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Addressing causal complexity in the drivers of teachers' innovative behavior: a configurational qualitative comparative approach

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Abstract
The literature emphasizes the importance of promoting employee innovative behavior, especially in knowledge-intensive sectors. In education, employee innovative behavior is important to achieve school innovation and provide high-quality educational services. This paper explores causal complexity in the drivers of teachers' innovative behavior. A review of the antecedents of innovative behavior shows that high-performance work systems, engagement, public service motivation, and empowering leadership are key antecedents of employee innovative behavior. Gender and experience are also relevant. Qualitative comparative analysis (QCA) is used to analyze combinations of these causal antecedents under possible causal asymmetry and equifinality. The action paths driving or hindering teachers' innovative behavior are identified. These findings provide a deeper understanding of this process. Engagement and high-performance work systems are prime drivers of innovative behavior, encouraging employees to revisit existing knowledge structures, broaden their cognition and perception, and attempt non-traditional combinations of ideas.

Keywords Innovative behavior · High-performance work systems · Engagement · Public service motivation · Empowering leadership · Qualitative comparative analysis (QCA)

Abbreviations

AMO	Ability-motivation-opportunity
EL	Empowering leadership
ENG	Engagement
ESA	Enhanced standard analysis
EXP	Experience
fsQCA	Fuzzy-set qualitative comparative analysis
GEN	Gender
HPWS	High-performance work systems
HRM	Human resource management

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IB	Innovative behavior
IWCCs	Innovative work characteristics and conditions
IWIIs	Innovative work inhibitors and interdependencies
IWLL	Innovative work learning and leadership
IWPPs	Innovative work processes and performances
LMX	Leader-member-exchange
PSM	Public service motivation
QCA	Qualitative comparative analysis

1 Introduction

In recent decades, there has been a growing interest in understanding the drivers that push individuals to engage in innovative behaviors at work (Hammond et al. 2011). Obviously, the contribution of employees to an organization's innovation performance is not uniform. In particular, knowledge workers—those whose roles primarily involve the generation, processing, and application of knowledge—(Drucker 1979) have been identified as playing a pivotal role in fostering innovation. As noted by Hayton et al. (2013), knowledge workers constitute a critical group of employees in firms that rely heavily on innovation as a source of competitive advantage. Accordingly, a growing body of recent research has concentrated on investigating this specific group of employees (Afsar and Umrani 2020).

A comprehensive literature review uncovered more than 150 causal antecedents of innovative behavior, characterized by differing degrees of theoretical grounding and empirical support. These antecedents span individual factors (demographics, personality and traits, personal competencies and skills, and individual attitudes and beliefs), organizational factors (leadership, HR practices and systems, job and task scope, and other organizational and team factors), and external factors.

Research on the determinants of innovative behavior has traditionally relied on variable-oriented methodologies, which conceptualize each independent variable as analytically distinct and separate. However, the relationships among antecedents of innovative behavior are often complex and interdependent. Mediating and moderating variables frequently possess their own diverse sets of antecedents, contributing to the analytical complexity. This methodological limitation may partially account for the inconclusive and, at times, contradictory findings reported in the existing literature. In this context, causal complexity is often more appropriately captured through set-theoretic approaches rather than conventional correlational analyses (Ragin 2008; Ragin and Fiss 2008).

To address this complexity, the present study employs Qualitative Comparative Analysis (QCA), a method well-suited for capturing causal complexity and equifinality. Rooted in a case-based approach, QCA posits that the effect of any given factor is contingent upon the specific configuration of other factors present within a case. In other words, it is the interplay among conditions—referred to as configurations—rather than their isolated effects, that accounts for the observed outcome (Fiss 2011; Ragin 2008; Ragin and Fiss 2008; Schneider et al. 2010). This methodological approach aligns with the objectives of the present study, as it facilitates the identification of multiple, non-linear pathways—or causal recipes—leading to innovative behavior, thus offering a more nuanced understanding than traditional variable-oriented analyses.

Adopting a strategic human resource management perspective, this study identified a set of factors considered particularly relevant based on four predefined criteria:

high-performance work systems (HPWS), empowering leadership (EL), public service motivation (PSM), engagement (ENG), experience (EXP), and gender (GEN). These causal antecedents were selected according to the following rationale. First, their significance in explanatory models of human behavior. Second, their potential for intervention at both the organizational level and the level of educational authorities—particularly in the cases of high-performance work systems and empowering leadership. Third, the limited attention these factors have received in relation to innovative behavior. This criterion was especially pertinent to empowering leadership, engagement, and public service motivation. And although the relationship between high-performance work systems and innovative behavior has received some scholarly attention, it has rarely been examined through a systemic lens that prioritizes employees' subjective perceptions—an approach that distinguishes the present study. Finally, the fourth criterion considered the specific characteristics of working within a knowledge-intensive public sector.

The aim of this study is to analyze the combined effect of selected antecedents—among which clear interrelationships exist—on teachers' innovative behavior. The study seeks to determine whether different combinations of these antecedents can lead to the same outcome, whether the patterns associated with innovative behavior differ substantially from those linked to its absence, and whether there are specific patterns related to gender and experience. In pursuit of this aim, several questions were tackled. Are any of these conditions necessary for innovative behavior to occur? Do different combinations of antecedents lead to the same outcome (i.e., the presence or absence of innovative behavior)? Can specific patterns of gender and experience explain the presence or absence of innovative behavior because of their influence on innovative behavior and/or the other antecedents? Can entrepreneurial behavior emerge in the absence of a human resource management system that actively promotes it? Do HR and leadership practices have any effect on innovative behavior if there is not a minimum level of engagement and/or public service motivation?

In order to try to answer these questions, two models were proposed: the first aimed to explain which combinations of conditions lead to the presence of innovative behavior (Model 1), while the second sought to identify the combinations that result in the absence of innovative behavior (Model 2).

This study focused on teachers within the public educational sector, specifically in the Region of Aragon (Spain), for several reasons. First, beyond its quantitative significance, education is a knowledge-intensive sector that represents one of the fundamental pillars of the welfare state. It plays a crucial role in preparing citizens capable of critical thinking, fostering economic development, and reinforcing social cohesion (Hanushek & Woessmann 2015). Second, teachers play a critical role not only in ensuring the quality of education and fostering student engagement, but also in promoting and facilitating the adaptation of the educational system itself to the numerous challenges it faces (Thurlings et al. 2015; Zainal et al. 2020). These challenges include increasing cultural diversity and classroom conflict, the widespread adoption of digital technologies and their misuse by students, rising bureaucratic demands on teachers, and ongoing regulatory reforms, evidenced by the enactment of eight different education laws in Spain since 1980. The tensions and disruptions experienced by educational institutions during the COVID-19 pandemic further highlight the need for a strong capacity for innovation within the education sector to respond effectively to emerging challenges (Ayoub et al. 2023). A third reason for focusing on this sector is that research on innovative behavior has predominantly concentrated on the private sector. On the rare occasions when the education sector has been examined, scholarly attention has largely been limited to higher education, with primary and secondary education remaining significantly understudied. Finally, in the case of the Region of

Aragon (Spain), teacher participation in innovation projects has declined in recent years, with internal sources from the Department of Education reporting a decrease of over 20%. As a result, there is growing institutional interest in implementing measures to foster such participation, which represents a key mechanism for promoting innovative behavior within the teaching profession.

This research offers insights into the human resource management-related drivers of teachers' innovative behavior. The findings identify four configurations of causal antecedents that explain the presence of innovative behavior and three that explain its absence. Notably, the presence of engagement emerges as a necessary condition for innovative behavior, whereas the absence of high-performance work systems is a necessary condition for its lack. Each of the antecedents examined is included in at least one configuration that leads to innovative behavior. Likewise, the absence of several of them usually leads to the absence of innovative behavior. Moreover, as was suggested, the causal patterns differ according to teachers' experience and gender.

These results, consistent with previous research (e.g. Boxall & Macky 2009; Perry and Hondeghem 2008), suggest that although numerous factors beyond organization's control can influence engagement and public service motivation, these can nonetheless be enhanced through appropriate human resource practices and leadership styles. This effect is particularly pronounced when HR practices and leadership styles are well-aligned and mutually reinforcing, as appears to be the case with high-performance work systems and empowering leadership (Paauwe 2004; Zhang & Bartol 2010).

By adopting a qualitative comparative configurational approach, this research addresses a significant gap in the literature by emphasizing the necessity of a systemic perspective. It highlights the importance of examining the combined effects of multiple conditions to deepen our understanding of the relationship between innovative behavior and its causal antecedents.

This research also makes practical contributions offering actionable recommendations for improving school management to enhance schools' innovation performance. These recommendations are aimed at education policymakers and education authorities at least as much as they are aimed at school management teams. The reason is that many decisions regarding human resource management (HRM) practices are taken directly by these decision makers or are strongly conditioned by the guidelines stipulated by the education authorities.

The structure of the study is as follows. Section 2 outlines the theoretical framework, describing the antecedents of innovative behavior and then focusing on the conditions used in the QCA (namely empowering leadership, high-performance work systems, public service motivation, engagement, gender, and experience). Section 3 describes the QCA methodology, and Sect. 4 presents the results. Section 5 outlines the main conclusions and discusses the findings of the study.

2 Theoretical background

2.1 Review of antecedents of innovative behavior

Innovative behavior can be defined as the set of behaviors through which employees can contribute to the innovation process (De Jong and Den Hartog 2007). In particular, it focuses on how new ideas are generated, created, developed, promoted, implemented,

and, if necessary, modified by employees through critical thinking to improve innovation and organizational performance (AlEssa and Durugbo 2022; Baharuddin et al. 2020).

This study focuses on the specific case of teachers. With teachers, innovative behavior refers to any action taken to improve teaching and learning by using more dynamic and inclusive pedagogical methods adapted to the needs of twenty-first century students, the challenges raised by new technologies, and the challenges posed by society (Hilario Silva et al. 2020; Sangrà et al. 2023; UNESCO 2016). Innovative behavior can improve not only educational processes, methods, and services but also learning and development in the classroom. It can thus exert a direct impact on teacher performance, educational quality, and the education of future leaders and professionals (Balkar 2015; Zainal et al. 2020).

As noted in the introduction, promoting employee innovative behavior in knowledge-intensive sectors such as education is essential to ensure the success of educational institutions. Innovative behavior has been linked to different individual and organizational outcomes, including task performance, job satisfaction, employee growth, teacher expertise, student learning, innovation performance, organizational productivity and performance, and competitive advantage (see Sánchez-Pérez 2025 for a review). This broad scope of innovative behavior gives an idea of the importance of understanding the mechanisms that encourage it so that appropriate measures can be taken.

The specialized literature also presents a variety of antecedents of innovative behavior.

Based on relevant previous reviews, like those of AlEssa and Durugbo (2022), Bos-Nehles et al. (2017), El Alfy and Naithani (2021), Kwon and Kim (2020), Li and Hsu (2016), Muchiri et al. (2020), Pons et al. (2016), Thurlings et al. (2015), Zhu et al. (2023), and others, Sánchez-Pérez (2025) conducted a snowball-inspired literature search and established a detailed classification of more than 150 antecedent variables of IB. These variables can be grouped into individual (demographic, personality and traits, competencies and personal skills, and individual attitudes and beliefs), organizational (leadership, HRM practices and systems, factors related to jobs/tasks, and other organizational/team factors), and external factors. A number of mediating (41), moderating (36), and control variables (25) included in models explaining innovative behavior were also identified.

Summarizing, the review of empirical studies suggests a considerable lack of consensus regarding which variables exert the greatest influence on innovative behavior. There also appears to be limited agreement regarding the role of these antecedent variables, as many have been examined within different models, sometimes as direct predictors of innovative behavior, and at other times as mediating, moderating, or control variables. Moreover, the findings reported in the literature reveal a certain degree of inconsistency (see Sánchez-Peréz 2025 for examples). This seems to be indicative of the complexity of the interrelationships between the variables that influence innovative behavior and the possible existence of circular causal relationships. When combined with the limitations of statistical methods, that treat each variable as independent and analytically distinct from the rest, and the predominance of cross-sectional studies, this situation may, at least partially, explain the existence of mixed and sometimes apparently contradictory results.

The following subsections offer a detailed analysis of the antecedents of innovative behavior examined in this study, which were selected based on the criteria previously outlined in the introduction of this paper: empowering leadership, high-performance work systems, public service motivation, engagement, gender, and experience.

2.2 Selected antecedent conditions

2.2.1 Empowering leadership

Despite the growing body of research on the association between leadership and employee innovative behavior (Bagheri 2017; Choi et al. 2016), the impact of the emerging concept of empowering leadership has been somewhat overlooked (Chen et al. 2011; Hassi et al. 2022; Jada et al. 2019). Hassi et al. (2022) cited empowering leadership as a promising leadership style for inquiry in this area. The meta-analytic review by Lee et al. (2020) confirmed that empowering leadership is one of the three contemporary and narrowly specified leadership styles with the strongest correlations with creativity and innovation.

What differentiates empowering leadership from other leadership styles is that it aims at creating autonomous and self-directed individuals (Hassi et al. 2022; Jada et al. 2019). Empowering leadership can be defined as a leadership style characterized by "behaviors that share power with subordinates" (Vecchio et al. 2010: 531).

Empowering leaders show confidence in employees, allow them to take control of their work, remove bureaucratic constraints and build employee capabilities (Ahearne et al. 2005; Arnold et al. 2000; Srivastava et al. 2006), enhancing their intrinsic motivation to take risks and try new things (Zhang and Bartol 2010). The nature of empowering leaders enhances employees' positive attitudes and allows employees to be more adaptive and receptive of their environments (Forrester 2000). The flexibility offered by an empowering leader encourages exploration at work, which in turn builds a foundation for innovation in the workplace (Gkorezis 2016).

According to self-determination theory (Deci and Ryan 2000; Ryan and Deci 2000), empowered employees find more meaning in their work, are more confident in their ability to innovate, and are intrinsically motivated to find innovative solutions (Afsar et al. 2014; Boerner et al. 2007; Choi et al. 2016). Empowering leaders encourage employees' proactive behavior (Martin et al. 2013) and urge their followers to experiment with innovative ways of working without the risk of being punished in the event of negative outcomes of these experiments (Jung et al. 2003).

Studies have confirmed the positive association between empowering leadership and innovative behavior. Examples include Chen et al. (2011), Cheong et al. (2016), Faulks et al. (2021), Guo et al. (2022), Jada et al. (2019), Mutonyi et al. (2020), Riaz et al. (2021), Slåtten et al. (2011), and Wihuda et al. (2017). In the case of teachers, Gkorezis (2016), Sagnak (2012), and Zhu et al. (2019) have reported similar results. Finally, according to Guo et al. (2022) the positive impact of empowering leadership on innovative behavior is especially relevant in the case of employees with highly complex jobs such as those in teaching positions.

2.2.2 High-performance work systems

HRM practices have been acknowledged as one of the key antecedents of employee attitudes, behavior, and performance, particularly innovative behavior (Alfes et al. 2013; Escribá-Carda et al. 2017; Pham-Thai et al. 2018). Like the present study, most research has adopted a systemic approach because the specialized literature shows that the effects of high-performance HRM practices are greater when these practices are defined as bundles that are applied synergistically (Chadwick 2010; Combs et al. 2006; Delery and Shaw

2001). There is also ample evidence that the attitudinal and behavioral consequences of high-performance work systems depend on employees' perceptions of these systems (Alfes et al. 2013; Jiang et al. 2017; Mustafa et al. 2016; Ogbonnaya and Messersmith 2019; Van De Voorde and Beijer 2015). Nevertheless, studies of the relationship between high-performance work systems and innovative behavior from a systemic perspective based on employee perceptions are scarce.

Regarding innovative behavior, there is ample evidence that HRM practices have a positive and significant relationship with employee innovative behavior (Riaz et al. 2021). Studies that have examined individual practices and those that have focused on bundles or systems of HRM practices have both concluded, with few exceptions, that their relationship with innovative behavior is positive and significant (Sánchez-Pérez 2025). Notable examples of studies that have adopted a systemic perspective based on employee perceptions and that provide evidence of the relationship between high-performance work systems and innovative behavior are those by Alfes et al. (2013), Dorenbosch et al. (2005), Escribá-Carda et al. (2017), Maden (2015), Ogbonnaya and Messersmith (2019), and Pham-Thai et al. (2018).

Three main theoretical frameworks support this relationship: social exchange theory, social identity theory, and the ability-motivation-opportunity framework. Social exchange theory (Cropanzano and Mitchell 2005; Rhoades and Eisenberger 2002; Sungu et al. 2019) suggests that employees who perceive their organizational environment as supportive will feel obliged to reciprocate with behaviors that are beneficial to the organization. High-performance work systems signal the organization's intention to invest in skills, offer workers opportunities, and develop mutually beneficial long-term relationships with employees (Chang and Chin 2018; Sun et al. 2007). Social exchanges involve discretionary actions and extra-role behaviors (Rhoades and Eisenberger 2002; Tavares et al. 2016) such as innovative behavior.

From a social identity theory perspective (Ashforth and Mael 1989), being part of an organization that deploys high-performance work systems can make employees feel proud, strengthening their positive self-concept and heightening their organizational identification (Liu et al. 2020; Newman et al. 2016). The more people identify with their organization, the more likely they will be to act with the organization's best interests in mind. That is, they will be more likely to perform discretionary actions and extra-role behaviors such as innovative behavior (Riketta 2005; Tavares et al. 2016; Van Dick et al. 2006).

The ability-motivation-opportunity model suggests that investing in high-performance work systems involves investing in employees' ability, motivation, and opportunity to perform relevant tasks and roles, which is essential to ensure that employees "go the extra mile" (Appelbaum et al. 2000; Boxall 2012; Obeidat et al. 2016). The implementation of high-performance work systems can prepare, motivate, and provide chances for employees to identify and exploit opportunities arising from shifts in an ever-changing environment and adopt innovative behavior (Farrukh et al. 2021; Jiang et al. 2012).

2.2.3 Public service motivation

Public service motivation is an increasingly researched yet intensely debated concept in public management and public administration (Vandenabeele et al. 2018). According to Mostafa et al. (2015: 749), public service motivation "captures the degree to which employees are committed to serving the public or the community at large. As such, the principal beneficiary of employee motivation lies outside the organization." The debate

around its fundamental nature seems to have led to the conclusion that, although public service motivation is a relatively stable trait that is the product of long-term socialization, it may be fostered or reduced by more immediate influences in an individual's organizational environment (Christensen et al. 2017; Piatak et al. 2021). In particular, HRM practices and leadership have been recognized as key elements in driving or inhibiting public service motivation (Gould-Williams et al. 2014; Gould-Williams 2016; Hameduddin and Engbers 2022; Mostafa et al. 2015; Nguyen et al. 2023; Park and Kim 2016; Piatak et al. 2021).

Although research in public administration has extensively supported the positive impact of public service motivation on both individual (Cun 2012; Hollósy-Vadász 2018; Homberg et al. 2015; Jin et al. 2018; Potipiroon & Faerman 2020; Vandenabeele 2009) and organizational outcomes (Bright 2007; Van Loon 2016), relatively few studies have specifically explored the relationship between public service motivation and innovative behavior, or the psychological mechanisms underlying this link (Nguyen et al. 2023; Ritz et al. 2016). The limited number of studies that have examined this association consistently report a positive direct effect of public service motivation on employees' innovative behavior (Cho & Song 2021; Miao et al. 2018; Nguyen et al. 2023; Vuong 2023).

With regard to its relationship with other key antecedents in our study, public service motivation has also been analyzed as a mediator or moderator of the relationships between, leadership, high-performance work systems and innovative behavior (Nguyen et al. 2023; Sánchez-Pérez et al. 2023; Vuong 2023). Finally, other studies have confirmed the positive relationship between public service motivation and engagement (Cooke et al. 2019; De Simone et al. 2016; Ugaddan and Park 2017).

In explaining the positive influence of public service motivation on employee attitudes and behaviors, Christensen et al. (2017), Mostafa et al. (2015), and Vandenabeele et al. (2018) have highlighted its close links with self-determination theory and identity theory (Tajfel and Turner 1985). If organizations can provide their employees jobs with content that is consistent with their prosocial identities, their self-identities will be reinforced. Hence, "they will then be desirous of displaying attitudes and behaviors of benefit to the organization" (Mostafa et al. 2015: 750). When individuals internalize public service values, these values become part of their identity, affecting their behavior positively (Christensen et al. 2017). As the existing empirical evidence has shown, innovative behavior may represent one of those positive behaviors that are beneficial both to the organization and to the public service (Sánchez-Pérez 2025).

2.2.4 Engagement

Employee engagement has attracted much attention because it is cited as a stronger predictor of job performance than other attitudinal constructs such as job satisfaction, job involvement or intrinsic motivation (Rich et al. 2010). Schaufeli et al. (2002: 74) defined job engagement as a "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption." Vigor refers to high levels of energy while working; dedication refers to being strongly involved in one's work and experiencing a sense of significance, enthusiasm, and challenge; absorption is characterized by being fully concentrated and happily engrossed in one's work (Bakker and Xanthopoulou 2013). Engagement can be conceptualized as an overarching construct comprising physical, cognitive, and emotional energies and manifested as a state of devoting all forms of energy toward work to make a difference (Kwon and Kim 2020; Mackay et al. 2017).

Due to the synergy of cognitive, emotional, and physical energies, employee engagement is expected to fuel innovative behavior (Hakanen et al. 2008). The three-dimensional nature of engagement fits well with innovative behavior, which represents a change-oriented form of idea generation, promotion, and realization to achieve something new. Cognitive engagement mobilizes innovative behavior by encouraging employees to revisit existing knowledge structures, broaden the scope of their cognition and perception, and attempt non-traditional tweaks and combinations of ideas (Fredrickson 2001; Shuck et al. 2017). Emotional engagement helps employees feel confident in the purpose and meaningfulness of innovative efforts, to communicate their optimism to others, and to help fuel proactive behaviors across the organization (Demerouti and Cropanzano 2010; Shuck et al. 2017). Finally, physical engagement is crucial in realizing ideas and maintaining innovative behaviors. The reason is that it helps people cope with the process of innovation, which is often complex and strenuous and takes considerable time and effort before seeing results (Anderson et al. 2014).

Again inspired by SET (Cropanzano and Mitchell 2005), some authors have argued that work engagement and positive job outcomes such as innovative behavior are mechanisms through which employees repay the economic and socioemotional benefits they receive from their company (Alfes et al. 2013; Karatepe 2013). High-performance work systems and empowering leadership act as powerful transmitters of messages reflecting the organization's orientation and values. High-performance work systems reflect the "mutual investment approach" in the employee-organization relationship, and empowering leadership fosters engagement by conveying the message to employees that the company wants their participation and trusts their judgment (Huertas et al. 2018).

From a conservation of resources perspective (Bakker and Demerouti 2008), both high-performance work systems and empowering leadership play an intrinsic motivational role because they promote employee development and fulfill basic human needs. Examples of such needs include the need for autonomy and competence. High-performance work systems and empowering leadership may also increase extrinsic motivation because they increase the likelihood that employees achieve their work goals, thereby improving engagement (Maden 2015).

Bakker (2015) also linked work engagement and public service motivation, which supposedly work in tandem to provide important organizational outcomes. Bakker (2015) argued that public service motivation facilitates engagement and can be instrumental in coping with organizational stressors. The role of engagement as a mediator in the relationships of high-performance work systems, empowering leadership, and public service motivation with different performance outcomes has also been validated in a number of studies (e.g., Alfes et al. 2013; Borst 2018; Karatepe 2013; Pham-Thai et al. 2018; Rajagukguk and Desiana 2021; Van Beurden et al. 2021; Wihuda et al. 2017).

In short, despite numerous individual, organizational, and contextual factors that can affect engagement, as conservation of resources theory explains, it is influenced by high-performance work systems, empowering leadership, and public service motivation, and the interrelationships between these variables affect innovative behavior.

2.2.5 Gender and experience

Gender and experience, together with education (omitted from the model because all participants had high levels of education), have received the most attention of any

demographic factors in the innovative behavior literature. When they have not been used as explanatory, mediating, or moderating variables, they have been used as control variables.

The evidence of their effects is contradictory. For example, Lambriex-Schmitz et al. (2020) found a positive effect of gender (greater in the case of women) and experience on some phases of innovative behavior. In contrast, Zhu et al. (2023) reported that the relationship between gender and innovative behavior was stronger among male employees and Yang and Huang (2008) observed that years of teaching experience were negatively related to innovative behavior. Similarly, Gkorezis (2016) reported a significant influence of gender and experience on teachers' innovative behavior, whereas Waheed et al. (2018) found no significant effects in the case of full-time faculty members.

Social role theory posits that society tends to have gender stereotypes that affect a person's perception, judgment, and behavior (Eagly and Wood 2012). The results of Pons et al. (2016) suggest that, among women, innovation is more related to intrinsic variables (e.g., self-confidence, empowerment, and social processes), whereas, for men, it seems to be more related to work demands. These findings seem to indicate that differences in innovative behavior between men and women may vary depending on context and other intervening variables.

The same may hold in the case of experience. Experience is related to more learning-based communication and further internal embedding of innovation. Highly tenured employees have already established connections and know how to function in the organizational environment. In contrast, employees who are new to the organization face high expectations and may come to the organization with new knowledge and high motivation (Lambriex-Schmitz et al. 2020; Sánchez-Pérez 2025; Ul Haq et al. 2017).

2.3 Propositions

As explained in the previous subsections, the literature supports the relevance of the conditions included in this study as antecedents of innovative behavior. There is also evidence of complex interrelationships between them. For example, HRM practices and leadership have been cited as key drivers or inhibitors of public service motivation (Gould-Williams 2016; Hameduddin and Engbers; 2022; Mostafa et al. 2015; Nguyen et al. 2023; Park and Kim 2016; Piatak et al. 2021) and engagement (Bakker and Demerouti 2008; Maden 2015). Likewise, Cooke et al. (2019), De Simone et al. (2016), Ugaddan and Park (2017), and others have confirmed the link between public service motivation and engagement. In turn, engagement has been observed to be a relevant mediator in relationships of high-performance work systems, empowering leadership, and public service motivation with innovative behavior. Public service motivation has also been validated as a mediator and moderator of relationships between, for example, different types of leadership and innovative behavior (Nguyen et al. 2023; Vuong 2023) and high-performance work systems and innovative behavior (Sánchez-Pérez et al. 2023).

Meanwhile, numerous individual, organizational, and contextual factors can affect public service motivation and engagement. Accordingly, high levels of these factors can be expected in both the presence and the absence of high-performance work systems and/or empowering leadership. Finally, as explained in the previous subsection, the inconclusive and sometimes contradictory results found in the literature seem to indicate that the differences in innovative behavior by gender and experience may vary depending on context and other variables.

Altogether, it is expected that different combinations of the antecedent conditions lead to the same outcome (presence or absence of innovative behavior). Moreover, these combinations are expected to vary depending on teachers' gender and experience. Accordingly, the following propositions can be formulated:

Proposition 1. No antecedent condition (presence or absence of high-performance work systems, empowering leadership, public service motivation, engagement, gender, and experience) is, by itself, necessary to predict the presence (or absence) of innovative behavior.

Proposition 2. High-performance work systems, empowering leadership, public service motivation, engagement, gender, and experience form multiple configurations that are sufficient to predict the presence (or absence) of innovative behavior.

Proposition 3. Specific gender and experience configurations are sufficient to predict the presence (or absence) of innovative behavior.

3 Methodology

3.1 Sample and data collection

Data were gathered using a questionnaire sent to teachers at public schools in the region of Aragon (Spain), thanks to the collaboration of the Educational Programs Unit of the General Council of Aragon. Three types of school were targeted: primary schools, secondary schools, and vocational training colleges. The questionnaires were collected between February and October 2022. A total of 1,416 valid responses were collected from a population of 17,011 teachers. Although teachers in the public system are, in theory, tenured civil servants with a permanent contract, nearly 40% are interim employees. Hence, the percentage of interim teachers in Aragon is far above the national average of just over 20%.

The sample mainly consisted of women (69.1%). The mean age was 44.3 years. Only 4% of interviewees did not have university studies, 66% had at least a higher education degree, and the remaining 30% had a short course university degree or diploma (three years). The mean time spent in the job (seniority) was 15.57 years, and the mean time spent at the current school was 7.37 years. Most teachers worked at either primary schools (45.8%) or secondary schools (40.9%).

3.2 Measurement scales

Measures of the core variables were based on previously validated scales, using a seven-point Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). To ensure scale reliability and validity, the back-translation procedure proposed by Brislin was followed.

The outcome variable, innovative behavior, was measured using the six-item scale developed by Scott and Bruce (1994). Nevertheless, the wording was modified to address the questions directly to employees instead of supervisors as in the original scale. Sample items include "I come up with creative ideas" and "I promote and champion ideas to others."

Regarding the antecedent conditions, high-performance work systems was measured using a 15-item scale developed by Jensen et al. (2013). Seven items (training and development, selection, teamwork, status, job security, information sharing, and engagement) corresponded to the perceived HRM practices scale originally developed by Gould-Williams

and Davis (2005). The other eight items corresponded to employee indicators (i.e., development, motivation, communication, and empowerment) developed by Truss (1999). Sample items include "I receive the training I need to do my job" and "I am given meaningful feedback on my performance at least once a year."

EL was measured using the 12-item scale of Ahearne et al. (2005). Sample items include "My manager helps me understand how my objectives and goals relate to those of the company" and "My manager believes in my ability to improve even when I make mistakes." To measure engagement, the nine-item scale proposed by Schaufeli et al. (2002) was used. Sample items include "At my work, I feel bursting with energy" and "My job inspires me."

Public service motivation was measured using the five-item shortened version of the scale provided by Perry (1996), which was included in a 1996 Merit System Protection Board Survey of federal employees (Wright et al. 2013). This scale has been widely used (Alonso and Lewis 2001; Brewer et al. 2000; Christensen and Wright 2011; Kim 2005; Pandey et al. 2008; Wright and Pandey 2008) and is considered one of the two strongest unidimensional measures of public service motivation (Wright et al. 2013). Sample items include "Meaningful public service is very important to me" and "Making a difference in society means more to me than personal achievements."

Finally, experience was measured by the number of years dedicated to teaching. Gender was measured with a dichotomous variable (0 male; 1 female).

3.3 Data analysis

Fuzzy-set qualitative comparative analysis (fsQCA) was used to capture the causal complexity and equifinality underlying the phenomenon of interest. QCA is used in a variety of disciplines, including political science, sociology, management, and psychology. A key assumption of the case-based approach is that the effect of any factor is likely to depend on the particular configuration of other factors with which it co-exists in any particular case.

This analytic technique was developed by Ragin (1987, 2000, 2008). The technique draws on Mill's cannons (1843) and relies on systematic comparisons of cases to identify their differences and similarities and thus the key elements that cause an outcome. In Mill's cannons, the method of agreement states that, given a group of examples of a particular phenomenon, if these cases have but one characteristic in common, that characteristic is the defining trait causing the phenomenon. Conversely, the method of difference establishes that if a phenomenon appears in one case and not in another and those cases are identical but for one characteristic, then this characteristic explains or contributes to a great extent to explaining the phenomenon under study.

Despite the importance of Mill's cannons as a basis for later advances in logic theory, these methods did not account for key concepts such as multicausality or the idea that a phenomenon can be caused by two or more conditions and by different combinations of conditions. Furthermore, the method of agreement could only be applied for positive outcomes.

According to Schneider et al. (2010: 247), configurational comparative methods "can be employed to test whether all, or only a fraction of, the causal conditions are related to the outcome, and how the relevant conditions must be combined." Therefore, such methods enable analysis of combinations of causal determinants and provide results in situations where causal asymmetry and equifinality may exist (Elgin et al. 2024; Ragin 2008; Ragin and Fiss 2008; Roig-Tierno et al. 2017). Hence, in this research, cases were studied

as configurations of causes and conditions (causal recipes), defined as specific combinations of causally relevant antecedents linked to an outcome.

The original form of QCA (Ragin 1987) was designed to be applied in the political sciences for small values of N. The main difference between QCA and previous correlation-based techniques is that QCA uses Boolean logic to establish configurational relationships. That is, whereas correlational techniques focus on identifying which conditions arise at the same time, QCA focuses on the identification of combinations of conditions (configurations) that cause a particular outcome.

The growing popularity of this methodology can be attributed to a rise in scholarly research focusing on case studies and researchers' attempts to achieve both in-depth knowledge of cases and a means to generalize research outcomes (Rihoux 2006; Roig-Tierno et al. 2017). QCA is especially applicable in the social sciences because social science studies often require considerable knowledge of each case and work with a small number of comparable cases. Nevertheless, its applicability to studies with a larger N has been verified (Fiss 2011; Huarng and Roig-Tierno 2016).

QCA generally involves three main steps: case selection, variable calibration, and Boolean minimization (Crilly et al. 2012; Ragin 2008; Rihoux and Ragin 2009; Woodside and Zhang 2013). Case selection involves selecting cases that are relevant to the research question. The cases must be comparable in terms of the outcome. Given that the outcome in this study was individual teachers' innovative behavior in public schools, the cases were individuals who met the aforementioned characteristics and taught at the pre-university level in these schools. Calibration entails defining the variables that are relevant to the research question and assigning values to these variables for each case. Boolean minimization involves reducing the data to a minimal set of conditions that are necessary and sufficient for the outcome to occur. In this way, the causal paths leading individuals to have innovative behavior are unraveled, which gives a deeper understanding of this process.

The QCA model in this study tested both the configurational role of the selected conditions in driving the innovative behavior of teachers (Model 1) and the absence of such behavior (Model 2).

$$\text{Model 1} : IB = f(HPWS, ELQ, PSM, ENG, GEN, EXP)$$

$$\text{Model 2} :\sim IB = f(HPWS, ELQ, PSM, ENG, GEN, EXP)$$

All teachers for whom the data from the study questionnaire had no missing values were used as a case in this study. Each teacher (case) either displayed or did not display innovative behavior. According to the models, this behavior is caused by different combinations of the conditions proposed as possible causal antecedents, which are those included in the functions expressed earlier.

4 Results

This section presents the results of the analysis of the drivers of innovative behavior using QCA. The first analysis examined the necessary conditions for the outcome (presence and absence of innovative behavior). In the first model (presence of innovative behavior), engagement was a necessary condition (consistency above 0.9) (Table 1). In the second model (absence of innovative behavior), absence of high-performance work systems was a necessary condition. Consequently, the proposition that none of the antecedent conditions

Table 1 Analysis of necessary conditions for the models (presence and absence of the outcome of innovative behavior)

Condition	Model Outcome: IB		Model Outcome: ~IB	
	Consistency	Coverage	Consistency	Coverage
GEN	0.697	0.557	0.676	0.443
EXP	0.611	0.701	0.622	0.587
HPWS	0.645	0.916	0.609	0.711
EL	0.816	0.816	0.697	0.573
PSM	0.860	0.807	0.765	0.589
ENG	**0.909**	0.757	0.803	0.550
~GEN	0.303	0.532	0.324	0.468
~EXP	0.640	0.673	0.683	0.590
~HPWS	0.796	0.713	**0.928**	0.682
~EL	0.573	0.697	0.776	0.776
~PSM	0.562	0.745	0.749	0.815
~ENG	0.460	0.740	0.645	0.853

The symbol "~" refers to the negation of a condition. For example, "~IB" refers to the absence of innovative behavior

(high-performance work systems, empowering leadership, public service motivation, engagement, gender, experience, or their absence) would be, by itself, necessary to predict high (or low) levels of innovative behavior was not validated.

Engagement refers to the enthusiasm of teachers for their work by showing a high commitment to pursue their vocational goals. High-performance work systems are a set of interrelated, complementary, and mutually reinforcing high-performance work practices intended to foster employee commitment to the organization. Engaged teachers are driven by a sense of purpose and intrinsic motivation, which can fuel their creativity and willingness to contribute innovative ideas and solutions. When educators feel connected to the school mission and values, they are more likely to engage proactively in activities that foster innovation and drive positive change (Benneworth et al. 2020). Moreover, these educators are more inclined to participate in open communication and collaborative initiatives (Saks 2006; Yalabik et al. 2013).

In the sufficient conditions analysis, Model 1 had four causal configurations (solution coverage = 0.868, solution consistency = 0.825), and Model 2 had three causal configurations leading to the absence of the outcome (solution coverage = 0.710, solution consistency = 0.872) (Table 2).

Model 1 consists of four causal configurations. As noted in the necessary conditions analysis, engagement is present in all paths. One of the causal configurations that leads to the outcome is HPWS*ENG. Thus, it seems crucial for the educational system to foster innovative behavior by promoting practices related to socialization, performance appraisal, and reward systems, following the ability-motivation-opportunity model (Appelbaum et al. 2000; Boxall and Purcell 2003). Moreover, through a variety of methods, including emphasizing the value of training and development, high-performance work systems can enhance employees' ability to assess situations and take advantage of opportunities in a more innovative manner.

Another recipe that leads to the outcome of innovative behavior is EL*ENG. Empowering leadership is characterized by the delegation of authority, support for employee

Table 2 Parsimonious solution for the models (presence and absence of the outcome of innovative behavior) – ESA solution

	Causal configuration	Raw coverage	Unique coverage	InclS. Consistency
Model Outcome: IB	[C1] HPWS*ENG	0.632	0.007	0.926
	[C2] EL*ENG	0.776	0.054	0.854
	[C3] GEN*PSM*ENG	0.566	0.022	0.855
	[C4] ~EXP*PSM*ENG	0.549	0.015	0.889
Solution coverage: 0.868 Solution consistency: 0.825				
Model Outcome: ~IB	[C1] ~HPWS* ~EL* ~PSM	0.635	0.117	0.896
	[C2] ~HPWS* ~EL* ~ENG	0.578	0.060	0.907
	[C3] ~GEN* ~HPWS* ~PSM* ~ENG	0.191	0.015	0.926
Solution coverage: 0.710 Solution consistency: 0.872				

autonomy, and encouragement of self-development. It has been found to influence innovative behavior positively (Zhang and Bartol 2010). Empowering leadership fosters a work environment that values teacher autonomy and empowerment, often also providing support and resources that enable people to explore creative solutions to challenges. Empowering leaders foster an environment that encourages the development and implementation of new ideas by providing direction and removing obstacles (Naqshbandi et al. 2019).

Another path that leads to innovative behavior is GEN*PSM*ENG. This configuration applies only to men. As noted earlier, public service motivation refers to an individual's inclination to serve the public interest and contribute to society. Public service motivation frequently reflects a deep commitment to addressing social challenges and meeting public needs. Male teachers with high levels of public service motivation are more likely to engage in innovative behaviors aimed at developing novel solutions to complex social problems and improving public services (Karim and Majid 2022). Moreover, these educators are driven by an intrinsic motivation to make a positive impact on society, which can foster a sense of responsibility. This sense of responsibility encourages them to initiate and implement innovative solutions that address public concerns and improve overall well-being (De Simone et al. 2016).

Finally, innovative behavior is also explained by the recipe ~EXP*PSM*ENG. Teachers with a lack of experience often bring fresh perspectives and a willingness to challenge existing norms and practices. This fresh viewpoint can lead to novel ideas and approaches, fostering innovative behavior (Walder 2017). A lack of experience may also be related to a high degree of adaptability and a strong desire to learn and acquire new skills, resulting in a learning mindset that is more inclined to seek innovative approaches and solutions.

In Model 2, the absence of high-performance work systems is a necessary condition. Hence, the antecedent of high-performance work systems is absent in all causal configurations that lead to the absence of the outcome. Configurations 1 and 2 are similar because they share the absence of high-performance work systems and empowering leadership. These factors are combined with the absence of public service motivation in Configuration 1 and engagement in Configuration 2. If three of the four main antecedent conditions are absent, innovative behavior does not occur. The third configuration also obeys this rule, although it is gender-specific (applicable to women). The recipe ~GEN* ~HPWS* ~PSM* ~ENG indicates that empowering leadership, defined as the

process of sharing power and assigning autonomy and responsibilities to followers, teams, or groups through a particular set of leader behaviors for employees to improve internal motivation and achieve professional success (Cheong et al. 2019), does not lead to innovative behavior in the absence of the other main antecedent conditions. In short, neither public service motivation nor engagement is sufficient in the absence of high-performance work systems and empowering leadership, regardless of gender. Unlike among men, in the case of women, the combination of public service motivation and engagement is not sufficient to achieve innovative behavior in the absence of high-performance work systems.

The results validate Propositions 2 and 3, given the existence of different configurations that are sufficient to predict a high (or low) level of innovative behavior and specific configurations of gender and experience that are sufficient to predict a high (or low) level of innovative behavior.

5 Discussion and conclusions

5.1 Discussion

This study shows that engagement is a major driver of innovative behavior because it encourages employees to revisit existing knowledge structures, broaden their cognition and perception, and attempt non-traditional combinations of ideas. The three-dimensional structure of engagement (cognitive, emotional, and physical) fits well with the iterative and change-oriented nature of innovative behavior. Although these dimensions have not been analyzed separately, the results appear to confirm the theory that cognitive engagement leads employees to revise their knowledge structures and facilitates non-traditional approaches based on novel combinations of ideas and concepts. Emotional engagement helps employees trust in the purpose and significance of their innovative efforts, communicate their optimism to others, and drive proactive behaviors. Finally, physical engagement helps them cope with the burden of these processes, which is due to their complexity and the constant effort required to achieve results.

A high level of engagement may be the result of several antecedents, including individual factors such as self-esteem, self-efficacy, creativity, and emotional intelligence (Bakker and Xanthopoulou 2013; Chen and Huang 2016; Choi et al. 2015; Toyama and Mauno 2017), group factors such as colleague support (Chen and Huang 2016), organizational factors like organizational climate and work-life balance (Macey and Schneider 2008; Schaufeli and Salanova 2007) or even contextual external factors such as sociocultural factors and labor regulations (Rich et al. 2010; Saks and Gruman 2014). However, the literature shows that multiple organizational factors are relevant (for an extensive list of explanatory factors, see Sánchez-Pérez 2025). Notable examples include high-performance work systems (Alfes et al. 2013; Pham-Thai et al. 2018) and empowering leadership (Wihuda et al. 2017). Notably, these two variables potentially have positive effects on innovative behavior, both directly and through engagement, because they can provide teachers with the necessary resources, support, and autonomy to engage in innovative activities. They also foster intrinsic motivation and a work environment that values autonomy and empowerment, enabling teachers to explore creative solutions to challenges. Intrinsic motivation drives the desire to learn, acquire new skills, and to seek out innovative approaches and solutions. High-performance work systems reflect an organization's orientation and values. They promote employee development and fulfill basic human needs such as autonomy and

competence. They also increase the likelihood that employees achieve their work goals, thus improving engagement and intrinsic motivation, which are key drivers of innovative behavior. This explains, at least partially, our results that show that the absence of high-performance work systems leads to a lack of innovative behavior.

On the other hand, the results have also shown specific patterns based on gender and experience. Together with an adequate level of engagement, public service motivation appears to be relevant for achieving innovative behavior among men and, in general, among inexperienced teachers. Although public service motivation is a relatively stable trait resulting from long-term socialization, it may be affected by more immediate influences in an organizational environment (Christensen et al. 2017; Piatak et al. 2021). In particular, HRM practices and leadership have been cited as key drivers or inhibitors of public service motivation (Gould-Williams et al. 2014; Gould-Williams 2016; Hameduddin and Engbers; 2022; Mostafa et al. 2015; Nguyen et al. 2023; Park and Kim 2016; Piatak et al. 2021), thus creating opportunities for tailored interventions within the organizational context.

With regard to the theoretical contributions derived from the present study, it is important to note, first and foremost, that it addresses the issue of promoting innovative behavior in the under-researched sector of education. More specifically, the study examines innovative behavior in pre-university public schools, a key sector both quantitatively (the number of people it affects) and because of its potential contribution to society.

Second, the study jointly examines various interrelated antecedents that the literature cites as highly relevant in explaining employee attitudes, behavior, and performance: high-performance work systems, empowering leadership, engagement, and public service motivation. In general, empowering leadership, engagement, and public service motivation have scarcely been studied in relation to innovative behavior. This lack of attention is surprising for several reasons. (a) Empowering leadership is one of the three narrowly specified contemporary leadership styles with the strongest correlations with creativity and innovation (Lee et al. 2020); (b) Engagement is cited as a stronger predictor of behavior and performance than other attitudinal constructs (Rich et al. 2010); (c) Public service motivation it is not only considered of particular relevance in the case of the public sector, but it is also widely supported by previous research as an antecedent of positive attitudes, behavior, and work outcomes (Nguyen et al. 2023); and (d) Although the relationship between HRM practices and innovative behavior has been studied extensively, there is a paucity of research from a systemic perspective based on employee perceptions (Sánchez-Pérez 2025).

Finally, using QCA as a methodological approach captured the causal complexity, causal asymmetry, and equifinality underlying teachers' innovative behavior. This method identified different action paths that explain the presence or absence of teachers' innovative behavior, some of which are specific to gender or experience. QCA thus overcomes some of the limitations of traditional quantitative analysis models used in human resource management research, that assess the isolated impact of individual independent variable on the dependent variable, fail to adequately capture the combined effects of highly correlated variables that may mutually reinforce each other, and do not address causal asymmetry effectively.

Regarding practical contributions, based on the findings of this study, it can be concluded that teachers' innovative behavior can be effectively fostered through targeted leadership and human resource management practices. This holds true even when fully acknowledging the complex interdependencies among influencing factors and the potential presence of circular causality.

Schools must provide resources, support, information, empowerment, autonomy, and opportunities to learn and acquire new skills, promoting employee development and recognition. This task requires stability in management teams, which can be achieved by offering the necessary financial and non-financial incentives (for the 2024/2025 academic year, the salary supplement for management teams increased by 7%). Also, specific training in management skills should be encouraged.

It should be combined with other activities that could help develop management competencies and provide managers with knowledge about reference models. Mentoring programs and visits to schools with an outstanding quality of management could be particularly useful. Simplifying bureaucracy also seems to be an important measure, because it overloads management teams. Other actions aimed at preventing burnout, which is common among teachers, enriching jobs, offering development opportunities, and recognizing teachers' contributions can improve engagement, which has been shown to be a key variable in promoting innovative behavior.

Regarding high-performance work systems, even though the core HRM policies and practices are defined centrally (e.g., compensation and selection), school management teams still have some room to maneuver and play an essential role in the implementation of many HRM practices. For example, they can provide onboarding processes, offer emotional support, give on-the-job training, encourage participation and teamwork, establish a good internal information and communication policy, and participate in the evaluation, feedback and recognition of the teaching staff.

However, whether they do so is another matter, hence the need for incentives. Their main intervention mechanisms are based on internal regulations, which are proposed by the management team and are approved by the school board. Also, the school's educational program indicates the direction that education at the school should take and the activities that should take place to improve the quality of education and support for teachers. These activities include training and innovation-oriented actions, especially through teaching innovation (e.g., introducing new technologies and project-based learning).

At the regional level, an annual call for innovation projects is published. The call for the 2024/2025 academic year welcomes a range of contents: (a) processes, actions, methodologies, and educational practices that contribute to the acquisition and development of key competencies; (b) strategies related to digital teaching skills; (c) the use of science, technology, engineering, arts, and mathematics (STEAM) methodology in projects that combine different areas of the curriculum and foster a critical, creative, and learning-friendly attitude in students; (d) collaborative design of proposals for improvements in the school, spanning the vision of the entire educational community; (e) new forms of managing and organizing the school; (f) better harmony, inclusion, and equity, as well as participation in the educational community; and (g) presence and commitment in the social sphere, working toward meeting the Sustainable Development Goals (SDGs).

The Director General does not offer restrictive guidelines on how to plan and implement these innovation projects, which can cover a wide range of contents that are not entirely limited to teaching. However, teachers who decide to submit a project must do so within their teaching hours. They are not allocated time in their working day to develop the project. It turns the project into an extra duty that requires commitment to extra-role tasks. Moreover, the only reward for participating teachers, besides the intrinsic satisfaction of the project, is a certificate that counts toward teacher training hours. Teachers who submit projects also have the chance to participate in European projects such as Erasmus+, Safe Future, Idea, Mensi, eTwinning, and others. In any case, participation in a project must

be approved by the faculty and the school board and requires the "unrewarded" initiative, time, and effort of the teachers.

Given that the general guidelines of the curriculum must be followed and that there is no scope to change it, teachers can nonetheless introduce innovations in the classroom. For example, they can adapt materials to the local socioeconomic and cultural context. For instance, in vocational training, they can encourage the use of materials and tools with the collaboration of workshops to help student inclusion. They can also use teaching methods based at least partially on gamification with the help of new technologies. Alternatively, they can use project-based teaching with a limited use of the flipped classroom. Nevertheless, these initiatives entail an additional teaching load that receives scarce recognition.

In short, there are (albeit imperfect) mechanisms to foster innovation in schools, and the use of these mechanisms can be substantially encouraged by the antecedents of innovative behavior examined in this study.

5.2 Limitations and future research proposals

Regarding the limitations of the research, it should be acknowledged that the use of QCA in this study may entail limitations in capturing the full complexity of causal relationships and equifinality in the context of teachers' innovative behavior. First, this study focused on the innovative behavior of teachers in pre-university public schools. The importance of this sector both qualitatively (because of its relevance) and quantitatively (because of the number of people involved) justifies the study of this sector. However, the generalizability of the findings to other professions or industries may be limited. For example, the combinations of factors that drive innovative behavior in schools may differ significantly from those in private education, where the school–student–family relationship, labor dynamics, HR policies, incentives, and employee autonomy may vary significantly.

Second, all measures were self-reported and collected at a single time because of the limitations imposed by the Educational Programs Unit of the Provincial Government of Aragon. This feature of the data is a major limitation for establishing causal relationships a high degree of certainty. Any measures adopted that affect the intervention conditions included in the model may take time to modify teachers' perceptions and hence their behavior. However, using teachers' perceptions of these intervention conditions mitigated this issue because it is their perceptions that condition their attitudes and behaviors. Regarding centralized decisions (education policies), there have been no recent substantial changes. A more relevant consideration may be the fact that innovative behavior was self-assessed. The fact that teachers think that they are innovative or have new ideas does not necessarily mean that it is the case, which would affect the validity of the results. Future research would ideally use data of causal antecedents and outcomes at different times and, if possible, use objective measures of innovative behavior or measures based on assessments by third parties (e.g., heads of school or department).

The analysis was also based on intervention variables on which management teams did not have full capacity to act. For example, as repeatedly noted, many HR decisions are made centrally, and there are limitations at both the regulatory and public policy levels in this area. Similarly, key aspects such as leadership and management skills training are in the hands of the agencies responsible for education policy or depend on the will and individual efforts of teachers. Nevertheless, as explained in the discussion of practical contributions, these management teams continue to have considerable scope to influence

the attitudes and behavior of their teaching staff. Many of the suggestions for initiatives to improve innovative behavior are directed at the institutions that establish education policy.

Another limitation is that the study did not explore potential contextual factors that may influence the relationships between the causal antecedents and innovative behavior, which could limit the understanding of the underlying mechanisms. The study did not address potential confounding variables or alternative explanations that could affect the relationships between high-performance work systems, engagement, and innovative behavior. These limitations can be seen as opportunities for future lines of research.

Finally, factors related to the organizational context should be considered. The absence of specific data on management teams and schools (e.g., experience of the principal, size of the management team, diversity, and stability over time) or the characteristics of the school itself may have significantly altered the results regarding the behavior of teachers and their responses. Without data on these and other contextual variables, there is no way of exploring how these factors influence the results, thereby limiting the scope to understand the specific dynamics of each school.

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