. Following March (1991) and the works of both Da'as (2024) and Dedering and Pietsch (2023), we modeled organizational ambidexterity in schools based on exploitation and exploration:

- *Exploitation* (ω = .834). Three items for screening ambidexterity in schools that Dedering and Pietsch (2023) developed were translated into Spanish and employed to assess a school's refinement and extension of existing competencies, technologies, and paradigms, thereby drawing on existing knowledge. The items were evaluated on a four-point scale (1 = strongly disagree to 4 = strongly agree). The following three items were used: "Our school continuously improves its quality"; "Our school is committed to becoming better and better"; and "Our school optimizes its offer so that the students of our school are always satisfied."
- *Exploration* (ω = .881). Another three items from Dedering and Pietsch (2023) were translated into Spanish and used to measure a school's orientation toward experimentation and the inclination to develop new solutions by searching for new knowledge. Items were answered on a four-point scale (1 = strongly disagree to 4 = strongly agree). The three items used are as follows: "Our school generates new ideas through unconventional thinking"; "Our school is successful because we often try something new"; and "Our school creates new offers in order to become attractive to students who do not know us yet."

Control variables. To control student achievement for contextual constraints and moderators, in accordance with our theoretical model presented in Fig. 1, we included the following control variables in our structural equation model: (1) school size, indicated by the number of students enrolled in a school; (2) percentage of students in poverty, as

indicated by the percentage of a school's total enrollment from the bottom 40% of the income distribution; (3) rurality and urbanity; (4) school administration—that is, public school vs. state-funded private school (voucher) vs. parent-funded private school.

Data analyses

Since our questionnaire data came from a single instrument, we preliminarily examined the common variance by loading all items used in the analyses on a single unrotated factor (Harman, 1976). If the value determined here is less than 50%, it is unlikely that method bias in model estimates due to common variance will be expected (Lance et al., 2010). In our data, the common variance amounted to 28.8%. To test our hypotheses, we applied various methodological approaches. First, we estimated structural equation models in M*plus* 8.5 using maximum likelihood estimation with robust standard errors (MLR) to account for potential skewness (Muthén & Muthén, 2017). Second, we used RSA to investigate the nature of the exploitation–exploration relation and their joint impact, utilizing the R package *RSA* (Schönbrodt & Humberg, 2023). Third, we employed a CART algorithm as a machine learning approach to investigate moderator effects and non-linear relationships between predictor variables and student achievement, utilizing the *rpart* package in R (Thernau et al., 2022).

Results

Descriptives and measurement model

The results of the descriptive statistics are shown in Table 2. Fifty-two percent of the schools in our sample are private schools (46% state-funded and 6% parent-funded), and 48% are public schools. Most of them are located in urban areas (86%). On average, 572 students attend these schools, of which an average of 57.6% can be described as poor. The average student achievement in the schools studied is 252.20 points in language and 263.96 points in mathematics. The orientation of schools is explorative (M = 3.65) rather than exploitative (M = 3.28); in other words, they seek new knowledge and experiment rather than exploit existing knowledge and strive for efficiency.

Additionally, we investigated the model fit of the two-dimensional exploitation–exploration measurement model by applying confirmatory factor analysis. Here, a root mean square error of approximation (RMSEA) of $< .08$, a standardized root mean square residual (SRMR) of $< .08$, and a comparative fit index (CFI) of $> .90$ indicate an acceptable fit (Hu & Bentler, 1999). The results demonstrate a good fit of our measurement model ($CFI = .974$, $RMSEA < .07$, $SRMR < .03$).

Structural equation model

To answer research question 1, we established an SEM. As 13.2% of the data were missing, we used a full information maximum likelihood (FIML) estimator to deal with missing data. We allowed for both the correlation between exploitation and exploration (r=.819) and the correlation between language achievement and math achievement in the model (r=.857). Fig. 2 shows the analytical model of the SEM. The results of the analysis are presented in Table 3.

In Model 1, we examined only the effects of exploitation and exploration on student achievement in Chilean schools. The results reveal a weakly positive but not statistically significant relationship between both exploitation and exploration and student achievement in language ($\beta_{exploitation} = .029$, $SE = .181$, $p > .05$; $\beta_{exploration} = .118$, $SE = .177$, $p > .05$) and mathematics ($\beta_{exploitation} = .061$, $SE = .174$, $p > .05$; $\beta_{exploration} = .137$, $SE = .171$, $p > .05$). The model accounted for 2% of the between-school variance in language achievement and 4% of the variance in mathematics achievement.

In model 2, following the most common approach for modeling ambidexterity (Caniëls & Veld, 2019), we added a latent interaction term to investigate possible joint effects of exploitation and exploration on student achievement. Since no fit indices are available for random effects models, we compared the log-likelihoods of models with and without a latent interaction, using a log-likelihood ratio test and report coefficient D (Klein & Moosbrugger, 2000). Further, we investigated whether more variance in student achievement between schools (ΔR^2) could be explained by the addition of the newly added parameter (Maslowsky et al., 2015).

Adding the newly created variable increased R^2 for language achievement to .070 and for mathematics achievement to .052. The corresponding values for ΔR^2 are .05 and .02. In other words, adding ambidexterity to the model increases the explanatory power of the model for language achievement by 250 percent and for math achievement by about 55 percent. The effect of ambidexterity on language achievement is relatively high and significant ($\beta_{ambidexterity} = .119$, $SE = .046$, $p < .05$), while the effect of ambidexterity on math achievement is low and not significant ($\beta_{ambidexterity} = .062$, $SE = .047$, $p > .05$). The coefficient D is 6.592 and statistically significant (df=2, $p <$ .05), indicating that the latent moderated structural equation model, including the latent interaction—that is, ambidexterity—fits our data better than the model without the latent interaction. The strong change in the coefficients of exploration and exploitation indicates that they depend on the interaction—that is, ambidexterity—and therefore cannot be considered independently.

Following best practice recommendations for interaction reporting, we also used a *pick-a-point*, simple slope procedure (Finsaas & Goldstein, 2021). Accordingly, in Fig. 3a and 3b, we graphically show how organizational ambidexterity relates to student achievement—that is, when exploration is zero (*average*) or 1 SD below (*low*) or 1 SD above (*high*) this value. It can be seen here that both language and math achievement are higher when exploitation and exploration increase, namely when organizational ambidexterity is evident.

We controlled for contextual factors in Model 3. The results show that organizational ambidexterity in schools positively affects language

Table 2
Means, standard deviations, and correlations of model variables.

	M	SD	Expi	Expr	Lang	Math	Povr	Size	Rura	Vouc	Pare
Expi	3.28	.59	1								
Expr	3.65	.41	**.818**	1							
Lang	252.20	24.80	**.140**	**.158**	1						
Math	263.96	23.46	**.168**	**.174**	**.855**	1					
Povr	57.61	21.18	.096	.086	**-.500**	**-.478**	1				
Size	571.56	441.76	.054	**.106**	**.291**	**.359**	**-.307**	1			
Rura+	.14	.34	**.126**	.004	-.086	-.066	**.256**	**-.232**	1		
Vouc#	.46	.50	-.132	**-.145**	**.243**	**.158**	**-.170**	**.319**	**-.102**	1	
Pare#	.06	.24	.082	.071	**.344**	**.371**	**-.610**	.089	-.086	-	1

Note: bold correlations $p < .05$; Expi = exploitation, Expr = exploration, Lang = language Achievement, Math = math achievement, Povr = poverty rate, Size = school size, Rura = rurality–urbanity, Vouc = state-funded private school, Pare = parental-funded private school; +reference group: urban school; #reference group: public school

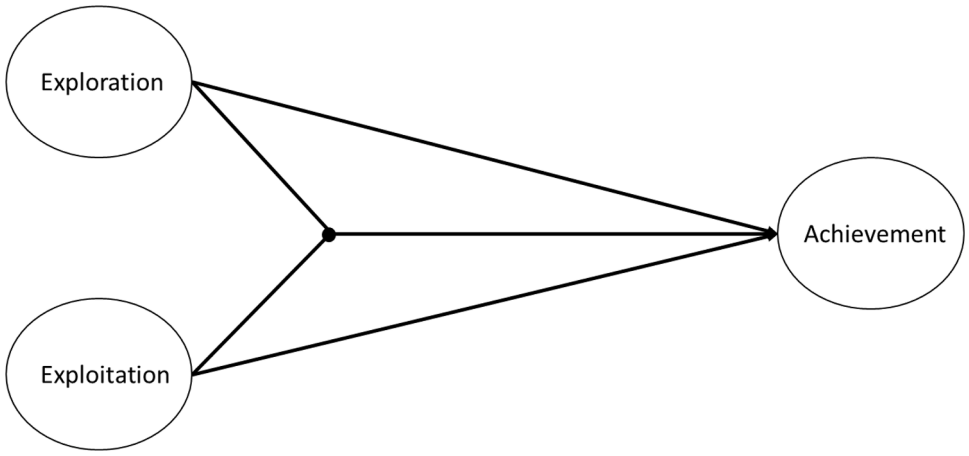

Fig. 2. Analytical model of the SEM analysis.

Table 3
Standardized path coefficients on student achievement.

	Language achievement			Mathematics achievement		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Expi	.029	.186	.140	.061	.133	.093
Expr	.118	.035	.077	.137	.099	.110
Ambi (Expi * Expr)		**.119**	**.083**		.062	.035
Povr			**-.355**			**-.288**
Size			**.133**			**.251**
Rura+			**.185**			.080
Vouc#			**.167**			**.196**
Pare#			.140			.093

Note: Bold $p < .05$; Expi = exploitation, Expr = exploration, Ambi = ambidexterity, that is, the latent interaction of Expi and Expr, Povr = poverty rate, Size = school size, Rura = rurality-urbanity, Vouc = state-funded private school, Pare = parental-funded private school; +reference group: urban school; #reference group: public school

achievement ($\beta_{ambidexterity}$= .083, SE = .038, $p < .05$) but not mathematics achievement ($\beta_{ambidexterity}$= .035, SE = .043, $p > .05$), even when we control for school context characteristics. In total, the third model accounted for 36% of the between-school variance in language and 35% of the variance in mathematics. Finally, the relevance of the ambidexterity coefficient—that is, the joint effect of exploitation and exploration on achievement—can be determined by calculating Cohen's incremental f^2 (Fey et al., 2023) for the ambidexterity coefficients as an effect size. Controlling for covariates and both exploitation and exploration, the f^2 value for ambidexterity concerning language is .04 and for mathematics it is .01. The value for language is well above Cohen's (2013) suggested cut-off value of .02 and can therefore be considered to be of relevant small-to-medium effect.

Response surface analysis

To further study the nature of the interaction effect in more detail and thus address research question 2, we used RSA. Exploitation and exploration were treated as commensurable variables, and their effect on achievement was depicted in a three-dimensional plot by utilizing the *RSA* package (Schönbrodt & Humberg, 2023). In the analyses, commensurable variables were separately centered around their median value, the missing data were dealt with using full information maximum likelihood (FIML) estimation, and all relevant parameters were

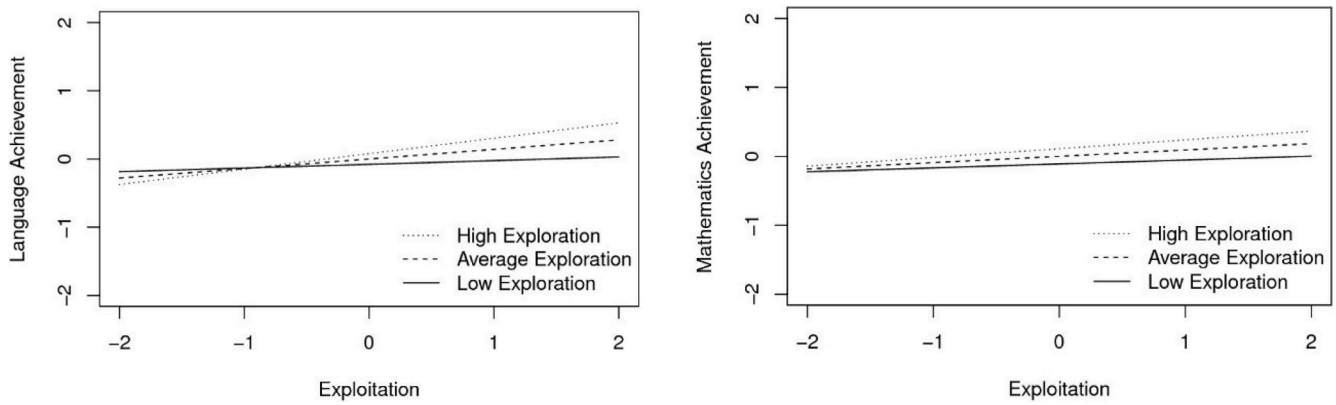

Fig. 3. a, b: Interaction plots showing the effect of ambidexterity on student achievement.

computed automatically using the *RSA* package. To present and discuss the results, we followed Mota et al. (2020), Ratchford et al. (2021), Humberg et al. (2019), and Schneider et al. (2022). Details of the RSA model are shown in Eq. (1).

$$Z_i = b_0 + b_1X_i + b_2Y_i + b_3{X_i}^2 + b_4X_iY_i + b_5{Y_i}^2 + e_i \quad (1)$$

where Z, X, and Y represent standardized achievement, median-centered exploitation, and median-centered exploration scores, respectively. Based on these b-coefficients, parameters a_1 to a_5 can be estimated. The a-coefficients are anchored around two orthogonal axes in the horizontal plane, describing perfect congruence (X = Y) and perfect incongruence (X = −Y). Consequently, the first axis is called the line of congruence (LOC) and the second is the line of incongruence (LOIC), with a_1 and a_2 representing the slope and curvature along the LOC and a_3 and a_4 representing the slope and curvature along the LOIC. Finally, the line on the surface that has maximal upward (or minimal downward) curvature is called the first principal axis (FPA). The position of the FPA is indicated by parameter a_5. Lastly, p_{10} and p_{11} are the intercept and slope of the FPA, which represent the position of the ridge line. The second principal axis (SPA) is necessary to define a bowl-shaped surface to study the reverse congruence effect, and the parameters p_{20} and p_{21} are the intercept and slope of the SPA, which is referred to as "the valley" by Humberg et al. (2019).

Both beta coefficients and surface parameters should not be interpreted individually. For our analyses, three parameter configurations are interesting. (a) Higher achievement is related to an interaction of exploration and exploitation; hence, exploration moderates the exploitation–achievement relationship (ambidexterity as a product). (b) Higher achievement is related to an imbalance between exploitation and exploration in either direction—that is, high exploitation and low exploration or low exploitation and high exploration (ambidexterity as a difference). (c) Higher achievement is related to a balance between exploitation and exploration (ambidexterity as a sum). Specifically, these are as follows: (a) an interaction model, with $b_3 = b_5 = 0$, $b_4 < 0$; (b) a reverse congruency model, with $b_1 = b_2$, $b_3 > 0$, $b_4 = -2b_3$, $b_5 = b_3$; and (c) a congruency model, with $b_1 = b_2 = 0$, $b_4 = -2b_3$, $b_5 = b_3$, $b_3 < 0$ (Mota et al., 2020; Schneider et al., 2022). From a methodological perspective (Mota et al., 2020), a null model (no effect of exploration and exploitation on student achievement) can be determined if $b_1 = b_2 = b_3 = b_4 = b_5 = 0$.

Unless all b parameters are zero, the surface parameters (i.e., a_1 to a_5) along with the FPA and SPA parameters can be computed based on these parameters and interpreted in more detail following Humberg et al. (2019). The a_1 and a_2 parameters attempt to quantify the effect of the commensurable variable match on achievement, a linear or quadratic effect, respectively, whereas a_3 and a_4 parameters attempt to quantify the effect of commensurable variable mismatch on achievement, a linear or quadratic effect, respectively. When $p_{10} = 0$, $p_{11} = 1$, $a_4 < 0$, and $a_3 = 0$, a broad congruence effect can be assumed; that is, congruence has a positive effect on the outcome, whereas they allow for the possibility that, in addition to this effect, the predictor variables can have common main effects (Humberg et al., 2019). For a strict congruence effect to occur—that is, a model without main effects—a further $a_2 = 0$ and $a_1 = 0$ must be demonstrated (Humberg et al., 2019). For a reverse congruence effect to occur, the following configuration must be given: $p_{20} = 0$, $p_{21} = 1$, $a_4 > 0$, and $a_3 = 0$.

For language achievement, parameters, with one-tailed p-values, are as follows: $b_1 = 7.88$ ($p > .05$), b_2=5.67 ($p > .05$), $b_3 = 16.01$ ($p > .05$), b_4 = -11.63 ($p < .05$), $b_5 = 6.13$ ($p > .05$); $a_1 = 13.55$ ($p < .05$), $a_2 = 10.51$ ($p > .05$), $a_3 = 2.20$ ($p > .05$), $a_4 = 33.77$ ($p > .05$), $a_5 = 9.87$ ($p > .05$); p_{10} = -1.35 ($p > .05$), p_{11} = -0.46 ($p > .05$); $p_{20} = .30$ ($p > .05$), $p_{21} = 2.16$ ($p > .05$).

For mathematics achievement, parameters, with one-tailed p-values, are as follows: $b_1 = 5.40$ ($p > .05$), $b_2 = 7.68$ ($p > .05$), $b_3 = 12.36$ ($p > .05$), b_4 = -17.76 ($p > .05$), $b_5 = 6.95$ ($p > .05$); $a_1 = 13.08$ ($p < .05$), $a_2 = 1.55$ ($p > .05$), a_3 = -2.28 ($p > .05$), $a_4 = 37.07$ ($p > .05$), $a_5 = 5.42$ ($p > .05$); p_{10} = -15.78 ($p > .05$), p_{11} = -0.474 (p > .05); p_{20} = -.01 ($p > .05$), $p_{21} = 1.35$($p > .05$).

Following Mota et al. (2020), for language achievement, we find support for an interaction effect as $b_3 = b_5 = 0$ and b4 < 0; that is, exploration moderates the exploitation–achievement relationship (see Fig. 4a). For mathematics achievement, the RSA results support the findings from our SEM, indicating no main or joint effects of exploitation and exploration on mathematics achievement, as b_1 to b_5 are not significantly different from zero. However, following the checklist by Humberg et al. (2019), our results indicate a weak reverse congruence effect for mathematics achievement, given that the intercept of the second principal axis (p_{20}) is around 0 but its slope (p_{21}) includes 1 in the confidence interval with large a_4 but low a_3 values (see Fig. 4b). This weak reverse congruence effect, or the weak "valley," might have occurred because of the strong negative effect of low ambidexterity; that is, the lowest achievement is monitored when both exploitation and exploration are low.

Classification and regression trees analysis

To investigate research question 3, in a final step, we tested for

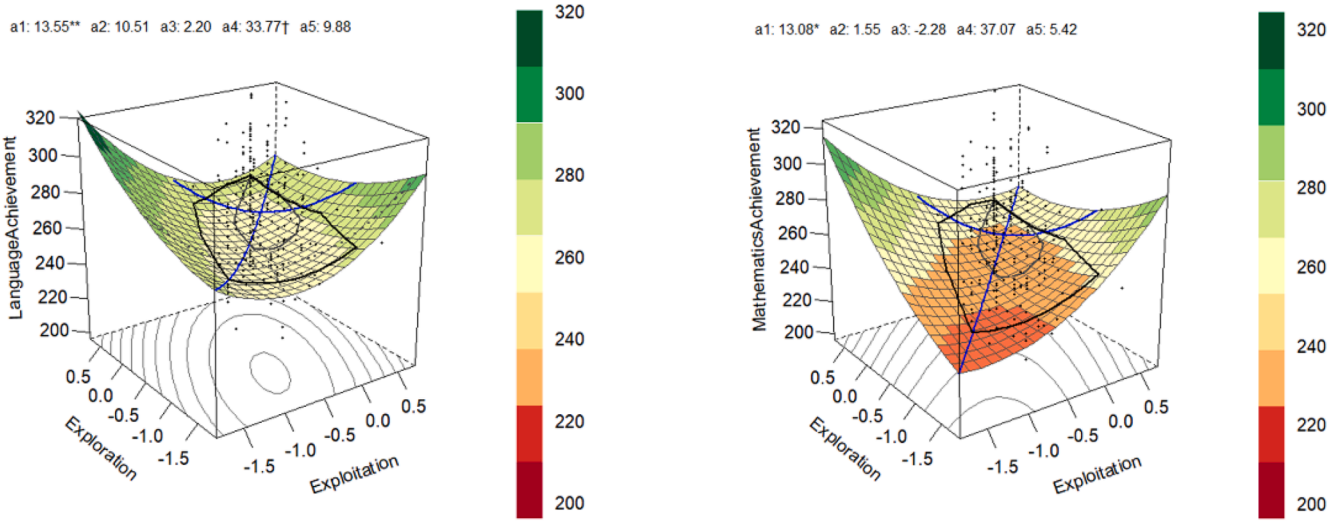

Fig. 4. a, b: Response surface plots showing the effect of ambidexterity on student achievement.

possible interaction, that is, ambidexterity, and non-linear effects of exploitation, exploration, and school contextual covariates, that is, poverty rate, school size, rurality–urbanity, and school funding. Adding these additional covariates and their nonlinear relations with ambidexterity to the RSA model is basically unfeasible and not aligned with the purpose of RSA. Moreover, even valid controls may be endogenous, representing a combination of multiple causal mechanisms (Hünermund & Louw, 2020). It is thus recommended that these interactions be modeled based on the data rather than specified through prior assumptions (Pietsch et al., 2024) to expand the range of explanations that an organizational theory can inhabit (Leavitt et al., 2021). Hence, the CART procedure (Breiman et al., 1984), as a machine learning approach, was utilized to predict achievement scores without making linearity or predefined non-linearity assumptions (i.e., RSA). Among other machine-learning approaches, CART is arguably easier to interpret (Krzywinski & Altman, 2017; Loh, 2014) and has recently attracted more attention from educational researchers (Hilbert et al., 2021; Zeybekoğlu & Koğar, 2022). The *rpart* function (Therneau & Atkinson, 2023) was chosen to implement an algorithm that divides data into subsets based on the predictive power of independent variables, with a minimum subset size of 20 schools to prevent overfitting. The CART results are depicted in Figs. 5 and 6 using the R package *rattle* (Williams, 2011). The splitting criterion (i.e., cut points or thresholds) in these figures is determined by the *rpart* function to obtain the best split based on the sum-of-squares, similar to the analysis of variance that aims to maximize the between-groups sum-of-squares (Therneau & Atkinson, 2023).

For language achievement, the CART results, presented in Fig. 5, indicated that all predictors have at least 1% importance in predicting language achievement with the following weights: student poverty rate 50%, school size 20%, parent-funded private schools 18%, state-funded private schools 5%, rurality–urbanity 3%, exploitation 3%, and exploration 1%. High scores are achieved in schools with a low poverty rate (< 34%), and low student performance can be observed particularly in medium-sized (≥ 161 and < 342) public schools (Vouc = 0). Exploration, on the other hand, has a positive association with language achievement at large schools with average high poverty rates (> 34% and < 73%). An exploratory orientation of the school is associated with a positive school performance difference of about half a standard deviation of language achievement (262 vs. 275 SIMCE points).

For math achievement, CART results, depicted in Fig. 6, indicated that 6 out of 7 predictors have importance in predicting mathematics achievement with the following weights: poverty rate 44%, school size 26%, parent-funded private schools 20%, exploration 4%, state-funded private schools 4%, and exploitation 2%. The poverty rate is also the main determinant of mathematics achievement. Schools with low poverty rates (< 34%) achieve the highest overall performance in mathematics. Similar to language, exploration plays an important role here: in smaller schools (size < 552), where the explorative orientation of the school tends to be lower, students' achievement in mathematics is particularly low. In these schools, exploration makes a crucial difference: in smaller schools (size < 395), the effect is about a third of a standard deviation (236 vs. 244 SIMCE points), and in medium-sized schools (size between 395 and 552 students), it is about half a standard deviation (236 vs. 255 SIMCE points).

Discussion

Our findings suggest that organizational ambidexterity in schools is a complex and contingent phenomenon. Thus, on the one hand, we found evidence that ambidexterity in Chilean schools follows a contextual path that emphasizes the integration of exploration and exploitation (Wang & Rafiq, 2014) to achieve higher student achievement, especially regarding language achievement. On the other hand, organizational ambidexterity simultaneously follows a structural route, with exploration and exploitation playing different roles in schools to enable higher student achievement in language and mathematics, particularly in high-poverty schools. Regarding the effects of ambidexterity on student achievement, statistically significant effects can only be determined for language achievement. Furthermore, the effect size of ambidexterity on

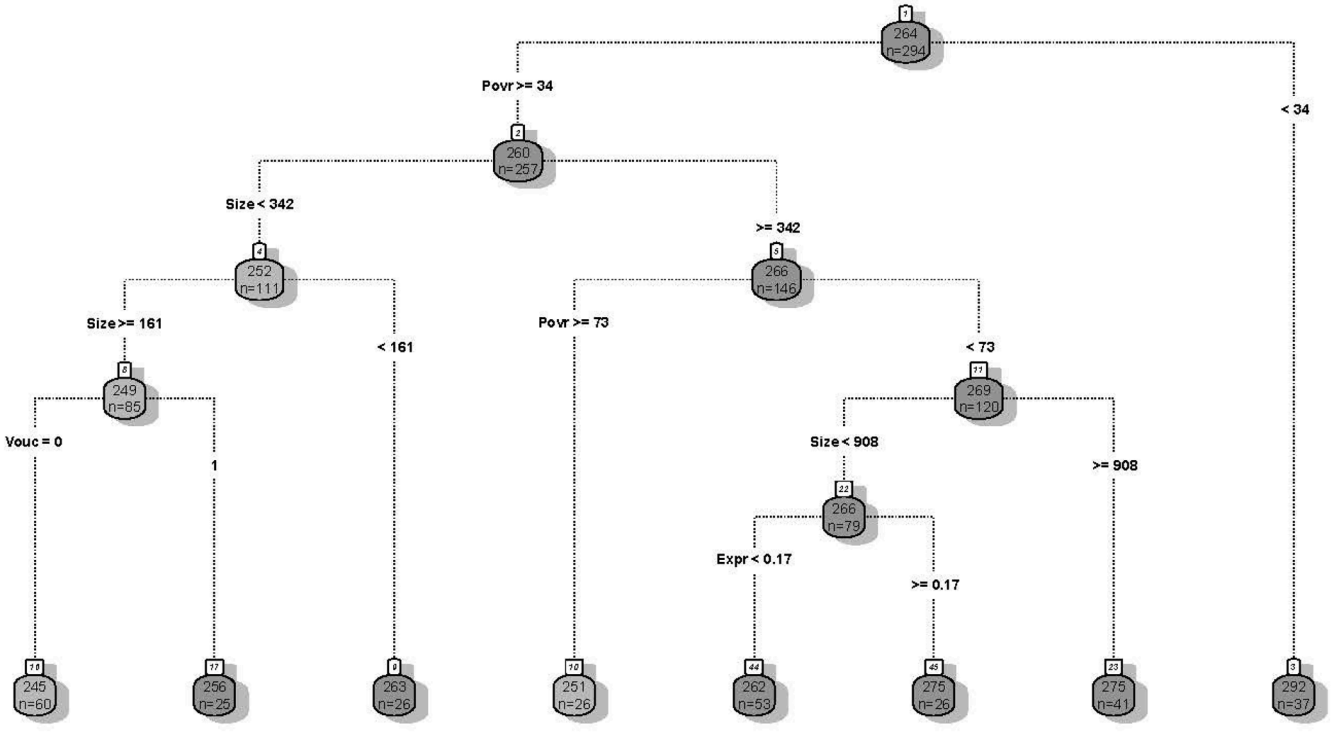

Fig. 5. CART plot showing the joint effects of exploration, exploitation, and covariates on language achievement
Note: Expr = exploration, Povr = poverty rate, Size = school size, Vouc = state-funded private school.

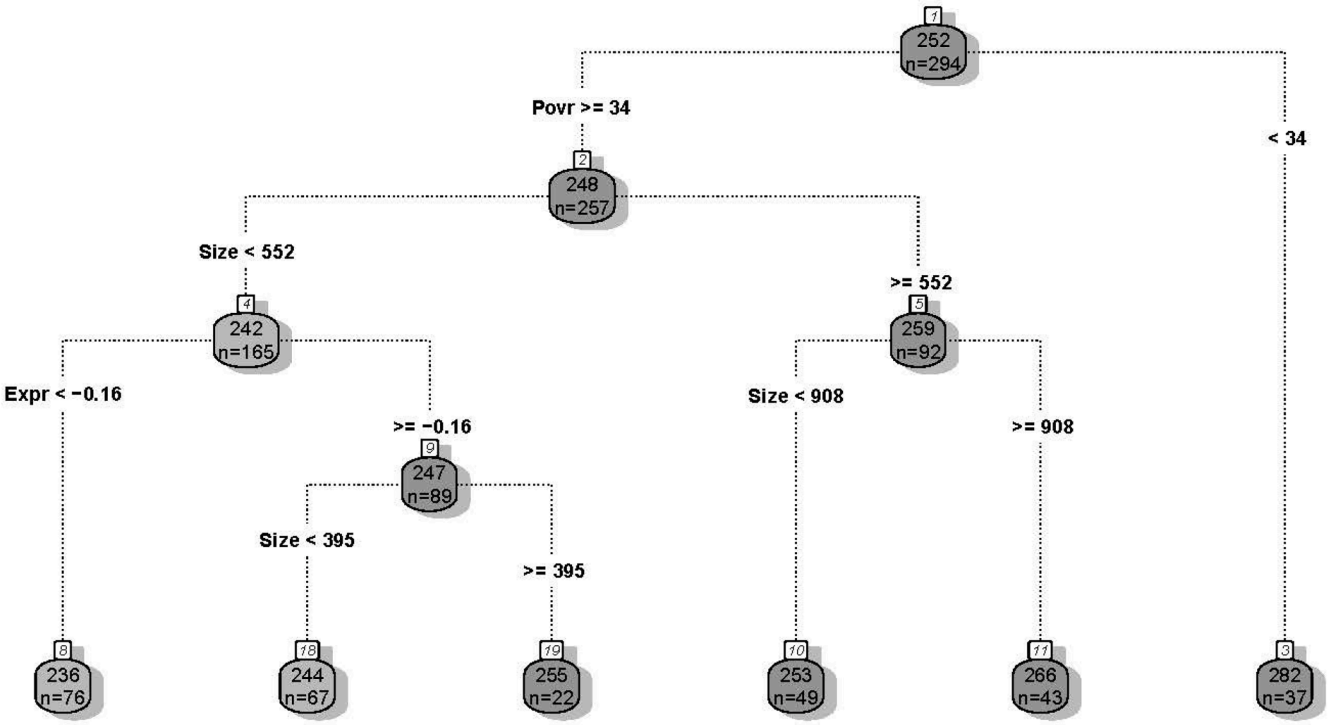

Fig. 6. CART plot showing the joint effects of exploration, exploitation, and covariates on mathematics achievement
Note: Expr = exploration, Povr = poverty rate, Size = school size.

student achievement, in general, is $f^2 = .01$ for math and $f^2 = .04$ for language. Hence, our results for language achievement are in line with the results reported by Junni et al. (2013) on the effect that organizational ambidexterity has on objectively measured performance indicators in general (ES = .04).

We further found evidence that organizational ambidexterity in schools can take different forms concerning the dependent variables: language achievement and math achievement. For language achievement, it is the interaction of exploitation and exploration that exerts an influence; that is, language achievement depends linearly on exploitation, and the strength of this association is moderated by exploration. This supports the contextual approach to ambidexterity, which suggests that a stronger focus on both exploration and exploitation would support better organizational performance (Rosing & Zacher, 2017). For math, it is a reverse congruence effect; that is, high math achievement is associated with a high discrepancy between exploitation and exploration. The findings related to math achievement seem to contradict a contextual view of ambidexterity (Wang & Rafiq, 2014), in which undertaking both types simultaneously is encouraged for better performance (Peng et al., 2019).

However, this finding supports the work of Caniëls and Veld (2019), indicating that a combination of high levels of exploitation and exploration activities is positively and significantly associated with performance and that the outcome is relatively higher in the case of an imbalance between exploration and exploitation. In the case of a discrepancy or imbalance, better math performance is evident when there is a stronger exploration, concurring with Rosing and Zacher (2017). This might suggest that particularly innovative practices are needed to increase student math learning. Additionally, consistent with previous research on firms (Caniëls & Veld, 2019), the absence of exploration and exploitation in schools, however, is associated with particularly low achievement scores. Combined with the fact that we see a strong influence of exploration in the area of mathematics, this could indicate that schools follow a sequential ambidextrous strategy for mathematics achievement—that is, a reorientation and temporal shift of a school or its mathematics department's structures and processes between exploration and exploitation over time.

Our CART results consistently suggest that student poverty is the main factor that explains the variation in both student achievement domains, which is in line with previous research on high poverty schools and achievement (Gümüş et al., 2022; Tan, 2018). When it comes to high-poverty schools, a school's explorative orientation and hence "a shift away from an organization's current knowledge base and skills" (Lavie et al., 2010, p. 114) toward "a longer time perspective, more autonomy, flexibility and risk-taking and less formal systems and control" (O'Reilly & Tushman, 2008, p. 190) seem to be more effective in increasing students' language scores. This indicates that focusing on routines and efficiency might be less important for students attending these schools. In general, our results show that exploration can partially offset the negative effects of poverty in schools, with observable effects on math and language achievement. The effects in each case amount to up to half a standard deviation. This is a comparatively large effect (Hill et al., 2008) and is roughly equivalent to the learning gains in primary school over one school year (Kraft, 2020). However, all this seems to be highly contingent on other environmental factors and organizational antecedents, such as school size and, with regard to language achievement, school type.

Limitations and future research

Several limitations should be highlighted. First, this is an inaugural study examining the relationship between organizational ambidexterity in schools and student achievement. Consequently, no comparative studies are available. Second, the data utilized in this study are drawn from a single country, Chile, with a distinctive contextual background. Consequently, the extent to which the presented findings can be generalized to other contexts remains uncertain (Pietsch et al., 2023a). Third, our study employs cross-sectional data, which inherently entail correlative conclusions based on inferences. It is therefore unclear whether exploration, exploitation, and ambidexterity may have no (or a

different type of) association with the change in student achievement over time, other than that reported here. Fourth, some of our predictors are based on self-reports, which might invite bias (Costa & Filho, 2019). The basic assumption of the self-report scales is that the answers given by respondents are a true reflection of their knowledge or ideas (Baumgartner & Steenkamp, 2001; van Herk et al., 2004). Fifth, as noted in the measures section, the student-level achievement data were not available, and only the observed school-level student achievement average scores based on a decent sample size per school were available. The average achievement of students in a school is an indicator of school effectiveness (Scheerens, 2000). To avoid ecological fallacy (Connolly, 2006), readers should keep in mind that the dependent variable of this study was average student achievement per school, not student achievement at the individual level.

Considering these limitations and the findings presented, further research might address the following topics. First, the findings indicate that ambidexterity in schools has some potential to raise student achievement schoolwide and mitigate social disparities between schools. Further research is required to gain a deeper understanding of this phenomenon and to ascertain whether there are any observable, longitudinal changes resulting from it. Second, our examination has thus far been limited to the initial findings on the contextual conditions of ambidexterity in schools. While there is a substantial body of literature examining the moderators of ambidexterity, the majority of these studies originate from the field of economics. Accordingly, it is necessary to examine which moderators are important for ambidexterity to have an effect in schools. Third, our study demonstrates the value of employing sophisticated and emerging methodologies to generate findings, thereby facilitating the rigorous testing, extension, and pruning of assumptions and models in organizational and management research, as exemplified by RSA and machine learning. We see an opportunity to drive forward the entire field through such methodologies.

Conclusion and implications

Despite the growing global pressure on educational systems to better address student achievement issues, there is a lack of research in the education literature regarding key concepts related to innovation. The results presented indicate that an ambidextrous orientation can have positive effects on school outcomes. It is essential to note that this seems to affect both key dimensions of school effectiveness at the same time (Kyriakides et al., 2018): quality and equity. While the available studies on the topic indicate that only a few schools typically succeed in achieving both dimensions simultaneously (Kyriakides & Creemers, 2011), our findings, based on the use and testing of a novel model in educational research, provide initial insights into the mechanisms that can be employed to achieve such performance. Our findings suggest that the integration of exploration and exploitation in schools might have strong potential for schools to gain increased student achievement and reduce educational inequalities simultaneously. However, the implications are different for math and language achievements, indicating that school organizational ambidexterity is domain specific (O'Reilly & Tushman, 2013). Although a simultaneous increase in exploration and exploitation could be beneficial for language learning, it seems to harm students' math achievement, for which a sequential approach to ambidexterity seems to be more fruitful.

This also suggests that each domain within a school has its own concept of ambidexterity—its own procedures and processes—and interacts distinctly with moderators and organizational antecedents. Given that ambidexterity is primarily about acquiring, exchanging, and utilizing both proven and novel knowledge (Dedering & Pietsch, 2023), the design of corresponding knowledge management processes within a school and across institutional borders (Pietsch et al., 2024) must align with each domain separately. The creation and maintenance of organizational ambidexterity thus represents a significant and time-consuming challenge for all those involved in schooling. This finding may provide insight into why it is so hard for schools to implement change (Mehta & Datnow, 2020; Tyack & Tobin, 1994) and why only a few of them succeed in achieving educational quality and equity simultaneously (Kyriakides & Creemers, 2011). The precise mechanisms that underpin this phenomenon and the specific actions that must be undertaken within schools to attain this objective have yet to be elucidated.

However, the presented results have implications for policy and practice in Chile, which has undergone various structural reforms. For example, the Inclusion Law prohibits student selection practices in state-funded schools, requiring practitioners to innovate to meet the needs of a more diverse student population (Valenzuela & Allende, 2023). The National System for Teachers' Professional Development Law places a new demand on school leaders who must innovate to plan and implement professional learning communities. Considering that this study did not explore innovative practices in the context of specific reforms, further research can examine teachers' and school leaders' use of exploitation and exploration—and their interactions—to address new policy demands (Bingham & Burch, 2019; Özdemir et al., 2024). The success of school reforms depends not only on how practitioners make sense of new demands but also on their ability to examine and respond to profound changes entailed by a reform (Spillane et al., 2002). The capacity of organizations to act ambidextrously is mainly contingent upon the ability of their members to effectively manage exploration and exploitation activities (Tarba et al., 2020). Recognizing when existing knowledge and practices can address these changes and when new knowledge is required can help explain the variability in policy impact on practice and outcomes at the school level. Ultimately, this may lead to the development of more effective and equitable schools.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used AI writing tools (DeepL) in order to recheck the English writing. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Consent for publication

All authors have reviewed and approved the final manuscript and consent to its publication in the Journal of Innovation and Knowledge.

Availability of data and materials

Data is available upon reasonable requests.

Competing interests

We do not have any competing interests.

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N/A

CRediT authorship contribution statement

Marcus Pietsch: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **Burak Aydin:** Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Carmen Montecinos:** Conceptualization, Investigation, Project administration, Validation, Writing – original draft, Writing – review & editing. **Mehmet Şükrü Bellibaş:** Conceptualization, Investigation, Validation, Writing – review & editing, Writing – original draft.

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