



From leadership to innovation: Psychological mechanisms behind teacher creativity in physical education

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ABSTRACT

The current study uses socio-ecological systems theory to study the influence of servant leadership on the innovative behavior of the teacher in relation to physical education in Chinese schools. The research examines the intermediating roles of school climate for creativity and creative self-efficacy of teachers and the moderating role of leader support for innovation. Of the 600 self-administered questionnaires that were issued, 408 were duly completed through a three-wave face-to-face survey in Beijing, Shanghai, Guangzhou, and Shenzhen. Hypotheses were tested using the structural equation modeling technique by employing Smart-PLS. This study establishes that servant leadership significantly predicts teachers' innovative behavior through the mediating mechanisms of a school climate for creativity, the teacher's creative self-efficacy, and the moderation role of leader support for innovation. These findings support the significance of servant leadership in creating an innovative and encouraging school climate and provide practical implications for educational managers and policy makers keen on enhancing innovation in physical education.

1. Introduction

The ability of teachers to display innovative behavior has been described as one of the most efficient methods to enhance the efficiency of the education systems (Ellis et al., 2019). Hence, in the context of the shift of paradigms in education, the ability to innovate is a defining attribute of the teacher's professional persona (Cai & Tang, 2021). Teachers' innovation facilitates the creation of an effective learning environment in the classroom since the world today is dynamic, and students also need to be innovative. This importance is especially crucial in physical education, where traditional practices are ineffective in supporting learning to address the student's learning needs and expectations (Almusawi et al., 2021). Innovations in physical education can complement the learning process, increase the students' interest in physical activities, and, therefore, influence their educational performance. Thus, it is necessary to encourage innovative activity as a response to the changes in the education system. This shift is not the change in the use of the available technologies or the emergence of new approaches in education but it is the shift in the paradigm of education (Fischer et al., 2022). With the capacity to innovate, they can organize better and more creative learning environments that satisfy learners'

present and future needs. This is especially true in physical education, which has long been associated with structures and traditional approaches. The fundamental tenet of physical education is that it cannot remain stagnant and has to be changed occasionally to be productive and helpful (Pangrazi & Beighle, 2019). The methods and approaches of physical education should always be updated according to the society's culture, norms, and values related to health and fitness. As a result, innovative physical education teachers' practice may contribute to the creation of new approaches to teaching and learning and increase students' attention and focus on the crucial aspect of exercise for life. Thus, the identification of factors that may affect the manifestation of innovative behavior in this regard can be considered relevant and valuable for the further evolution of the future education.

Teachers' innovative behavior is increasingly recognized as vital for improving educational outcomes. In particular, innovative teaching methods in physical education can boost student engagement and performance. For example, the Chinese government's Education Modernization 2035 plan explicitly calls for more innovative teaching in physical education to develop high-quality talent (Chen, Zheng, & Jiang, 2022). However, many teachers still struggle to implement new ideas in practice. This gap emphasizes the importance of understanding what drives

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teacher innovation, as even modest improvements in teaching effectiveness can significantly enhance student success and future earnings. By focusing on teacher innovation as a core issue – rather than broad educational evolution, we highlight a problem with direct impact on student learning and long-term educational value.

One critical factor influencing teachers' capacity to innovate is leadership. Effective leadership can empower educators to take risks and try new approaches, creating a culture where creativity is encouraged. Servant leadership, in particular, is known for its strong leader-follower relationships and emphasis on developing subordinates. Servant leaders prioritize the growth and needs of their teachers, providing support that helps them be creative (Eva et al., 2019). Relational leadership theory (Uhl-Bien, 2006) further explains this dynamic: leadership is fundamentally a social influence process shaped by high-quality leader-follower relationships (Kim, 2022). Servant leaders cultivate trust, inclusiveness, and empowerment in their relationships, which, in turn, foster an environment where teachers feel confident to experiment and innovate. This study builds on those insights by examining how a servant leader can spark innovative behavior in teachers, particularly in the demanding context of physical education.

The primary aim of this study is to test a comprehensive framework linking servant leadership to teachers' innovative behavior in school physical education. Drawing on socio-ecological systems theory, we propose that servant leadership affects innovation through dual mediating mechanisms, the school climate for creativity and the teacher's creative self-efficacy, and that these effects depend on the level of leader support for innovation. In other words, we investigate how servant leadership leads to teacher innovation and when this effect is amplified or diminished. This integrated approach allows us to capture the complex process by which leadership translates into innovative teaching practices. By empirically testing this framework, we respond to calls for more nuanced, evidence-based models of educational innovation that include multiple pathways and conditional factors.

Our study is set in the context of Chinese secondary schools, focusing on physical education programs in major cities. This context offers a unique and valuable setting because China is placing growing emphasis on educational quality and innovation in recent years (Lv et al., 2022). Physical education, historically rooted in traditional routines, is now under pressure to modernize and better engage students amid rising concerns about youth fitness. By examining Chinese physical education teachers, we extend research on teacher innovation to a non-Western, relatively understudied context, where cultural values and educational policies may shape how leadership influences innovation. This setting provides a critical testing ground for our framework and ensures that our findings contribute globally relevant insights into educational leadership and innovation. This can be a perfect backdrop to study servant leadership's effect on teachers' innovative behavior with reference to physical education, which is becoming an essential facet of learning in educational institutions.

Despite growing interest in teacher innovation, several research gaps persist. First, prior studies have seldom examined how leadership styles like servant leadership specifically drive teacher innovation in physical education, a field that demands creative pedagogy. We address this gap by focusing on servant leadership's role in a subject area where teacher creativity is crucial (Gu, 2022; Pill et al., 2012). Second, there is a lack of comprehensive analyses that include both mediating and moderating variables in the leadership-innovation relationship. Most research explores either *how* leadership affects outcomes (mediation) or *when* it does so (moderation), but rarely both in concert. Our study contributes on this front by integrating dual mediators and a moderator into one model, thus offering a more holistic understanding (Chen, Ghardallou, et al., 2022). Third, existing evidence comes largely from Western contexts; comparatively few studies explore these dynamics in East Asia. By studying Chinese schools, we respond to calls for research in diverse cultural settings, recognizing that cultural factors can influence how leadership behaviors translate to innovation. Finally, methodological

limitations in past work (e.g., single-source, cross-sectional designs) may obscure the true nature of these relationships. We designed our study to overcome some of these issues (e.g., collecting multi-wave data) and thus provide stronger evidence. In sum, by tackling these theoretical, contextual, and methodological gaps – all documented in prior literature – our research offers a meaningful advancement in understanding how teacher innovation can be nurtured through leadership.

2. Literature review

2.1. Servant leadership and employee innovative behavior

Teachers' innovative behavior refers to the purposeful enactment of new ideas, ways of working, products, or methods in a role, team, or organization to improve performance (Thurlings et al., 2015). It is important to improve and transform educational practices as students' needs are constantly changing. Teacher innovativeness is relevant in physical education as conventional practices do not always capture the students' attention or tackle modern health issues (Chang et al., 2021). Therefore, promoting innovation among physical education teachers should be considered a priority to improve the overall educational process and create effective conditions for advancing healthy lifestyles.

According to Greenleaf (2002), servant leadership is a leadership style in which a leader intends to serve his/her followers. It has been proved that this leadership style fosters organizational creativity and innovation (Hunter et al., 2013). As Eva et al. (2019) stated, servant leadership is characterized by the orientation of the leader to the followers, the promotion of common interest, and the encouragement of collective work, which are favorable conditions for innovative behaviors.

The existing body of knowledge establishes a positive connection servant leadership-teacher innovative behavior relationship. As an example, Zhu and Zhang (2020) established that servant leadership positively impacted the employees' innovative behavior in corporations because of the increase in intrinsic motivation. Also, Iqbal et al. (2020) proved that servant leadership increases trust and psychological safety, which are the foundation of innovation. These studies suggest that servant leadership's aspects, such as empowerment, trust, and willingness to support followers, foster innovative thinking among them. Namely, servant leadership has been also discovered to have several positive undertones in education for example, job satisfaction, commitment with an organization, and overall performance of a teacher (Anshori et al., 2023; von Fischer & De Jong, 2017). Nonetheless, there exists a lacuna in the past literature in understanding how servant leadership influences teachers' innovative behavior in the context of physical education. Physical education is one of the areas where teachers have to be creative in their approach to the students regarding the type of physical activity to be conducted (Pill et al., 2012). In this process, servant leadership can greatly contribute to the culture of innovation (Gu, 2022). Furthermore, since the teaching context in physical education requires creativity and other innovative elements to make the lesson interesting, the study of servant leadership on innovative behavior is timely and appropriate in this context. One of the most common issues that physical education teachers encounter is the ability to engage and motivate students, which is why creativity is very important. Through creating a positive and enabling climate, servant leaders can assist physical education teachers in addressing these adversities and design new effective methods that will improve students' participation and accomplishment.

Servant leaders empower their followers, build trust, and promote a shared vision, all factors known to spark innovative thinking (Ahmad, Scholz, et al., 2021; Anshori et al., 2023). In educational settings, servant leadership can translate into giving teachers the freedom and support to experiment with new teaching methods. When teachers feel supported rather than micromanaged, they are more willing to generate and implement novel ideas in the classroom. Prior studies outside the school domain have found positive relationships between servant

leadership and employees' innovative behavior, often through enhanced intrinsic motivation and psychological safety (Karatepe et al., 2020; Wang et al., 2019). However, there is a notable gap in understanding this relationship within schools, especially in physical education, where creative approaches are needed to engage students. From a relational leadership perspective, servant leaders create high-quality relationships that encourage teachers to go beyond routine practices. They act as mentors and stewards, which can cultivate a sense of loyalty and inspiration among teachers to try new ideas. The socio-ecological systems theory also supports this view by pointing to the relationship between people and their social context, arguing that the leadership environment can greatly affect people's behaviors and attitudes (Bronfenbrenner, 1979). This theory holds that people's behaviors depend on the relationship between the intrapersonal factors and the context in which they operate. In this case, servant leadership contributes to the formation of an empowering social context that encourages the innovative behavior of teachers. The socio-ecological systems theory also suggests that a supportive leadership environment can profoundly shape individual behavior (King & Travers, 2017). In sum, theory and evidence suggest that servant leadership should inspire greater innovative behavior from teachers by creating a nurturing, open climate. Therefore, we hypothesize:

H1. Servant leadership is positively related to teacher innovative behavior.

2.2. School climate for creativity as a mediator

The first potential pathway linking servant leadership to teacher innovation is through the school climate for creativity. A school climate for creativity refers to the extent that an organization's environment supports and encourages new ideas (Péter-Szarka, 2012). Servant leaders play a key role in shaping this climate: by valuing teachers' input, providing resources, and celebrating creative efforts, they set a tone that innovation is welcome. Research shows that servant leadership behaviors can significantly influence the development of an organizational climate (Liana & Hidayat, 2021) that is conducive to creativity. For example, servant leaders build trust and a sense of community, which helps teachers feel safe to take creative risks (Karatepe et al., 2019). A positive climate for creativity in turn fuels teachers' innovative actions, it gives them "permission" and motivation to devise novel solutions in their teaching. An environment that fosters such freedom promotes individual and group creativity, which is an important factor in education. Servant leadership practice significantly influences the development of the organizational climate for creativity (Aboramadan et al., 2021). As servant leaders value their followers' needs and growth, they provide an atmosphere of creativity (Hunter et al., 2013). According to the literature, servant leaders can build trust, integrate the team, and ensure that all the necessary resources are available to generate new ideas (Zada et al., 2023). It is important to mark that this kind of leadership is most appropriate for creating a positive climate for creativity as it corresponds to the principles of support, empowerment, and community.

As stated in the literature, it is essential to underline that the climate of creativity has a critical role in the employees' innovative behavior in a servant leadership framework (Karatepe et al., 2020). For instance, Aboramadan (2021) affirmed that the extent of creativity of the organization determines innovative practices among employees. Similarly, Ekmekcioglu and Öner (2024) noted that the level of organizational support for creativity influences individual and group creative activities. From the above findings, it is clear that there is a need to promote organizational climate that will boost creativity to promote innovation among employees. Hence, within the physical education context, it is posited that a positive school climate for creativity is of great significance. Physical education teachers are frequently required to develop new creative ways of getting students to be active. A positive school

context may offer the conditions, motivation, and permission for physical educators to try out new ideas and methods (Gao et al., 2020). This can result in better approaches to teaching and learning, increased attention from students, and improved educational results. From the perspective of socio-ecological systems, by providing encouragement and support from the organizational context, servant leaders can improve the creativity of their followers, which in turn increases innovative conduct. This mediating mechanism of school climate for creativity offers a sophisticated understanding of how servant leadership impacts innovation. In physical education classes, such a climate might mean having support for trying unconventional activities or integrating technology into lessons, ultimately leading to better student engagement and learning outcomes. By examining climate as a mediator, we capture how servant leadership's influence cascades through the school environment to affect teachers. Empirical evidence supports each link: servant leadership tends to improve creative climate (Aboramadan, 2021) and a creative climate tends to increase employees' innovative behavior. When combined, we expect the climate for creativity to carry (at least part of) the effect of servant leadership onto teacher innovation. Hence, we propose:

H2. Servant leadership is positively related to the school climate for creativity.

H3. The school climate for creativity is positively related to teachers' innovative behavior.

H4. The school climate for creativity mediates the relationship between servant leadership and teacher innovative behavior.

2.3. Teacher creative self-efficacy as a mediator

The second pathway considers teacher creative self-efficacy as a mediator. Creative self-efficacy is a teacher's confidence in their ability to generate and implement creative ideas (Nemeržitski & Heinla, 2020). It is a psychological asset that determines an individual's ability to participate in creativity and execute innovations. According to the self-efficacy literature, the individuals with a higher level of self-efficacy are likely to engage themselves in more challenging tasks, continue to work hard and have a high level of tenacity even if they face a lot of difficulties (Bandura, 1977). In addition to self-efficacy, teacher innovation is strongly influenced by motivational factors. Self-determination theory (Ryan & Deci, 2000) provides a robust framework for understanding motivation by distinguishing between intrinsic and extrinsic motivation. Intrinsic motivation refers to engaging in an activity for its inherent satisfaction, whereas extrinsic motivation involves performing an activity to obtain external rewards or avoid punishment. This theory posits that environments which support autonomy, competence, and relatedness enhance intrinsic motivation. In educational settings, leadership that is supportive and empowering—such as servant leadership—can satisfy these basic psychological needs, thereby fosters an internal drive for creativity and innovation. Furthermore, Ahmadi et al. (2023) have recently classified a range of motivational behaviors, offering insights into how these behaviors can be nurtured within teaching environments. By integrating these perspectives, we suggest that servant leadership may boost teacher innovative behavior not only by enhancing creative self-efficacy but also by promoting intrinsic motivation. Future studies could further explore how specific motivational behaviors mediate or moderate the relationship between leadership and innovation in educational contexts. In the context of education, creative self-efficacy enables teachers to create and implement innovative strategies to teach their students and increase students' levels of interest and achievement. Servant leadership can nurture this confidence by providing encouragement, mentoring, and a safe space to fail. When leaders focus on developing their teachers, they help teachers build belief in their own creative capabilities. Recent studies confirm this link: for instance, Iqbal et al. (2023) found that servant leadership

significantly boosted employees' creative self-efficacy, which in turn led to more innovation, and Jaiswal and Dhar (2017) reported similar findings with empowerment as a driver of self-efficacy.

It can be postulated that servant leadership can enhance teacher creative self-efficacy. Establishing a positive environment for the development of teachers, which is the case with servant leadership, can bring out the followers' self-confidence in their creativity (Zainal & Lata, 2021). Servant leaders are with teachers and assist them in getting what they need to attempt new things and not suffer the repercussions of failure by teachers. This support is required to enhance and sustain higher levels of creative self-efficacy in the teachers (Zada et al., 2023). Some studies have pointed out that servant leadership correlates with creative self-efficacy. Iqbal et al. (2023) have confirmed that servant leadership positively predicted the employees' creative self-efficacy and stimulated their innovative performance. Gelaidan et al. (2023) correspondingly confirmed that their creative self-efficacy is enhanced when the employees receive psychological empowerment through servant leadership. Thus, given the findings of these studies, it is feasible to determine that the concept of servant leadership can serve as the means to increase the creative self-efficacy of teachers, which is necessary for the stimulation of innovative behavior within the sphere of education. This has been found to hold across different settings, and hence it has been established that creative self-efficacy is one of the most significant determinants of innovative behavior (Teng et al., 2020).

In a school context, a servant leader might encourage a teacher by praising innovative lesson plans or by giving constructive feedback, thereby strengthening the teacher's conviction that "I can be creative in my teaching." High creative self-efficacy is known to be a strong predictor of innovative behavior. Teachers who believe in their creative skills are more likely to design new teaching activities, adapt curricula in original ways, and persist through challenges when trying out innovations (Chang et al., 2016). By elevating teachers' creative self-efficacy, servant leadership indirectly promotes innovation in the classroom. We expect this psychological boost to act as a bridge between leadership and innovation. In line with social cognitive theory, the supportive actions of servant leaders should translate into teachers' self-belief, which then drives their creative actions. In a school context, a servant leader might encourage a teacher by praising innovative lesson plans or by giving constructive feedback, thereby strengthening the teacher's conviction that "I can be creative in my teaching." High creative self-efficacy is known to be a strong predictor of innovative behavior. Teachers who believe in their creative skills are more likely to design new teaching activities, adapt curricula in original ways, and persist through challenges when trying out innovations (Chang et al., 2016). By elevating teachers' creative self-efficacy, servant leadership indirectly promotes innovation in the classroom. We expect this psychological boost to act as a bridge between leadership and innovation. In line with social cognitive theory, the supportive actions of servant leaders should translate into teachers' self-belief, which then drives their creative actions. Therefore, physical education teachers with higher creative self-efficacy are better placed to formulate and implement creative teaching strategies that determine students' participation and learning outcomes. The socio-ecological systems theory is useful in explaining the role of teachers' creative self-efficacy, which is enhanced by servant leadership that creates a positive climate for teachers' creative self-efficacy. Therefore, the current work tends to extend the existing body of knowledge by examining the relationship of servant leadership with teachers' innovative behavior considering the mediating role of teacher creative self-efficacy. Hence:

H5. Servant leadership is positively related to teacher creative self-efficacy.

H6. Teacher creative self-efficacy is positively related to teacher innovative behavior.

H7. Teacher creative self-efficacy mediates the relationship between

servant leadership and teacher innovative behavior.

2.4. Leader support for innovation as a moderator

Leader support for innovation can be regarded as the degree to which leaders offer encouragement, resources, and support for innovation by their subordinates (Vincent-Höper & Stein, 2019). This support is very essential in creating an environment that will enhance innovation. Managers who promote innovation foster an organizational culture that embraces creativity and risk-taking and the culture that accepts failure as a natural step in the learning process. Such an environment is necessary for converting innovation concepts into utilitarian use and continued innovative performance (Jaiswal & Dhar, 2015).

Servant leadership, by its nature, fosters innovation. The main idea of servant leaders is to develop followers to the best they can be to assist them in acquiring all the tools they need to become the best. These supports encompass availing of resources, encouraging the candidates, acknowledging their efforts, and creating an environment of togetherness (Cheung & Wong, 2011). While servant leadership lays the groundwork, the level of leader support for innovation in the school can further shape these dynamics. Leader support for innovation refers to how much leaders actively encourage and facilitate innovation among their staff (e.g., by providing resources, moral support, and recognition for innovative efforts). Even in a servant leadership context, some leaders may be more explicitly supportive of innovation than others. We propose that such support serves as a moderator in our model – essentially a catalyst that strengthens the effects of servant leadership. When a servant leader is also highly supportive of innovation, teachers are likely to perceive an even stronger mandate and enthusiasm for trying new ideas. Under these conditions, we expect the positive impacts of servant leadership on both the creative climate and on teachers' self-efficacy to be magnified. On the other hand, if leader support for innovation is low (even if the leader is servant-oriented in other ways), the translation of servant leadership into a creative climate or into teacher confidence might be weaker. In this regard, it is posited that leader support for innovation will enhance the relationship between servant leadership and school climate for creativity and teacher creative self-efficacy.

Prior research offers clues about this moderating role: for example, De Jong and Den Hartog (2007) found that leaders who actively support innovation amplify the effect of leadership on employees' innovative performance. Likewise, Gumusluoglu and Ilsev (2009) showed that the relationship between transformational leadership and innovation was stronger when leaders provided high support for innovation.

According to the studies, the support of leaders for innovation directly influences the overall climate of for creativity. Management that fosters innovation provides conditions that encourage people to think creatively, use available resources, and accept the risks involved in the innovation process (Ekvall, 1999). This climate is required to enable the teachers to think creatively and practice innovations. In physical education, leader support for innovation can motivate teachers to try out new strategies and techniques in their practice, thus developing more interesting and fruitful programs.

In addition, it is suggested that the support from the leader for innovation can improve the creative self-efficacy of teachers. If teachers are convinced that their leaders support their innovations, they will also have faith in their creative skills and the capability to develop and implement new ideas (Tierney & Farmer, 2002). This increased self-efficacy results in more commitment to innovative practices and, thus, higher innovative behavior. In physical education, where creativity is central to teaching and learning, and extra innovation is needed to ensure the students' interest in the subject as well as encourage physical activity, leader support for innovation can significantly positively influence teacher creative self-efficacy and, therefore, promote the use of innovative teaching methods. According to the socio-ecological systems theory, leader support for innovation is moderated by the social context since social context influences behavior and attitude. In this way, leaders

can facilitate support for innovation, which will strengthen the positive impact of servant leadership on the school climate for creativity and teacher creative self-efficacy and, subsequently, the innovative conduct of teachers. In summary, we expect a moderated mediation pattern, where leader support intensifies the indirect effects of servant leadership on teacher innovation via both climate and self-efficacy. To clarify this, we break Hypothesis 8 into two parts focusing on each mediating pathway. Thus, we hypothesize:

H8a. Leader support for innovation moderates the relationship between servant leadership and the school climate for creativity, such that this relationship is stronger when leader support is high.

H8b. Leader support for innovation moderates the relationship between servant leadership and teacher creative self-efficacy, such that this relationship is stronger when leader support is high.

3. Methodology

We conducted this study in the context of Chinese secondary school physical education programs. This context was deliberately chosen because China's education system has been undergoing reforms emphasizing innovation and quality improvement, particularly in student health and physical education. Focusing on physical education teachers in China provides a relevant backdrop to examine our framework, as these teachers face pressure to modernize teaching methods in response to national initiatives for improving youth fitness and engagement. By selecting multiple major cities with diverse educational environments (Beijing, Shanghai, Guangzhou, and Shenzhen), we aimed to capture a broad perspective and enhance the generalizability of our findings. Each of these cities is known for significant investments in education and could offer a supportive setting for innovative practices. The unit of analysis for our study is the individual teacher; each teacher's perceptions of leadership and their own behaviors constitute one data point in our analysis. This research adopts a post-positivist, quantitative approach. We follow a deductive logic, beginning with theory-driven hypotheses and then testing these with empirical data. The study is designed under a survey research paradigm, aiming for objectivity and generalizability. Our ontology assumes an objective reality of leadership and innovation constructs (as measured by validated scales), while our epistemology emphasizes measurement and statistical analysis to uncover relationships. In practical terms, this means we treat the collected data as evidence to confirm or refute our theoretical model, consistent with the positivist tradition in social science research.

An in-person survey was steered to collect data. We initially distributed 600 questionnaires across the participating schools (approximately 150 per city spread over multiple schools). Using G*Power software for a priori power analysis, we had determined a minimum sample size of around 370 would be needed to detect medium-sized effects with adequate power (0.80) given our model complexity. To account for possible non-responses or dropouts between waves, we oversampled (Ahmad, Ahmad, & Siddique, 2024; Ahmad, Samad, & Han, 2024). Ultimately, we received 442 completed questionnaires in Wave 3, of which 408 were usable after discarding those with missing data or inconsistent responses. The final sample of 408 physical education teachers had a roughly balanced representation from each of the four cities, with each city contributing about 22–28 % of the respondents. This distribution suggests that no single city dominated the sample, aligning with our goal of capturing diverse organizational cultures and practices. The teachers came from a mix of urban public schools and a few private schools, ensuring variability in organizational context. We also collected demographic information (see Table 1) to characterize the sample: the teachers' ages ranged broadly (with sizable groups in their 20s, 30s, and 40s), and teaching experience varied from new educators to veterans of 15+ years. About half the sample was male and half female, which reflects the typical gender balance in physical education teaching. These details indicate a diverse sample that is

Table 1
Demographic information.

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age	Under 25	40	9.8
	25–34	160	39.2
	35–44	140	34.3
	45–54	48	11.8
	55 and above	20	4.9
Gender	Male	210	51.5
	Female	198	48.5
Years of Experience	< 1 year	20	4.9
	1–5 years	130	31.9
	6–10 years	150	36.8
	11–15 years	78	19.1
	> 15 years	30	7.3
Education Level	Bachelor's Degree	180	44.1
	Master's Degree	190	46.6
	Doctorate	38	9.3

suitable for examining general patterns rather than being idiosyncratic to one narrow subgroup.

Data were collected from schools that met specific criteria to ensure relevance and quality. Schools selected for the study were those with a recognized commitment to physical education and innovation, a diverse student body, and a willingness to participate in educational research. Selection criteria included schools with established physical education programs, a history of involvement in educational development projects, and geographical diversity to capture a broad spectrum of educational practices.

We employed a three-wave survey design to collect data, which helped strengthen the study's methodological rigor (Chen, Ghardallou, et al., 2022; Liu et al., 2023). First, we identified and contacted a number of secondary schools in the target cities that met specific criteria: each school had a well-established physical education program, a demonstrated openness to educational innovation (such as prior involvement in pilot programs or teacher training initiatives), and willingness to participate in our research. After securing school approvals, we administered surveys on-site in three rounds, approximately one month apart each. In Wave 1, teachers provided data on servant leadership (perceptions of their school leaders) and demographics. Wave 2 occurred a month later, where the same teachers (matched via anonymous codes) answered questions about the school climate for creativity and their own creative self-efficacy. Wave 3 conducted another month after Wave 2, collected data on leader support for innovation and the teachers' innovative behavior. All surveys were administered face-to-face in the schools, usually at staff meetings or professional development sessions arranged with the school administration's help. Research assistants distributed paper questionnaires and explained that participation was voluntary and responses would remain confidential. To ensure honest reporting, teachers sealed their completed surveys in envelopes before returning them, and we reiterated that only aggregated data would be used. This staggered data collection approach (time-lagged design) reduces common method bias by separating the measurement of predictors and outcomes in time (Guo et al., 2021; Murtaza et al., 2021). It also helps mitigate any immediate response tendencies, providing a more accurate capture of the hypothesized temporal sequence of events.

To measure the variables, the study employed already validated scales using a five-point Likert scale. Servant leadership (7-items) was adapted from Liden et al. (2015), which includes items such as “My supervisor puts my best interests ahead of his/her own.” Teacher innovative behavior (7-items) was measured using Lin and Shin (2021) source, including items like “I have proposed and tried to implement new ideas to solve difficult or convoluted problems in physical education.” The school climate for creativity included 5 items taken from the study of Kim and Yoon (2015) with items such as “In our school, there are adequate resources devoted to innovation in the physical education

program.” Teacher creative self-efficacy (3 items) was measured using Jaiswal and Dhar (2015) scale, which includes items like “I have confidence in my ability to solve teaching problems creatively in physical education.” Leader support for innovation (9 items) was measured using Montani et al. (2017) source, including items like “ Our supervisor invites us to express ideas and opinions about how to improve current physical education practices.”

To mitigate response bias, social desirability bias, and method bias, the study employed several strategies. The three-wave data collection strategy helped reduce common method bias by separating the measurement of predictor and criterion variables over time (Ahmad, Ullah, et al., 2023; Fu et al., 2023). To minimize social desirability bias, participants were ensured about anonymity and confidentiality (Jiang et al., 2025; Wang et al., 2024). Additionally, using well-established and validated scales ensured the validity and reliability of the measures, further reducing the potential for response bias (Ahmad, Han, & Kim, 2024; Liu et al., 2024).

In the coming section (Results) we report several statistics to demonstrate the reliability and validity of our measures. First, all multi-item scales showed high internal consistency. Cronbach's alpha values for each construct were well above the recommended 0.70 threshold (Ahmad, Samad, & Mahmood, 2024; Li et al., 2024), ranging from approximately 0.90 to 0.95 for our five main constructs (servant leadership, school climate for creativity, creative self-efficacy, leader support for innovation, and innovative behavior). Similarly, the composite reliability (CR) values were strong, between 0.918 and 0.959, indicating that the items consistently measure their intended latent construct. In terms of convergent validity, the average variance extracted (AVE) for each construct exceeded 0.50 (ranging from 0.584 to 0.857), meaning that on average, >50 % of the variance in the items is explained by the construct (Ahmad, Ahmad, Lewandowska, & Han, 2024; Xu et al., 2022). These CR and AVE values meet the criteria suggested by (Fornell & Larcker, 1981), supporting the quality of our measurement model. We also checked discriminant validity through the Fornell-Larcker criterion and found that each construct's AVE square root was greater than its

correlations with other constructs (details can be provided upon request), indicating that each measure is distinct from the others. In sum, these results give confidence that our survey instruments are reliable and valid; reducing the likelihood that measurement error could obscure the findings.

4. Results

We used partial least squares structural equation modeling (PLS-SEM), implemented in Smart-PLS, to test our hypotheses. PLS-SEM was chosen for several reasons. First, our theoretical model is complex, involving two mediators and one moderator, and PLS-SEM is well-suited for handling such complexity, especially in prediction-oriented research frameworks. Unlike covariance-based SEM, PLS-SEM makes fewer assumptions about data distribution and can be more robust with moderately sized samples (Ahmad, Samad, & Han, 2023). Given our sample of 408 and the exploratory nature of moderated mediation in a new context, PLS-SEM provided an appropriate balance of statistical power and model flexibility. This approach allowed us to examine all relationships (direct, mediated, and moderated) in a single integrated model. We followed accepted guidelines for PLS-SEM analysis (Hair et al., 2019) to ensure rigor: evaluating the measurement model first for reliability and validity, then assessing the structural paths for hypothesis testing. We also mean-centered the predictor variables involved in interaction terms to reduce multicollinearity before creating the interaction construct.

The data analysis (using Smart-PLS) examined the validity and reliability of the measurement model and the structural model in order to understand variable associations. Table 2 includes the values of factor loadings, composite reliability, AVE, and R-square values. All factor loadings were above 0.7 (Guan et al., 2023), indicating good convergent validity, with the lowest at 0.693. Constructs for leader support for innovation (LSI), school climate for creativity (SCC), servant leadership (SL), teacher creative self-efficacy (TCSE), and teacher innovative behavior (TIB) showed strong loadings. Composite reliability values

Table 2
Data quality stats on the measurement model.

Items	LSI	SCC	SL	TCSE	TIB	Composite Reliability	AVE	R-Square
LSI1	0.813							
LSI2	0.830					LSI: 0.926	LSI: 0.584	SCC: 0.477
LSI3	0.768					SCC: 0.959	SCC: 0.824	TCSE: 0.379
LSI4	0.815					SL: 0.918	SL: 0.619	TIB: 0.559
LSI5	0.805					TCSE: 0.947	TCSE: 0.857	
LSI6	0.710					TIB: 0.918	TIB: 0.614	
LSI7	0.713							
LSI8	0.702							
LSI9	0.704							
SCC1		0.880						
SCC2		0.880						
SCC3		0.928						
SCC4		0.920						
SCC5		0.930						
SL1			0.707					
SL2			0.693					
SL3			0.720					
SL4			0.834					
SL5			0.817					
SL6			0.846					
SL7			0.867					
TCSE1				0.979				
TCSE2				0.912				
TCSE3				0.885				
TIB1					0.735			
TIB2					0.809			
TIB3					0.779			
TIB4					0.804			
TIB5					0.818			
TIB6					0.775			
TIB7					0.763			

were all above 0.7, ranging from 0.918 to 0.959, indicating high internal consistency. AVE values were between 0.584 and 0.857, confirming convergent-validity (Ahmad, Mahmood, et al., 2021; Ullah et al., 2021). R-square values indicated the variance explained by independent variables: SCC (0.477), TCSE (0.379), and TIB (0.559). The measurement and structural models are shown in Fig. 1 and Fig. 2.

Table 3 includes the correlation values and discriminant validity values through square-root of AVEs and HTMT values. The correlation matrix shows relationships between leader support for innovation, school climate for creativity, servant leadership, teacher creative self-efficacy, and teacher innovative behavior. The square-root of the AVE values on the diagonal indicates the variance captured by each construct relative to measurement error. Significant correlations between constructs fall within acceptable ranges, indicating good discriminant validity. For example, the correlation between servant leadership and school climate for creativity is 0.589, and between servant leadership and teacher innovative behavior is 0.674. The square-root of AVE values on the diagonal is higher than the off-diagonal values, indicating that each variable shares more variance with its indicators than with other variables. HTMT values, all below 0.90, further confirm discriminant validity, such as the value between leader support for innovation and school climate for creativity at 0.627, between servant leadership and teacher innovative behavior at 0.748, and between teacher creative self-efficacy and teacher innovative behavior at 0.630.

After confirming the measurement model's quality, we evaluated the structural model. Table 4 presents the path coefficients (β), t-values (based on bootstrapping with 5000 resamples), and significance levels for each hypothesized relationship. In support of H1, servant leadership had a positive and significant direct effect on teacher innovative behavior ($\beta = 0.424$, $t = 7.214$, $p < .001$). Servant leadership also positively predicted the proposed mediators: the school climate for

creativity ($\beta = 0.688$, $t = 14.782$, $p < .001$) and teacher creative self-efficacy ($\beta = 0.547$, $t = 10.461$, $p < .001$), supporting H2 and H5 respectively. These results indicate that in schools where leaders practice servant leadership, teachers perceive a more creative-friendly climate and feel more confident in their creative abilities.

Consistent with H3, a supportive school climate for creativity was associated with higher teacher innovative behavior ($\beta = 0.341$, $t = 6.324$, $p < .001$). Likewise, confirming H6, teachers' creative self-efficacy was positively related to their innovative behavior ($\beta = 0.448$, $t = 8.031$, $p < .001$). To test the mediation hypotheses (H4 and H7), we looked at the indirect effects. The indirect effect of servant leadership on innovative behavior through school climate for creativity was significant ($\beta = 0.234$, $t = 5.124$, $p < .001$). This indicates partial mediation, as servant leadership still had a direct influence on innovative behavior even with the mediator in the model. Similarly, the indirect effect of servant leadership on innovative behavior via creative self-efficacy was significant ($\beta = 0.246$, $t = 5.870$, $p < .001$), supporting the mediating role of teacher self-efficacy. We therefore find evidence that both the school climate for creativity (H4) and teacher creative self-efficacy (H7) serve as mediating mechanisms through which servant leadership contributes to teacher innovation. Notably, since the direct path H1 remained significant alongside these mediators, both mediators can be characterized as partial mediators rather than full – servant leadership continues to have a direct impact on innovation, albeit reduced in magnitude when the mediators are accounted for.

For the moderation hypotheses, our analysis also supported H8a and H8b. Leader support for innovation significantly moderated the effect of servant leadership on school climate for creativity (interaction $\beta = 0.179$, $t = 3.564$, $p = .001$) and on teacher creative self-efficacy (interaction $\beta = 0.200$, $t = 4.123$, $p < .001$). In simple terms, this means that servant leadership had an even stronger positive impact on the climate

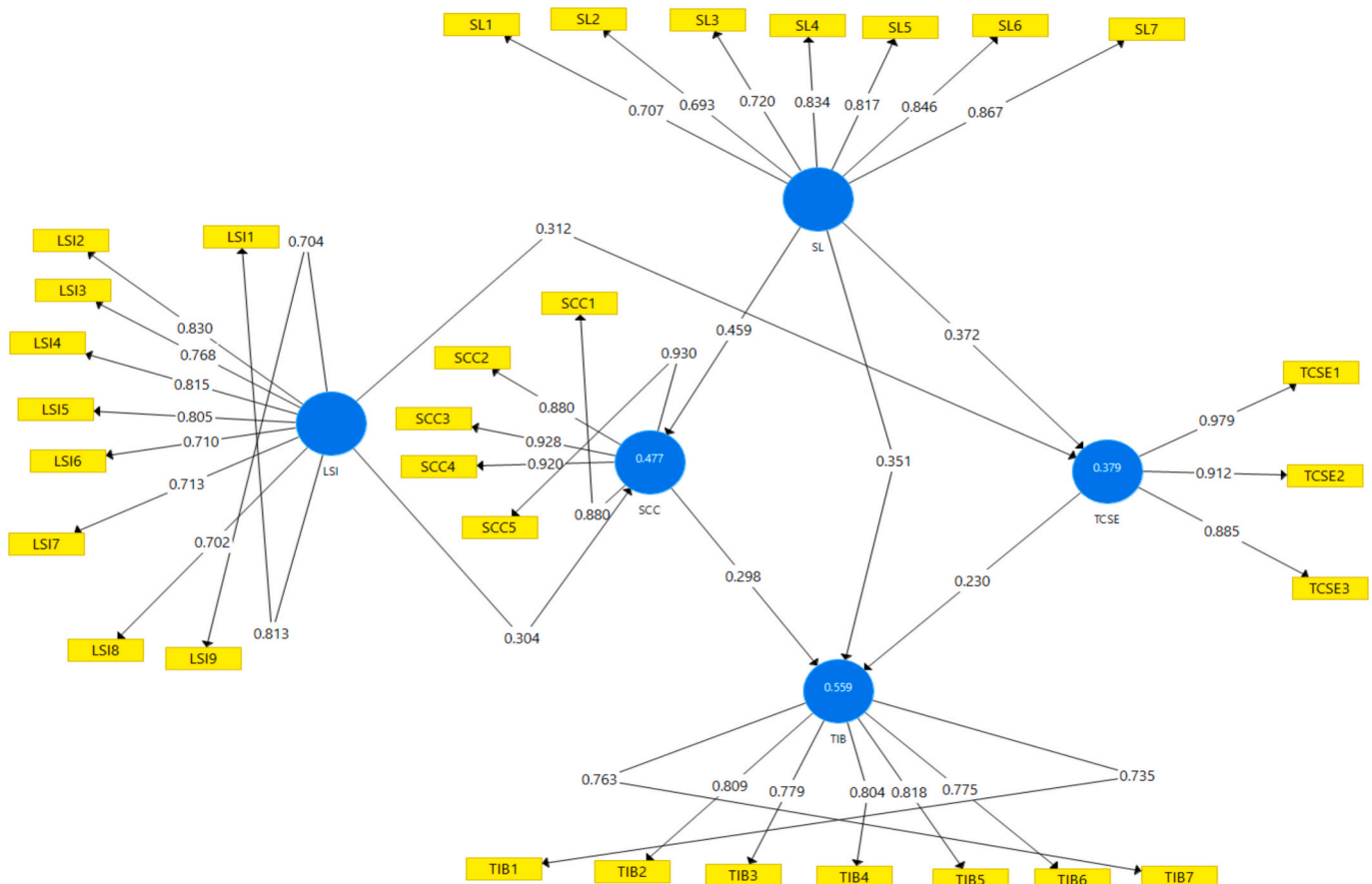


Fig. 1. The measurement model.

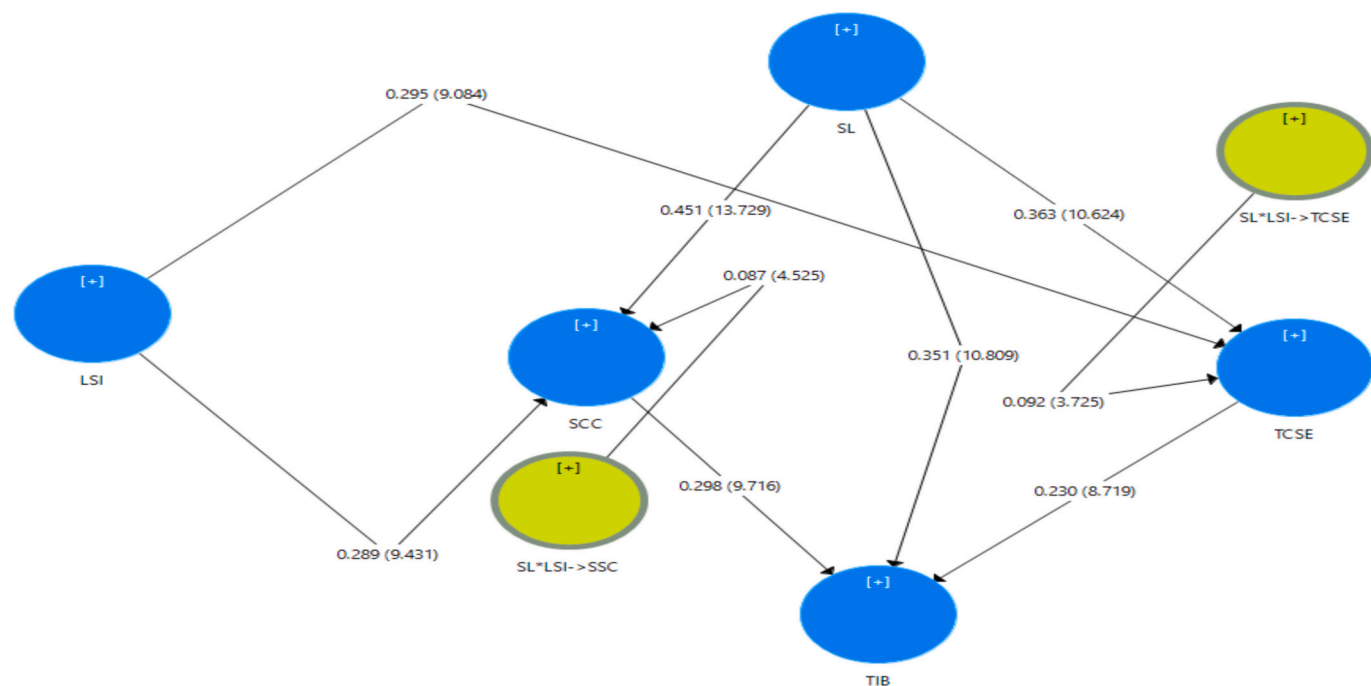


Fig. 2. The full structural model.

Table 3
Correlations, square root f AVE, and HTMT values.

Variables	LSI	SCC	SL	TCSE	TIB
LSI	0.764				
Correlations					
SCC	0.589	0.908			
SL	0.621	0.648	0.786		
TCSE	0.543	0.489	0.566	0.926	
TIB	0.639	0.638	0.674	0.575	0.784
HTMT					
LSI		0.627	0.692	0.592	0.702
SCC			0.697	0.526	0.689
SL				0.623	0.748
TCSE					0.630

Table 4
Hypotheses testing results.

Hypothesis	Path	β	t-value	p-value	Decision
H1	SL \rightarrow TIB	0.424	7.214	<0.001	Accepted
H2	SL \rightarrow SCC	0.688	14.782	<0.001	Accepted
H3	SCC \rightarrow TIB	0.341	6.324	<0.001	Accepted
H4	SL \rightarrow SCC \rightarrow TIB	0.234	5.124	<0.001	Accepted
H5	SL \rightarrow TCSE	0.547	10.461	<0.001	Accepted
H6	TCSE \rightarrow TIB	0.448	8.031	<0.001	Accepted
H7	SL \rightarrow TCSE \rightarrow TIB	0.246	5.870	<0.001	Accepted
H8a	LSI moderates SL \rightarrow SCC \rightarrow TIB	0.179	3.564	<0.001	Accepted
H8b	LSI moderates SL \rightarrow TCSE \rightarrow TIB	0.200	4.123	<0.001	Accepted

Note: SL = Servant Leadership, TIB = Teacher Innovative Behavior, SCC = School Climate for Creativity, TCSE = Teacher Creative Self-Efficacy, LSI = Leader Support for Innovation.

and on teachers' self-efficacy when leader support for innovation was high, compared to when it was low. To ensure our moderation analysis was sound, we constructed interaction terms by multiplying the standardized values of servant leadership and leader support for innovation, as per the product indicator approach for PLS-SEM (Henseler et al., 2015). We also probed the interactions with simple slope analyses at ± 1

SD of leader support. The simple slope results confirmed our interpretation: at one standard deviation above the mean of leader support, servant leadership's effect on creative climate was much stronger than at one standard deviation below the mean. A similar pattern was observed for the creative self-efficacy pathway. These findings validate H8a and H8b, leader support for innovation acts as a positive moderator on the first stage of both mediation chains.

Figs. 3 and 4 illustrate how Leader Support for Innovation (LSI) moderates the relationship between Servant Leadership (SL) and two mediators: Teacher Creative Self-Efficacy (TCSE) and School Climate for Creativity (SCC). In both figures, SL is plotted on the x-axis, while TCSE or SCC is on the y-axis. Three lines represent LSI at -1 SD (blue), the mean (red), and $+1$ SD (green). The green line in each figure is steepest, indicating that SL has the strongest positive effect on the mediator when LSI is high. In contrast, the flatter blue line at -1 SD of LSI shows a weaker SL-TCSE or SL-SCC relationship. These results confirm that leader support for innovation amplifies servant leadership's impact on teachers' creative confidence and the broader school climate.

5. Discussion

Our study set out to explore how servant leadership can foster innovative behavior among physical education teachers, and the findings largely support our hypotheses. In this section, we discuss each key result in relation to our hypotheses and the existing literature, explaining both the theoretical and practical significance. Overall, we found that servant leadership has a potent positive effect on teacher innovation, operating through a more creative school climate and enhanced teacher self-efficacy, and that these effects are further strengthened by supportive leadership behavior. We elaborate on each of these points below.

Consistent with expectations, we found that servant leadership positively influences teacher innovative behavior (H1 was supported). This result reinforces prior research that leadership styles oriented toward empowering and caring for subordinates can spur innovation (Iqbal et al., 2023; Pill et al., 2012). In our context, when school leaders adopted a servant leadership approach, their physical education teachers were more likely to introduce new ideas and creative methods in

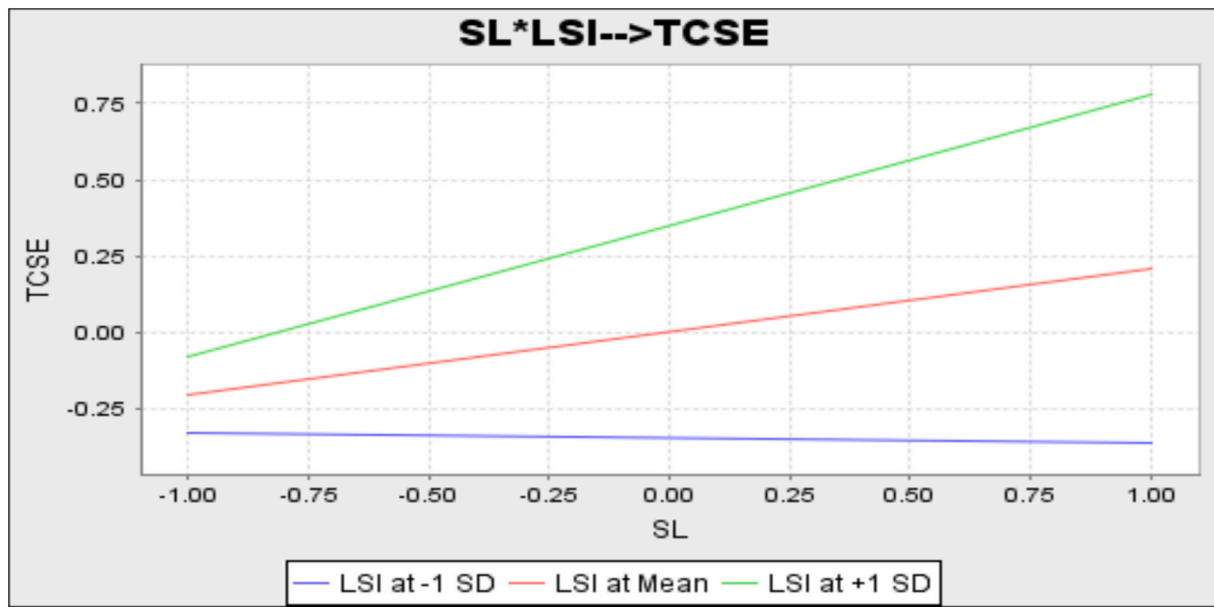


Fig. 3. A line graph with SL on the x-axis and TCSE on the y-axis. Three lines (blue, red, green) show the relationship at LSI = −1 SD, Mean, and + 1 SD, respectively. The green line is the steepest, indicating a stronger SL–TCSE relationship when LSI is high.

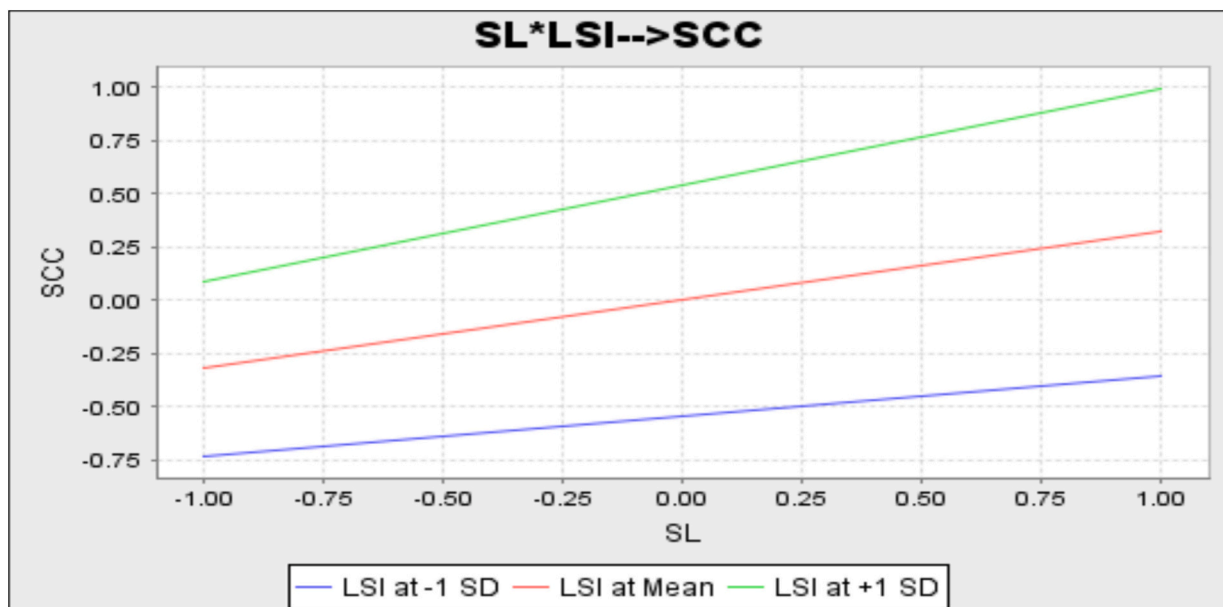


Fig. 4. A line graph with SL on the x-axis and SCC on the y-axis. Three lines (blue, red, green) represent LSI = −1 SD, Mean, and + 1 SD. The slope is highest (green line) at +1 SD, showing the strongest positive SL–SCC link under high LSI.

their teaching practice. This finding aligns with the idea that a leader who serves – by prioritizing teachers' needs and professional growth, creates an atmosphere of trust and psychological safety where teachers feel comfortable experimenting. It echoes earlier studies in corporate settings that tied servant leadership to increased employee creativity via intrinsic motivation (Zhu & Zhang, 2020) and in education settings linking servant leadership with positive teacher outcomes like job satisfaction and performance (Anshori et al., 2023; von Fischer & De Jong, 2017). Our contribution is to confirm this relationship in the physical education domain, suggesting that even in traditionally structured subjects like physical education; a servant leader can break inertia and encourage pedagogical innovation. This direct effect also implies that part of a teacher's creative performance comes straight from leadership influence, independent of other factors, a point that school

administrators should note when hiring or training principals.

The results also confirmed the mediating role of school climate for creativity in the servant leadership–innovation link. First, we verified that servant leadership is strongly associated with a more creative school climate (H2 supported). This means that leaders who practice servant leadership indeed succeed in shaping their school's environment – teachers perceive more encouragement for new ideas, greater resource support for experimentation, and a general openness to change. This finding is in line with theoretical arguments and past evidence that servant leaders help build a culture of trust and innovation (Aboramadan, 2021; Hunter et al., 2013). Second, as hypothesized in H3, a positive school climate for creativity led to higher innovative behavior among teachers. When the work environment supports creativity, teachers respond by being more creative, a relationship well-

documented in organizational psychology (Ekvall, 1999) and now validated in our educational context. Most importantly, we found that the school climate for creativity partially mediates the effect of servant leadership on teacher innovation (supporting H4). This partial mediation indicates that servant leadership encourages teacher innovation in part by cultivating a creative climate. In practical terms, one reason servant leadership works is because it changes the workplace atmosphere: teachers in such environments feel empowered and motivated to try new things, which directly boosts innovation. However, since the mediation is partial, there are other channels at play (including the direct relationship and the second mediator, self-efficacy). Our findings here underscore the theoretical implication that contextual factors (like climate) are a key piece of the puzzle in understanding how leadership translates to innovation. It adds to socio-ecological systems theory by empirically demonstrating that the organizational context (school climate) is an intermediary layer connecting leadership practices to individual teacher behaviors. For school leaders, this means that part of their job in fostering innovation is to actively manage and improve the school climate, for example, by recognizing creative efforts, setting aside time for collaborative idea generation, and ensuring teachers have the materials they need for new activities.

In addition to the organizational climate, our study found that a psychological factor, teachers' creative self-efficacy, mediates the effect of servant leadership on innovation. Servant leadership was shown to significantly boost teachers' creative self-efficacy (supporting H5), aligning with previous findings that empowering leadership behaviors enhance followers' confidence in their creative abilities (Gelaidan et al., 2023; Zainal & Lata, 2021). This result makes intuitive sense: when leaders encourage and mentor teachers, and shield them from harsh consequences of failed attempts, teachers build a belief in their own creative potential. We also confirmed that higher creative self-efficacy is associated with greater innovative behavior (H6 supported), echoing a large body of research in education and organizational psychology that identifies self-efficacy as a critical driver of innovation and proactive behavior (Tierney & Farmer, 2002; Zada et al., 2023). Teachers who trust in their creative skills are more inclined to develop novel lesson plans, adapt on the fly, and persist in improving their teaching methods. The mediation test (H7) showed that creative self-efficacy partially mediates the relationship between servant leadership and innovative behavior. This means that servant leadership works in part by empowering teachers internally – changing how teachers see themselves. The finding contributes to theory by highlighting the psychological mechanism through which leadership exerts influence. In our dual-mediator model, both climate and self-efficacy mediated the effect, and interestingly both mediators had comparable indirect effect magnitudes. This suggests that servant leadership attacks the innovation challenge from two fronts: externally, by shaping the environment (climate), and internally, by shaping the person (self-efficacy). Such a dual pathway insight is a theoretical contribution of our work, expanding on prior single-mediator studies. For practical implications, this points to the importance of leader actions that build teacher confidence – for instance, providing professional development, positive feedback, and celebrating creative successes. Strengthening teachers' belief in their creative capacity can be a lever for innovation in schools, as evidenced by our data.

Our final set of hypotheses examined whether the leader's support for innovation moderates the relationships involved in the mediation pathways. The evidence supported both H8a and H8b: leader support significantly amplified servant leadership's effects on the school climate for creativity and on creative self-efficacy. In the context of our model, these findings establish a moderated mediation; the indirect effects of servant leadership on teacher innovation (through climate and self-efficacy) are stronger when there is high leader support for innovation. We initially hypothesized a “boosting” effect, and that is exactly what the results indicate. Practically, even a servant leader benefits from explicitly championing innovation. When teachers observe that their

principal or department head not only leads in a servant-oriented way but also actively pushes for new ideas (for example, by allocating funds for experimental programs or publicly praising innovative teaching), the impact on creating a creative climate is heightened. Teachers in such cases reported the greatest levels of creative atmosphere and personal creative confidence. This moderated pattern resonates with relational and contingency leadership theories, which suggest that leadership effectiveness often depends on situational factors and specific behaviors. Our study demonstrates that supportive behaviors focused on innovation are a crucial situational enhancer in a servant leadership context. Interestingly, the moderator (leader support) is conceptually related to servant leadership but not identical – one can imagine a leader who is generally supportive and people-oriented (servant leader) but doesn't particularly emphasize innovation, versus one who does both. Our results suggest that doing both yields the best outcome for fostering innovation. In discussing these findings, it's important to clarify, as we have in our revisions, that leader support for innovation is a moderator, not a mediator. The earlier draft mistakenly described it as “mediating,” which was incorrect. The corrected interpretation is that leader support changes the strength of the effect, rather than carrying an effect itself. This distinction matters theoretically: it means that the presence of strong innovation support can make the difference between a servant-led school that is moderately innovative and one that is highly innovative. This finding adds nuance to the servant leadership literature by indicating that certain complementary leader behaviors (like supporting innovation) can unlock the full potential of servant leadership. It corroborates previous research that highlighted the importance of supportive leadership practices for innovation (Vincent-Höper & Stein, 2019) and extends it by integrating such practices into a broader moderated mediation model.

By incorporating, organizational (climate) and individual (self-efficacy) mediators, along with a contextual moderator (leader support), our study provides a more integrated view of leadership and innovation in line with socio-ecological systems theory. We show that the influence of leadership on innovative behavior operates at multiple levels: the organizational environment, the personal psychological state, and is conditioned by the social support context. This multi-level insight is a theoretical implication on its own. It suggests that future theories of educational innovation should not view leadership effects as linear or singular. Instead, they should account for the interplay of context and person-centered factors. Our findings emphasize that paying attention to both the organizational climate and individual capacity (self-efficacy) is essential when trying to enhance innovation through leadership. In sum, the discussion of our results, hypothesis by hypothesis, confirms our proposed model and highlights new contributions to the literature on leadership in education. We next turn to what these findings mean for practitioners and policymakers, and then address the study's limitations and directions for future research.

5.1. Theoretical implications

The following are the theoretical contributions of this research to the knowledge of leadership and innovative behavior in educational institutions. The use of socio-ecological systems theory enables the study to adopt an integrated approach of elucidating how factors like school climate for creativity and teacher creative self-efficacy work in conjunction with leadership to enhance innovation. This dual mediation model presents a more complex picture of the ways in which servant leadership influences innovative behavior, and expands the knowledge base on leadership for innovation.

First of all, this research confirms the significance of servant leadership in encouraging innovation among teachers. As mentioned in the literature review, past studies have shown the significance of servant leadership in different organizational results; however, this research focuses on the relationship between servant leadership and teacher innovative behavior in physical education. This focus on physical

education brings a different perspective to the literature, as the majority of the studies have been conducted in general education contexts. Secondly, the study puts into perspective the role of school climate for creativity as a mediator of the relationship between servant leadership and teacher innovative behavior. This underlines the importance of educational leaders in promoting a favorable school climate that will help to boost innovative practices among teachers. Hence, this study contributes to the enhancement of the socio-ecological systems theory by establishing that a positive school climate for creativity mediates the relationship between leadership and innovative behavior.

Thirdly, the present research highlights the teacher's creative self-efficacy's importance for the leadership-innovation connection. It is therefore proposed that creative self-efficacy mediates the relationship between leadership practices and innovative behavior by indicating that teachers' beliefs in their creative abilities are important in facilitating the implementation of leadership practices to promote innovation. The present conclusion is consistent with self-efficacy literature and contributes to the knowledge of how psychological resources affect innovation within educational contexts. Finally, the analysis of the moderating role of leader support for innovation offers suggestions on how other forms of support enhance the impact of servant leadership. This implies that within the context of a supportive leadership environment, additional initiatives aimed at promoting and enabling innovation can add value to the teachers' innovative actions. Thus, this study adds to the existing literature on the effect of supportive leadership behaviors and their relation to organizational performance.

5.2. Practical implications

Educational leaders and policymakers can draw several important lessons from this research on how to increase teachers' innovative behavior – especially in physical and sports education, but also potentially in other subjects. Based on our findings, we offer the following practical recommendations:

First, schools should consider implementing the principles of servant leadership in their management practices. This could involve training principals and department heads to adopt a servant leader mindset – for example, by focusing on supporting teachers' professional growth, actively listening to teachers' needs, and involving teachers in decision-making. Our results show that when leaders put teachers first, it sparks greater innovation among staff. School administrators can institute mentorship programs, where experienced servant-oriented leaders coach others on how to be more empathetic and empowering. By making the work environment more caring and open, teachers are inspired to try out new strategies without fear, which ultimately benefits student learning. It's also important for educational authorities to select or promote individuals with servant leadership qualities into leadership positions, as their natural orientation can nurture a culture of innovation over time.

Second, create and maintain a school environment conducive to innovation. The organizational climate must actively encourage creativity if teachers are to be consistently innovative. Leaders can do this by ensuring adequate resources for new projects (e.g., budgets for sports equipment to pilot a new activity), providing time and space for teachers to collaborate on creative lesson planning, and publicly recognizing and rewarding innovative teaching practices. For instance, a school might establish an "Innovation in Teaching" award or showcase successful creative PE lesson plans in staff meetings. Our findings affirm that such a supportive climate significantly contributes to innovative outcomes. When teachers perceive that creativity is valued and even expected, they will be more comfortable developing and implementing new ideas. Thus, school leaders should embed creativity into the school's culture – this can include everything from classroom-level policies (allowing flexible lesson structures) to school-wide initiatives (like innovation incubator groups or periodic brainstorming workshops among teachers).

Third, invest in building teachers' creative self-efficacy as a pathway

to boosting innovation. Teachers need to feel confident in their creative abilities to take the leap into uncharted teaching methods. Professional development programs should be geared not only toward skill-building but also toward confidence-building. Workshops on creative teaching strategies in physical education, for example, could include hands-on practice and positive feedback sessions to show teachers that they *can* successfully implement new approaches. Administrators might also encourage teachers to set small creative goals and gradually increase the challenge as their confidence grows. Another strategy is to create peer support networks or communities of practice where teachers share innovative ideas and encourage each other. When teachers see their peers innovating and hear encouragement, their own self-efficacy can improve. Our study suggests that these psychological empowerment efforts will pay off: higher creative self-efficacy led to more innovative behavior. Therefore, initiatives like innovation labs for teachers, creativity training sessions, and reflective practices where teachers recount successful innovations can strengthen this inner belief and lead to more frequent and bold innovation in the classroom.

Fourth, and importantly, school leaders must provide active support for innovation in addition to having a servant leadership style. This means that beyond general support and care, leaders should explicitly champion new ideas and protect those who take innovative risks. Concretely, administrators could set aside "innovation time" each week during which teachers can experiment with new techniques or develop new curricula without worrying about strict adherence to the standard lesson plan. Leaders should also make it safe to fail – if an experimental activity doesn't work out, it should be treated as a learning experience rather than a mistake. By doing so, teachers understand that their leadership truly has their back when they try something novel. Our moderated mediation results demonstrated that such leader support intensifies the effects of servant leadership; in practice, a principal who both behaves as a servant leader and vocally supports innovation will likely see the most creative output from teachers. School management can implement policies like small grants for classroom innovation, where teachers can propose creative projects and receive funding and release time to try them. Additionally, leaders should regularly ask for teachers' input on how to improve and be willing to allocate resources (like new sports equipment, technology, or training) to facilitate those teacher-driven innovations. By nurturing this supportive atmosphere, leaders effectively amplify teachers' innovative efforts, embedding innovation into the daily fabric of school operations.

In summary, the practical message is that cultivating teacher innovation requires a combination of leadership approach and supportive actions. Educational managers and policymakers should not only promote servant leadership values but also create structures and incentives that encourage innovation at the ground level. By doing so, schools, particularly in physical education, can become more dynamic, responsive, and effective in meeting student needs. Ultimately, these efforts contribute to an educational culture where continuous improvement and creativity are part of the norm, preparing students for a rapidly changing world and fostering lifelong healthy habits through engaging physical education.

5.3. Limitations and future research directions

Like all studies, this research has limitations that open avenues for future inquiry. First, our study employed a cross-sectional (though multi-wave) design, which limits our ability to draw strong causal conclusions. While the temporal separation of measurements helps, we cannot definitively say that servant leadership causes changes in teacher innovation. Future studies should consider longitudinal designs or experiments, for example, tracking schools over multiple years as leadership styles or support initiatives change, to better establish causality and observe how the leadership-innovation relationship unfolds over time. Second, our sample is specific to physical education teachers in Chinese secondary schools, which may affect generalizability. The cultural

context (e.g., Chinese collectivist culture and hierarchical school structure) and the subject matter (physical education) could produce unique dynamics. Future research could test our model in different contexts, other countries, other school subjects (like science or arts), or different education levels (primary schools or universities), to see if the findings hold or if new patterns emerge. Comparative studies might reveal, for instance, whether servant leadership has an even stronger effect in cultures with different power distance, or whether certain subjects (like arts education) have even higher innovation responsiveness than physical education. Third, we relied on self-reported data from teachers for all variables, raising the possibility of common method bias and social desirability bias. Although we took steps to mitigate this (assuring anonymity, separating the survey waves) and statistical tests did not indicate severe common method variance, it remains a concern. Future studies can strengthen this aspect by collecting multi-source data. For example, researchers could obtain independent assessments of teacher innovation (such as peer or principal ratings of a teacher's innovativeness, or even objective indicators like number of new programs initiated) and combine those with teacher self-reports of leadership perceptions. Including student outcome data (e.g., student engagement or performance in classes) might also be valuable to connect teacher innovation with its impact. Fourth, our model focused on specific mediators and one moderator, but there are likely other important factors in the servant leadership–innovation process. We did not consider other potential mediators (e.g., teachers' intrinsic motivation or trust in leader) and moderators (e.g., school policies, teacher personality traits) that could influence the relationships we studied. Future research could explore additional variables, for instance, examining if intrinsic motivation or psychological safety are parallel mediators, or if organizational tenure or resource availability moderate the strength of the effects. Another interesting direction would be to compare servant leadership with other leadership styles (like transformational or instructional leadership) in predicting teacher innovation, potentially through different pathways. Finally, qualitative research (such as interviews or case studies) could complement our quantitative findings by providing deeper insights into how teachers and leaders interact to produce innovative outcomes, and what specific behaviors or school norms encourage or stifle innovation. Addressing these areas in future research would not only test the robustness of our findings but also enrich the understanding of fostering innovation in educational settings.

6. Conclusion

In conclusion, this study sheds light on the psychological and contextual mechanisms through which servant leadership can spark innovative behavior among teachers in the physical education domain. By integrating socio-ecological systems theory, we developed and tested a comprehensive model that includes dual mediators (school climate for creativity and teacher creative self-efficacy) and a moderator (leader support for innovation). The findings provide strong evidence that servant leadership, characterized by its follower-centric and empowering approach, contributes significantly to teachers' innovative practices. It does so both by creating a supportive, creativity-friendly environment and by bolstering teachers' confidence in their own creative abilities. Moreover, when leaders actively support innovation, they amplify these positive effects, leading to an even greater impact on innovation. These results highlight the multifaceted role of leadership in educational innovation and underscore the importance of looking at both organizational context and individual psychology to fully understand how innovation can be encouraged.

Our study contributes to the literature by offering a nuanced view of how and why leadership matters for teacher innovation. We not only demonstrate that “leadership matters,” but we illustrate the pathways of influence and the conditions under which its impact is strongest. For scholars, the model validated here can serve as a foundation for further theoretical development on leadership and innovation in schools, and it

confirms that combining mediators and moderators yields richer insights than examining each in isolation. For practitioners and policy-makers, the message is clear: to foster innovation in schools (particularly in subjects like physical education that are ripe for creative revitalization), one must pay attention to leadership style, the climate that leaders cultivate, and the explicit support leaders give to creative endeavors. By nurturing servant leadership qualities and supportive behaviors in school leaders, educational institutions can cultivate an innovation-based culture, wherein teachers continuously seek better ways to engage students and improve learning outcomes. In an era where education must adapt to fast-changing societal needs, such an innovative culture is invaluable. We hope that this research inspires further efforts, both in study and practice, to harness the power of leadership in unleashing teachers' creativity for the betterment of education.

CRedit authorship contribution statement

Lili Liu: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Umer Zaman:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Data availability

Data will be made available on request.

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