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Modelling the determinants of innovative teaching practices among primary school teachers in Oman through a multi-group analysis using PLS-SEM

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Abstract

In this research, the factors influencing innovative teaching practices among primary school teachers in Oman were explored, with specific references to transformational leadership, school climate, teacher self-efficacy, and organizational learning, considering gender as a moderating variable. The study aims to fill a significant gap in the literature by addressing the issue of leadership, organizational, and individual factors influencing innovative behavior in teachers working in the context of Omani schools. The design used was quantitative and cross-sectional; the data were collected from 368 primary school teachers in Muscat using a structured questionnaire that was tested and validated based on expert reviews and reliability testing. The data analysis was performed using the Partial Least Squares Structural Equation Modelling (PLS-SEM) of SmartPLS 4 based on the existing analytical principles. The results reveal that transformational leadership is significantly and positively associated with innovative teaching ($\beta=0.128$), and teacher self-efficacy is strongly and positively associated with innovative teaching ($\beta=0.749$). In contrast, school climate and organizational learning did not show statistically significant direct associations. The multi-group analysis also demonstrates gender differences in the way people respond to the determinants of critical significance, which supports the necessity of differentiated approaches and inclusivity. This research adds to the paucity of existing empirical research on educational innovation in Oman by identifying teacher self-efficacy as the strongest individual-level correlate of innovative teaching alongside transformational leadership, and points out the significance of gender as a contextual moderator of the leadership-innovation and self-efficacy-innovation relationships. The results provide practical information to policymakers and school leaders who want to support innovative teaching from the angles of transformational leadership development, specific professional learning, and gender-sensitive approaches.

Keywords Innovative behavior, Transformational leadership, Self-efficacy, School climate, Organizational learning, Oman, Gender, Primary education



1 Introduction

Innovation and creativity have become synonymous with improvement and excellence in education and the institution. Innovation can be defined as educational environments where the introduction of new practices and techniques can improve the performance of the organization and the achievements of students; creativity means the development and efficient application of new ideas [1, 29, 46]. With increasing social, technological, and pedagogical change faced by the education systems, new teaching methods have become significant in providing students with the skills necessary to traverse an uncertain and dynamic future. Transformational leadership has long been associated with better organizational performance in any field, but its influence on the innovative behavior of teachers, especially in primary education, has not been well theorized and studied [20, 40]. Transformational leaders encourage and inspire people to go beyond what is expected of them, thus leading to improved performance and commitment [43]. In the context of schools, leadership style is particularly relevant to the improvement of teacher and student performance, especially in the primary level, where formative, cognitive, and social skills are acquired [7]. An innovative behavior of the teachers, associated with the production, use, and application of new pedagogical concepts, technologies, and teaching methods, has become a significant tool for mitigating the current educational challenges and improving the quality of education [4, 51, 53].

However, transformational leadership is not sufficient to explain the innovative practice of the teachers. Encouraged organizational climate, which consists of collaboration, psychological safety, and resource access, is a key factor in facilitating creativity and innovation in schools. The previously conducted studies show that a favorable school climate is likely to make teachers indulge in professional learning, instructional risk-taking, and experiment with new strategies, which reinforce innovative behavior [35, 55]. Besides, these climates increase the ability of transformational leadership to turn vision into an ongoing change in the organizations that work in educational institutions [18].

Besides leadership and organizational climate, self-efficacy in teachers, which is the belief that teachers can effectively perform their teaching-related tasks, is a strong predictor of innovative behavior. Educators who have high self-efficacy tend to embrace new instructional methods and incorporate new technology, as well as find effective ways to address challenges in the classroom [5, 24, 34]. Notably, empirical studies indicate that self-efficacy may operate as an important mechanism linking transformational leadership to innovation, because supportive leadership practices can enhance teacher confidence and perceived ability to innovate [26, 30]. This potential indirect pathway is theoretically important, but it lies outside the direct-effects framework tested in the present study, which instead evaluates the comparative predictive strength of four determinants simultaneously alongside gender-based multigroup differences in an Omani primary-school context that has not previously been examined in this way (see Sect. 2.6). Creative teaching is also supported through organizational learning; the schools with a focus on learning-oriented processes, including the constant development of professionals, collegial knowledge sharing, and organized access to instruction materials, provide the conditions in which teachers can specialize their skills and implement new methods [37, 50]. A robust organizational learning culture facilitates flexibility and constant improvement, which enables teachers to maintain innovation in the long term [11, 23, 42, 45, 57].

Despite the growing global evidence on these determinants, a notable gap exists in the Omani educational context. Oman's education system is undergoing significant modernization efforts; however, the mechanisms through which leadership, climate, and individual factors translate into innovative teaching practices remain insufficiently studied [3]. This gap is particularly important because Oman presents a unique sociocultural and institutional context, characterized by centralized curricula, traditional pedagogical norms, and an emerging emphasis on educational reform, that may distinctly shape how these determinants operate. Existing international studies may not fully account for these contextual specificities, which justifies the need for a context-sensitive empirical investigation. This study therefore addresses this gap by simultaneously examining transformational leadership, school climate, teacher self-efficacy, and organizational learning as predictors of innovative teaching behavior, and by introducing gender as a moderating variable to capture within-context variation. Moreover, the available literature indicates that gender could moderate the effect of these factors since male and female educators tend to vary in their vision of leadership practice, organizational climate, and self-efficacy beliefs, which eventually can determine their innovative behaviors [54].

2 Literature review and hypotheses development

2.1 Transformational leadership practices and teachers' innovative behavior

Transformational leadership has received much academic interest owing to its ability to produce desirable results on individual and organizational levels; transformational leaders challenge and encourage followers to express their full potential and go beyond personal and professional expectations [13]. This kind of leadership has been continuously related to increased innovativeness and self-efficacy in the behavior of teachers within the educational setting. The role of transformational leaders in influencing innovative practices by teachers has been supported by empirical evidence; for instance, Zainal and Matore [59,60] showed that teachers' self-efficacy, along with transformational practices of the school leaders, are significant predictors of innovative behavior of teachers, which explains almost half of the identified variance. On the same note [31] named certain transformational leadership behaviors, including communicating a common vision, questioning routine practices, and demonstrating new behaviors, as key facilitators of teacher change. Their results also suggest that transformational leadership has an indirect influence on innovative behavior in terms of increased teacher commitment, with the relationship being mediated by trust in the school leadership.

According to other researchers, not every transformational dimension has the same impact. For instance, Pangestu et al. [44] discovered that even though motivation and intellectual stimulation are relevant to innovation, their impacts are not as strong as those of other leadership practices. These studies confirm a strong relationship between transformational leadership and innovative behavior of teachers, but the mechanisms and dynamic context of these associations in the context of Omani primary schools are under-researched. Theoretically, transformational leadership is expected to directly stimulate teachers' innovative behavior by fostering intellectual stimulation and inspirational motivation, thereby creating conditions in which teachers feel encouraged to experiment with and adopt new pedagogical approaches. Therefore, this study proposes that:

Hypothesis 1 (H1) The transformational leadership practices of Omani school headmasters have a direct and significant positive association with teachers' innovative behavior.

2.2 School climate and teachers' innovative behavior

The organizational climate is also known to be a very important determinant of the context of innovativeness in educational institutions. An innovative climate promotes the psychological safety, improvisation, and creative self-efficacy of teachers [35, 55]. These settings help teachers to explore innovative teaching methods and change their practice according to the new challenges. The previous studies also indicate the importance of school climate in the process of organizational learning, which subsequently serves as a precursor to innovative work behavior. Dewantara et al. [18] and You et al. [56] believe that the activities within innovation-oriented settings trigger learning activities that foster creativity and constant enhancement. There are also complicated mediating and moderating factors that influence this relationship. As an illustration, Yutian et al. [58] discovered that psychological ownership is a complete mediator between the organizational innovation climate and innovative behavior, whereas task interdependence mediates between the two.

Research conducted in educational settings always confirms that a school climate that is conducive to innovations is needed to enhance the creative and adaptive teaching behaviors of the teachers. From a theoretical standpoint, a supportive school climate directly enables innovative teaching by reducing perceived risks associated with experimentation and by providing access to collaborative and material resources necessary for pedagogical change. Regardless of this accumulated literature, minimal empirical focus has been paid to the effect of school climate on the innovative behavior of teachers in Omani primary schools. Therefore, it is hypothesized that:

Hypothesis 2 (H2) The climate of Omani primary schools has a direct and significant positive association with teachers' innovative teaching practices.

2.3 Teachers' self-efficacy and innovative behavior

Self-efficacy among teachers is one of the psychological motivating factors of innovative work behavior (IWB). It is always observed that innovative self-efficacy of educators has a positive correlation with innovation practices, which means that the greater the beliefs in creative ability, the more the innovation [24, 34]. In addition to innovation, there is a connection between teacher self-efficacy and less work-related stress, increased motivation, and job satisfaction. The aspects of self-efficacy levels in instructional areas are influenced by elements like the development of cross-curricular skills and exposure to innovation-focused campus cultures [47]. Also, the self-innovativeness of teachers has been reported to have a great impact on their confidence and teaching efficacy in distance learning situations, especially in times of crisis, like the COVID-19 pandemic [22]. Such results highlight the relevance of professional development programs, which would foster innovation and enhance the adaptive ability of teachers. Grounded in [9] self-efficacy theory, teachers who hold strong beliefs in their instructional capabilities are more likely to take pedagogical risks, experiment with novel strategies, and persist in the face of classroom challenges, all of which are core components of innovative teaching behavior. Although the correlation between self-efficacy and innovative behavior has

been extensively recorded in the international context, little has been done to study this relationship in the Omani primary school environment; therefore:

Hypothesis 3 (H3) The self-efficacy of Omani primary school teachers has a direct and significant positive association with their innovative behavior.

2.4 Organizational learning and teachers' innovative teaching practices

Organizational learning is one of the enablers of innovative practices of teachers because it promotes the culture of professional development and flexibility. Schools that focus on the learning-related processes enable teachers to experiment with novel pedagogical strategies and apply them to the classroom environment [50]. The main aspects, like collaborative working, educational leadership, and professional resources, enable the development and application of new teaching methods [36]. Moreover, trust and psychological safety in educational institutions motivate educators to take creative risks, a prerequisite for sustained innovation [11]. Empirical research has shown that schools that have highly developed organizational learning systems are in a better position to embrace high-level teaching practices, hence improving the quality of teaching and student interaction [45]. Theoretically, organizational learning is expected to directly support innovative teaching by systematically building teachers' knowledge base, promoting reflective practice, and enabling the diffusion of innovative ideas across the school community. Though extensive studies have been done on the role of organizational learning in fostering teacher innovativeness in international settings, very little research has been done in the Omani schools; therefore:

Hypothesis 4 (H4) Organizational learning has a direct and significant positive association with teachers' innovative teaching practices.

2.5 The moderating role of teachers' gender

The existing body of literature also records that gender discrepancy in innovation-related behaviours and outputs has always been present and that gender has been used as a moderator variable in innovative work behavior (IWB). Research indicates that women have a higher risk of underestimating their competencies, are less engaged in innovation-related activities, and face more barriers to resource mobilization [8, 39]. The disparities in the learning styles, vocational education, and systems of higher education have also been demonstrated to benefit men in innovation-based positions [2, 6, 17, 19].

Such a difference is commonly supported by larger sociocultural environments, and how the individual learning activities will translate into inventive results; for instance, studies have shown that men are more likely to receive a positive advantage of such processes [41, 48]. The Gender of teachers in the educational setting has been observed to affect their reactions towards leadership practices, attitude towards school climate, self-efficacy, and organizational learning processes. Gender disparities in confidence, problem-solving techniques, and learning dispositions, also precondition the success of these variables in spurring innovation [5, 24]. This reasoning is grounded more formally in Social Role Theory [21], which holds that men and women, through differential socialization into gender roles, tend to develop distinct behavioral repertoires and expectations, with women more often socialized toward communal, relationally oriented behaviors

and men more often socialized toward agentic, task-oriented behaviors; because transformational leadership operates substantially through relational and individualized-consideration behaviors, Social Role Theory predicts that female teachers would be comparatively more responsive to it. Consistent with this reasoning, recent gender-based evidence from teaching contexts shows that male and female teachers report distinct instructional attitudes and challenges when adopting innovative pedagogical tools such as ICT, with female teachers more likely to value technology for relational, student-centered purposes and male teachers more likely to emphasize its practical efficiency [38]. Specifically, gender is theorized as a boundary condition that shapes the strength of the relationship between leadership and innovation: female teachers, who tend to be more responsive to relational and supportive leadership behaviors, may derive greater innovative motivation from transformational leadership than their male counterparts. Similarly, the translation of self-efficacy beliefs into innovative behavior may differ across genders given differential socialization, confidence norms, and access to professional resources [54]. Although gender differences in education have been widely documented, there is little information regarding the moderating role of gender on leadership, self-efficacy, and innovative behavior among Omani school teachers, therefore;

Hypothesis 5a (H5a) Teachers' gender moderates the relationship between transformational leadership and teachers' innovative behavior

Hypothesis 5b (H5b) Teachers' gender moderates the relationship between self-efficacy and teachers' innovative behavior

2.6 Conceptual framework

In this paper, a conceptual framework has been hypothesised to investigate the main predictors of innovative teaching practices among primary school teachers in Oman. The framework combines transformational leadership practices, school climate, teachers' self-efficacy, and organizational learning as the key areas of explanation, as well as teachers' gender as a moderating variable to highlight any potential differences in the ways these relationships can occur across groups. The theorized practices of transformational leadership, which are operationalized on the basis of intellectual stimulation, personalized consideration, inspirational motivation, and idealized influence, are expected to have direct impacts on the self-efficacy and innovative behavior of teachers [31, 44]. Simultaneously, a favorable school climate, including collaboration, psychological safety, and access to instructional resources, presents an enabling environment that helps experimentation and innovation in the teaching practice [35, 55].

Teacher self-efficacy, operationalized through skills related to classroom management, student engagement, and instructional delivery, is positioned in the framework as a direct predictor of innovative teaching behavior. Although the broader literature suggests that self-efficacy may serve as a mediating mechanism between leadership and innovation [26, 30], the present study does not formally test mediation pathways. Instead, the framework focuses on the direct effects of all four predictors on innovative teaching behavior, while gender is introduced as a moderator of the leadership–innovation and self-efficacy–innovation relationships. Organizational learning also helps to support such relationships by creating flexibility, exchange of knowledge, and constant

improvement within schools, which in turn reinforces the ability of teachers to adopt new teaching methods [11, 45].

Gender is assumed to moderate such relationships, which is the possible variation in the perceptions of leadership practices, experience of organizational conditions, and the transfer of self-efficacy to innovative behavior among male and female teachers [54]. Combining these constructs into a single framework, the research provides a broad method of identifying the motivators of innovative teaching practices in Omani primary schools. The conceptual framework of this study is presented in Fig. 1.

3 Methodology

3.1 Instrument

A quantitative, cross-sectional design using a structured questionnaire comprising 92 items, including three demographic questions, was used in this study; the tool was adapted from already tested measures with moderate modifications to ensure contextual and technological relevance, primarily consisting of linguistic adaptation for the Omani schooling context and updated wording of item stems referring to instructional technology; the underlying item content and factor structure of the original scales were retained wherever possible so that construct meaning was preserved. The scale created by De Jong and Den Hartog [16] was used to test the innovative behavior of teachers. The level of self-efficacy of teachers was measured using items adapted from Tschannen-Moran and Woolfolk Hoy [49] and Zainal and Matore and [60]. Transformational leadership practices of school leaders were measured using scales adapted from Bass [10] and Zainal and Matore [60]. Scales used to measure organizational learning included 25 items as developed by Watkins and Marsick [52]; school climate was measured with an 18-item School Climate Scale developed by Bradshaw et al., [12]. A five-point Likert scale reflecting respondents' levels of agreement was used to rate all the items in this study.

All scales were originally developed in English. Given that the study was conducted in Oman, the questionnaire was translated into Arabic using a forward-backward

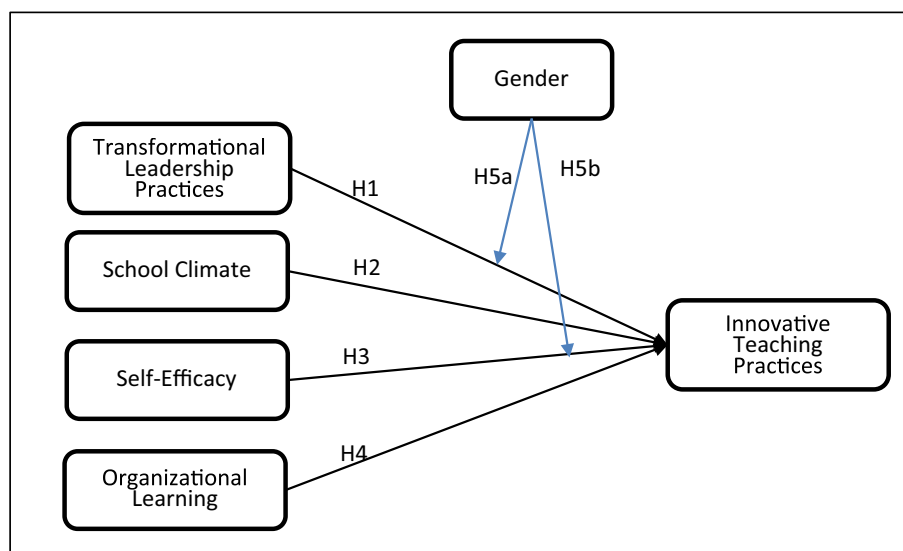


Fig. 1 Study conceptual framework

translation procedure to ensure linguistic and conceptual equivalence. Two bilingual experts independently translated the instrument into Arabic, and a third expert back translated it into English. Discrepancies were discussed and resolved through consensus. A pilot study involving 30 primary school teachers from outside the main sample was conducted to assess item clarity, readability, and preliminary reliability. Items that showed low clarity ratings or corrected item-total correlations below 0.30 were revised accordingly before full-scale data collection.

Expert review by five specialists in leadership and education was used to assess face validity; the review focused on item clarity and relevance, as well as to ensure alignment with operational definitions and construct clarity [15]. Measures of internal consistency reliability for all constructs were based on Cronbach's alpha.

3.2 Research context and participants

This research was done in primary schools located in Muscat with a total of around 7,303 teachers; 368 teachers were sampled from the list of schools in the area using a simple random sampling method of data collection. The sampling frame consisted of the official register of primary school teachers maintained by the Muscat Directorate of Education. Schools were first randomly selected from this register, and then teachers within the selected schools were randomly approached to participate. The overall response rate was approximately 85%, as questionnaires were distributed to 432 teachers and 368 complete responses were retained for analysis after excluding incomplete returns. The sample size was identified based on the suggested guidelines on Partial Least Squares Structural Equation Modelling (PLS-SEM) [25, 32]. To further confirm the adequacy of the sample, a minimum sample size calculation was performed using the 10-times rule recommended for PLS-SEM, which indicated that a sample of at least 100 was required based on the maximum number of paths directed at any single construct in the model. The obtained sample of 368 comfortably exceeds this threshold. Inclusion criteria required participants to be currently employed, full-time teachers in a Muscat public primary school; teachers in purely administrative roles, part-time or substitute teachers, and questionnaires with substantial missing data were excluded, which accounts for the difference between the 432 distributed and 368 retained responses. Because teachers were nested within schools, the possibility of school-level clustering (e.g., variation in leadership style, resources, or climate across schools) was considered; however, the present design and sample size did not support multilevel modelling, and school-level variance was therefore not partitioned separately from individual-level variance. This is acknowledged as a limitation of the sampling design (see Sect. 7), and future studies with larger, multi-stage samples should consider multilevel or hierarchical modelling to formally test for school-level effects. There was an equal gender representation in the sample (51.4% male and 48.6% female). In terms of qualification, 72.6% of the respondents had a bachelor's degree, 20.1% had a postgraduate degree, and 7.3% of the respondents had a diploma. With respect to teaching experience, 53.3% of them had 16 years or above, 26.1% had 11–15 years, 9.2% had 5–10 years, and 11.4% had less than five years of teaching experience (see Table 1). The questionnaire was sent to the randomly selected teachers to provide a robust empirical foundation for subsequent PLS-SEM analysis and interpretation of the proposed research model.

Table 1 Demographic profile of the respondents (N = 368)

Demographic variable	Category	Frequency (n)	Percentage (%)
Gender	Male	189	51.4
	Female	179	48.6
Academic qualification	Bachelor's degree	267	72.6
	Postgraduate (Master's / PhD)	74	20.1
	Diploma	27	7.3
Teaching experience	Less than 5 years	42	11.4
	5–10 years	34	9.2
	11–15 years	96	26.1
	16 years and above	196	53.3

3.3 Data analysis

The descriptive and multivariate statistical methods were used together to analyse the data and to test the hypothesised conceptual framework. SPSS (version 29) was used to create descriptive statistics to summarize (describe) demographic and affective characteristics of the respondents. PLS-SEM (SmartPLS 4.0), which is a variance-based method, was used to test the hypothesized relationships [25]. PLS-SEM was selected over covariance-based SEM (CB SEM) for several reasons. First, the study involves a predictive research objective aimed at explaining variance in innovative teaching behavior, which aligns with the strengths of PLS-SEM. Second, the model includes formative as well as reflective components, and PLS-SEM is better suited to handle such mixed measurement specifications. Third, PLS-SEM performs robustly with non-normal data distributions and does not impose strict distributional assumptions, making it appropriate for social science survey data [25]. Although the study is theory-driven and builds on well-established reflective constructs, CB-SEM was judged less suitable here because it requires large samples relative to model complexity and multivariate normality to yield unbiased parameter and standard-error estimates, assumptions that are difficult to guarantee with survey data of this size and that are not required under the variance-based, non-parametric bootstrapping approach used in PLS-SEM. The formative specification concerns the higher-order constructs of Transformational Leadership and Organizational Learning, each of which was modelled using a reflective-formative (Type II) specification: the lower-order dimensions (for Transformational Leadership, idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration; for Organizational Learning, dimensions such as continuous learning, empowerment, and strategic leadership per [52]) were each reflectively measured, while the higher-order construct itself was formed by these dimensions in a formative manner, following the two-stage approach for higher-order construct estimation recommended for PLS-SEM [25]. This mixed reflective-formative structure is a further reason CB-SEM, which handles formative specifications less flexibly, was not the preferred estimator for this model. As per the suggested analytical processes, the PLS-SEM analysis consisted of two phases [25]; the measurement model was first tested to determine construct reliability, convergent validity, and psychometric adequacy. After the verification of the measurement model, the structural model was further evaluated to determine the direct effects of transformational leadership, school climate, teacher self-efficacy, and organizational learning on innovative teaching behavior, as well as the moderating role of gender. Prior to the structural model assessment, common method bias (CMB) was examined using Harman's single factor test via SPSS, in which all items were loaded into

an exploratory factor analysis. The first unrotated factor accounted for less than 30% of the total variance, suggesting that common method bias is unlikely to be a serious threat in this study. Additionally, full collinearity VIF values for all constructs were examined and found to be below the threshold of 3.3, providing further assurance against CMB [33]. It is nonetheless acknowledged that Harman's single-factor test and full collinearity VIF are statistical remedies that provide only indirect and partial evidence against common method bias; neither can fully rule out common method variance, social desirability bias, or response bias, particularly because all constructs in this study were measured via self-report using a single questionnaire administered at one point in time. This limitation is revisited in Sect. 7. Such a step-by-step process guaranteed high-level validation of the measurement and structural components, which is a sound basis for model interpretation.

4 Results and findings

4.1 Assessment of the outer model

The measurement model was analyzed before the structural relationships to test the psychometric characteristics of the study constructs (see Fig. 2 for the outer model assessment). The model comprised five latent variables, namely: Transformational Leadership (TL), School Climate (SC), Teacher Self-Efficacy (TSE), Organizational Learning (OL), and Teachers' Innovative Behavior (TIB). The standardized indicator loading was used to evaluate convergent validity, and the recommended values of convergent validity include ≥ 0.60 loading and ≥ 0.50 AVE [25]. Construct reliability was assessed through Composite Reliability (CR), with a result of ≥ 0.70 showing good internal consistency [25]. The model fit was also assessed using the Standardized Root Mean Square Residual (SRMR), which yielded a value of 0.071, below the recommended threshold of 0.08 [27], indicating acceptable model fit.

4.2 Assessment of constructs' reliability and convergent validity

Construct validity (AVE) and convergent validity (CR) were high, as all the constructs had a value of over 0.50 and 0.70, respectively, which are within the required criteria of Hair et al. [25]. The alpha values were also above the 0.70 mark, which proved internal consistency. The dimensions of Organizational Learning, such as "Empowerment"

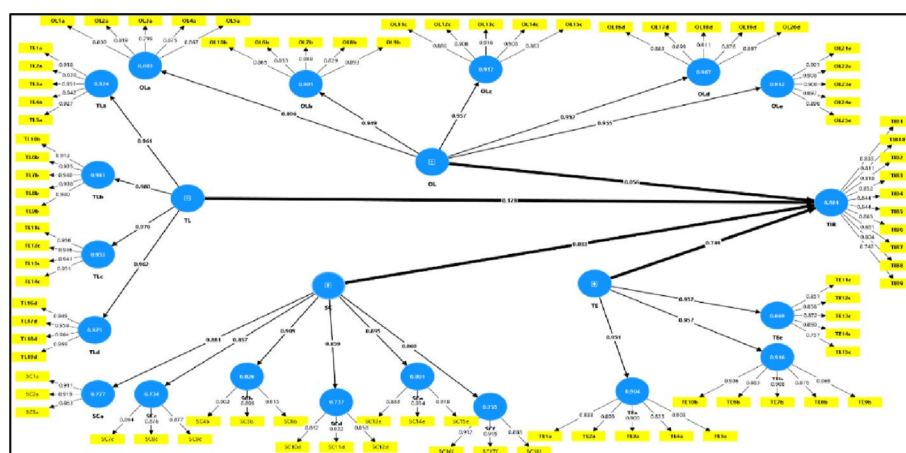


Fig. 2 Outer model assessment

Table 2 Construct reliability and convergent validity

Construct (lower-order dimension)	Composite reliability (CR)	Average variance extracted (AVE)
Organizational Learning (Empowerment)	0.943	0.813
Transformational Leadership (Individualized Consideration)	0.970	0.917
Recommended threshold	≥ 0.70	≥ 0.50

All reflective constructs met the recommended thresholds (Composite Reliability ≥ 0.70 ; AVE ≥ 0.50 ; Cronbach's $\alpha \geq 0.70$). The complete construct-level reliability, Cronbach's α , and convergent-validity statistics are to be inserted by the corresponding author from the SmartPLS 4 output

Table 3 Discriminant validity: heterotrait–monotrait (HTMT) ratios

Construct	TL	SC	TSE	OL	TIB
TL (Transformational Leadership)	–				
SC (School Climate)		–			
TSE (Teachers' Self-Efficacy)			–		
OL (Organizational Learning)				–	
TIB (Teachers' Innovative Behaviour)					–

All Heterotrait–Monotrait (HTMT) ratios were below the 0.85 threshold, confirming discriminant validity between all construct pairs. The full HTMT ratio values are to be inserted by the corresponding author from the SmartPLS 4 output

(CR = 0.943, AVE = 0.813), and Transformational Leadership, such as “Individualized Consideration” (CR = 0.970, AVE = 0.917), had high reliability and validity (see Table 2). A total of six items were deleted following the initial measurement model assessment because their factor loadings fell below the recommended threshold of 0.60. These items were removed iteratively, with the model re estimated after each deletion, to improve construct reliability and convergent validity. Because each deleted item was conceptually redundant with other retained indicators of the same underlying dimension, their removal is not considered to have altered the substantive meaning of the corresponding constructs, though it does narrow the specific facets captured within each measure. All retained factor loadings exceeded 0.60 after eliminating problematic items. These outcomes confirm the measurement model and provide a strong basis for the structural model analysis.

4.3 Assessment of discriminant validity: heterotrait-monotrait ratio (HTMT)

The Heterotrait–Monotrait (HTMT) ratio was used to estimate discriminant validity, which was essential to ensure the distinctiveness of the constructs under study. In accordance with Henseler et al., [27], all the values of HTMT were lower than the 0.85 threshold, which means that there were no problems with discriminant validity (see Table 3). The full HTMT matrix is presented in Table 3, showing pairwise HTMT values for all construct combinations. All values fell below 0.85, confirming that each construct is empirically distinct from the others and that discriminant validity is satisfactorily established. This is an attestation of the fact that constructs in the model are clearly distinct to support substantial structural relations.

4.4 Estimation of the hypothesized structural model

After the reliability and validity of the measurement model were confirmed, the hypothesized structural (inner) model was tested to study the postulated relationships between the study constructs (Fig. 3). SmartPLS 4 was used to analyze the data; bootstrapping

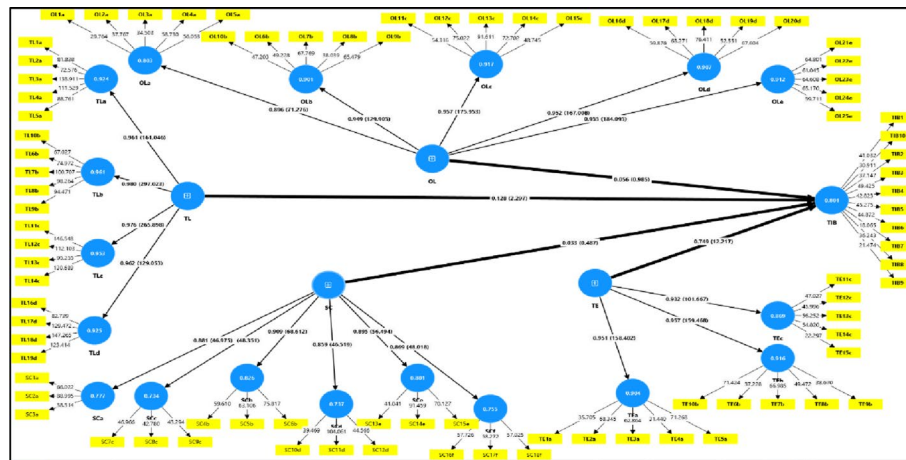


Fig. 3 Graphical representation of the inner model after the bootstrapping procedure

Table 4 Direct hypotheses of the study

Hypothesis	Structural path	β	t-value	p-value	95% CI	Decision
H1	TL $\rightarrow$ TIB	0.128	2.297	0.022	[0.018, 0.238]	Supported
H2	SC $\rightarrow$ TIB	0.033	0.487	0.626	[-0.101, 0.167]	Not supported
H3	TSE $\rightarrow$ TIB	0.749	12.217	< 0.001	[0.630, 0.868]	Supported
H4	OL $\rightarrow$ TIB	0.056	0.985	0.325	[-0.057, 0.169]	Not supported

analysis with 5,000 resamples was used to determine the statistical significance of path coefficients in line with the recommended guidelines of PLS-SEM [25]. A higher number of bootstrap resamples (5,000) was selected over the minimum recommended (1,000) to produce more stable and precise confidence interval estimates, as advised by Hair et al., [25]. Collinearity among the predictor constructs was assessed using Variance Inflation Factor (VIF) values; all VIF values were below 3.3, confirming the absence of multicollinearity concerns.

According to Table 4, the findings partially confirm the assumed correlations; Transformational Leadership (TL) was positively and significantly associated with Teachers' Innovative Behavior (TIB) ($\beta = 0.128$, $t = 2.297$, $p = 0.022$, 95% CI [0.018, 0.238]), which proved H1, indicates a significant but modest association between leadership and innovation. Teacher Self-Efficacy (TSE) was strongly and positively associated with TIB ($\beta = 0.749$, $t = 12.217$, $p < 0.001$, 95% CI [0.630, 0.868]), which is a good confirmation of H3 and supports the importance of self-efficacy as a motivation factor in the implementation of innovative teaching behavior. School Climate (SC), conversely, was not significantly associated with TIB directly ($\beta = 0.033$, $t = 0.487$, $p = 0.626$, 95% CI [-0.101, 0.167]), so H2 is rejected. Equally, Organizational Learning (OL) did not show any substantive relationship with TIB ($\beta = 0.056$, $t = 0.985$, $p = 0.325$, 95% CI [-0.057, 0.169], making H4 rejected. All path coefficient significance values are based on two-tailed bootstrap t tests with 5,000 resamples. These results indicate that although leadership and self-efficacy are significantly and directly associated with innovative behavior, the direct associations of school climate and organizational learning are not statistically significant. Any interpretation of school climate and organizational learning as "enablers" remains theoretical speculation rather than an empirical finding of this study, as their direct effects were non-significant.

4.5 Coefficient of determination and effect size

The coefficient of determination (R^2) of TIB was 0.640, implying that 64% of the variability of TIB is shared by Transformational Leadership, School Climate, Teacher Self-Efficacy, and Organizational Learning. According to Hair et al. [25], R^2 values of 0.25, 0.50, and 0.75 represent weak, moderate, and substantial levels of explanatory power respectively; the obtained R^2 of 0.640 therefore reflects a substantial level of predictive accuracy. This indicates a great explanatory capability of the structural model. The adjusted R^2 was 0.636, confirming that the explanatory power is not artificially inflated by the number of predictors. The level of effect on TIB was medium-to-large with Teacher Self-Efficacy ($f^2 = 0.221$, indicating a medium-to-large effect). There was also a significant contribution ($f^2 = 0.123$) in Transformational Leadership, representing a medium effect size. Conversely, School Climate ($f^2 = 0.005$) and Organizational Learning ($f^2 = 0.001$) showed negligible effect sizes, which confirms their minor effect on innovative behavior in direct relation. Effect size interpretation follows [14] conventions: $f^2 = 0.02$ indicates a small effect, $f^2 = 0.15$ a medium effect, and $f^2 = 0.35$ a large effect. (see Table 5). The predictive relevance of the model was assessed using the Stone-Geisser Q^2 statistic via blindfolding procedures in SmartPLS 4. The Q^2 value for TIB was 0.398, which is above zero, confirming that the model has satisfactory predictive relevance for the endogenous construct [25].

4.6 Multigroup analysis (MGA) across gender groups

Since the moderator was categorical, multigroup analysis (MGA) was used to measure the differences among genders in the structural relationships [25]. Prior to conducting MGA, measurement invariance was established through the MICOM (Measurement Invariance of Composite Models) procedure recommended by Henseler et al. [28]. Step 1 confirmed configural invariance by demonstrating that the same model configuration was estimated for both the male and female subgroups. Step 2 assessed compositional invariance through permutation tests; all construct correlations between the full-sample and group-specific composites were above 0.90 and statistically non-significant in their differences, confirming compositional invariance. Step 3 assessed the equality of means and variances across groups; partial invariance was established, which is sufficient to proceed with MGA comparisons while acknowledging that mean-level comparisons should be interpreted with caution. The MGA was conducted using Henseler's MGA approach, which is a non-parametric test comparing path coefficient differences across groups via permutation testing with 5,000 resamples.

This method allowed the comparison of path coefficients between male and female teacher sub-samples (Table 6). In the case of the relationship between Transformational Leadership and Teachers' Innovative Behavior (H5a), the MGA showed statistically significant differences between the groups. The impact was also more on female teachers ($\beta = 0.276$, $p < 0.001$) compared to male teachers ($\beta = 0.191$, $p = 0.046$), and the path

Table 5 Coefficient of determination (R^2) and Effect's size (F^2)

Hypo	Structural Path	F^2	R^2
H1	Transformational Leadership $\rightarrow$ TIB	0.123	0.640
H2	School Climate $\rightarrow$ TIB	0.005	
H3	Teachers' self-efficacy $\rightarrow$ TIB	0.221	
H4	Organizational learning $\rightarrow$ TIB	0.001	

Table 6 Multigroup analysis (MGA) across gender groups

Hyp	Path	Female Path Coefficient	Female <i>p</i> -value	Male Path Coefficient	Male <i>p</i> -value	Path Difference	<i>p</i> (Difference)	Invariance
H5a	TL → TIB	0.276	0.000	0.191	0.046	-0.085	0.046	No
H5b	TSE → TIB	0.541	0.000	0.653	0.000	0.112	0.221	Yes

coefficient difference was -0.085 ($p = 0.046$), indicating a statistically significant gender difference at the 0.05 level. However, while statistically significant, the practical magnitude of this difference (0.085) is relatively modest, and this finding should be interpreted with appropriate caution. These findings show gender as a moderating factor of the effect of transformational leadership on innovative behavior, which is in support of H5a. Conversely, Teacher Self-Efficacy and Innovative Behavior did not show any significant gender difference in the relationship (H5b). Strong and consistent effects were also observed between the male ($\beta = 0.653$, $p < 0.001$) and female teachers ($\beta = 0.541$, $p < 0.001$), with a path coefficient difference of 0.112 ($p = 0.221$), which is not statistically significant, confirming invariance and indicating the absence of a moderating effect (Table 6).

5 Discussion

This paper explored the relationships that define innovative instructional practices among primary school educators in Oman; the predictor variables comprised transformational leadership, school climate, self-efficacy of teachers, and organizational learning, and gender was used as a moderating factor. Using sophisticated analytical methods (PLS-SEM and MGA), the research provides a delicate insight regarding the interaction of leadership, organizational factors, and individual aspects towards innovation in learning institutions. The results indicate a significant positive association between transformational leadership and the development of innovative practices in teaching (H1), in agreement with the existing literature [13, 44]. The effect size ($\beta = 0.128$, $f^2 = 0.123$) suggests a significant but modest direct contribution.

Transformational leaders encourage innovation through the articulation of a powerful vision, breaking old habits, and supporting imaginative problem-solving. The Omani context, whereby traditional pedagogical practices are still very common, makes such leadership especially relevant in the context of instructional modernization. Transformational Omani school leaders can foster an environment that promotes risk-taking and experimentation, which supports risk-taking and experimentation by building trust, collaboration, and psychological safety, as well as ensuring the significance of leadership development programs that address these competencies.

The self-efficacy of teachers turned out to be the most significant predictor of innovative teaching practices (H3) and supports the central role of self-efficacy in the field of educational innovation [24, 34]. In line with the self-efficacy theory by Bandura, teachers who strongly believe in their abilities tend to explore new methods of instruction, implement new strategies, and continue to overcome the obstacles in the pedagogical practice. In the Omani education system, empowering self-efficacy is of particular importance, with confident teachers being in a better position to manage the structural constraints, i.e., strict curricula and scarce resources. Professional development programs that focus

on skill building, mentoring, and learning with colleagues can hence be significant in the attainment of innovation.

However, to the contrary, school climate (H2) and organizational learning (H4) did not show any statistically significant direct associations with innovative teaching practices. These non-significant findings are noteworthy and merit careful interpretation. Unlike findings reported in some international studies [35, 55], the absence of direct effects in the Omani context may reflect the centralized and structured nature of the Omani school system, where curriculum and pedagogical decisions are largely prescribed at the national level. It should be stressed that centralization, systemic constraint, and cultural characteristics were not directly measured in this study; this explanation is therefore offered as a plausible post-hoc interpretation grounded in the broader literature on the Omani education system [3], not as an empirically demonstrated mechanism, and it should be tested directly in future research using measures of centralization or curricular autonomy. In such a context, even a supportive school climate or strong organizational learning culture may not be sufficient on their own to directly produce innovative teaching behavior, as teachers may feel constrained by systemic and regulatory boundaries. It is important to emphasize that, because the direct effects were not statistically significant, any interpretation of school climate and organizational learning as “enabling conditions” or indirect drivers remains theoretical speculation that was not empirically demonstrated in this study. Future research should investigate these potential indirect mechanisms more explicitly. These findings demonstrate that the mediating factors, like collaborative culture and psychological safety, require further study.

The analysis was supported by Multigroup, which showed significant gender differences in the connection between transformational leadership and innovation in instructional practices (H5a), and that the association was stronger in the case of the female teachers. This finding is consistent with Social Role Theory ([21]) and with evidence suggesting that female educators may be more attuned to the relational and individualized dimensions of transformational leadership, such as personalized consideration and collaborative vision-building, which resonate more directly with motivational patterns associated with feminine socialization [54]. However, the magnitude of the difference (coefficient difference of -0.085) is relatively modest; therefore, while the moderation effect is statistically significant, its practical importance should not be overstated. In the Omani cultural context, where gender roles and professional socialization may differ significantly between male and female teachers, such differential responsiveness to leadership styles is theoretically plausible and practically significant. Contrary to this, there was no gender difference in the correlation between self-efficacy and innovative behavior (H5b), suggesting that the motivational mechanism of self-efficacy operates universally across genders in this context, irrespective of gender-based differences in confidence or resource access. This may reflect the relatively equal professional development opportunities available to both male and female teachers within the Omani primary school system. Collectively, these results indicate that gender-sensitive leadership approaches that consider the differences in reaction to leadership activities are required.

In general, the findings are consistent with the world of educational research and provide context-specific information about the Omani education system. The significant associations of transformational leadership and self-efficacy with innovative teaching reflect universal organizational principles, and the limited direct association of school

climate and organizational learning reflects the contextual, cultural, and systemic factors. Since Oman is still in the process of educational modernization, these results highlight the need to implement specific changes that will empower school leadership, enhance the abilities of teachers, and create supportive organizational environments.

6 Implications

6.1 Theoretical implications

This paper is relevant to the current body of knowledge regarding educational innovation because it highlights the self-efficacy of teachers as the strongest individual-level correlate of innovative behavior, alongside transformational leadership, in this context. The results are relevant to the current theories, suggesting a plausible, though untested, indirect pathway through which leadership practice may be associated with innovation via the confidence and abilities of teachers through pathways that should be further investigated using formal mediation analysis, which the present direct-effects design did not test. Moreover, the findings indicate that school climate and organizational learning are possibly enabling factors and not direct predictors, as the indirect routes and mediating processes need to be investigated in future studies. The incorporation of gender as a moderating variable also contributes to the theoretical understanding, as it shows a statistically significant, though modest, difference in the impacts of leadership among male and female teachers.

6.2 Practical implications

Practically, the results highlight the need to arm school principals with transformational leadership skills. The skills that are to be prioritized by the leadership development programs should be associated with vision-building, trust development, collaboration, and individualized support. Gender sensitivity of such programs could be a useful implementation since it could capture a different motivational factor between male and female teachers.

Another important priority is the self-efficacy of teachers; school leaders and policy-makers should also invest in professional development programs which encourage mentorship, collaborative learning, as well as experience training to enhance the confidence and readiness of teachers to innovate. Even though the school climate and organizational learning did not demonstrate any direct impact, they are still critical elements of an innovation-supportive ecosystem, though their role was not empirically confirmed as direct drivers in this study. Leadership and self-efficacy effects can be enhanced through efforts to create a psychological safety, collaboration, and access to learning resources to support sustained innovation.

7 Limitations and future research

Some constraints should be taken into consideration:

(i) The primary school teachers in Muscat are the subject of the research, and this restricts the generalizability of the results to the rest of the regions and levels of education in Oman; future research should use more generalized and wider samples. (ii) The cross-sectional design limits causal inference; hence, longitudinal research is advisable to represent the dynamic nature of the relationship between leadership, self-efficacy, and innovative behavior over time. Consequently, all relationships reported in this study

are statistical associations rather than confirmed causal effects, and the directionality implied by the hypothesized paths (e.g., leadership predicting innovation) reflects a theoretical assumption rather than an empirically established causal order; reverse or reciprocal relationships (e.g., more innovative teachers being perceived as more self-efficacious) cannot be ruled out with the present design. (iii) Although gender was factored into the analysis, further moderation testing studies should be developed to determine gender influence on more pathways. (iv) Although common method bias was assessed and found to be minimal, these statistical checks (Harman's test, full collinearity VIF) offer only indirect, partial reassurance and cannot substitute for procedural remedies; the cross-sectional self-report design remains a limitation. Future studies should consider collecting data from multiple sources, such as peer or principal ratings of teachers' innovative behavior, to further mitigate this concern. (v) The study did not formally test mediation pathways. Future research should investigate whether teacher self-efficacy mediates the relationship between transformational leadership and innovative behavior, and whether school climate or organizational learning operate through indirect mechanisms.

8 Recommendations

In light of the findings, various recommendations can be considered as follows:

- i) Educational administrators ought to introduce focused leadership training programs that focus on transformational leadership habits that encourage innovation.
- ii) Mentoring, peer collaboration, and opportunities for unceasing professional development should be considered as the activities that would empower the self-efficacy of teachers.
- iii) Schools are also encouraged to put in place systematic feedback systems that enable teachers and other stakeholders to provide feedback on the continuous enhancement of the leadership and innovation strategies.
- iv) There is a necessity that gender-sensitive policies should be made so that there is equitable access to the resources and professional development that suits both male and female teachers.

9 Conclusion

This research brings to the fore the key functions of transformational leadership and self-efficacy among teachers in enhancing innovative teaching practices among primary school teachers in Oman. Although the direct effects of school climate and organizational learning were not much, their potential as enabling conditions is worth future research. Policymakers and practitioners can encourage meaningful educational innovation by embracing an integrative approach that is context-sensitive, which builds and enhances leadership capacity, boosts teacher self-efficacy, and facilitates collaborative organizational learning settings. This effort is essential in both enhancing the quality of teaching and performance of students, and in ensuring that Oman education system is well placed to handle the challenges of the future.

Author contributions

authorship contribution statement Said Alshuhumi: Writing - original draft, Conceptualization. Dawood Al-Hidabi: Supervision, Writing review and editing, Investigation. Ali Ateeq: Methodology, Validation. Investigation. Siddig Ibrahim: Writing review and editing, Visualization, Resources, Software. Abdulmajid Aldaba: Conceptualization, Formal analysis,

Validation. Data curation, Visualization. Abd Al-Aziz Al-refaei: Writing - original draft, Data curation, Software. Project administration.

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Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The protocol of this study was reviewed and approved by the research ethics committee in Gulf University (Approval references No: GU-PR17CR-FO6). All research activities were carried out in alignment with internationally recognized ethical principles, including the Declaration of Helsinki and the institutional guidelines for research involving human participants. Informed consent was obtained from all participating teachers, and participation was entirely voluntary, and respondents were informed of their right to withdraw at any time without any consequences.

Consent for publication

Consent to publish is not applicable, as the manuscript does not contain any individually identifiable information.

Declaration of the use of AI

AI tools were used in a limited manner for minor language editing and proofreading only. The authors are fully responsible for the content of the manuscript.

Competing interests

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References

1. Abdulsamad A, Ateeq A, Al-Zubaidi R, Al-refaei AAA, Ali ANA, Fahad NM. Entrepreneurial Orientation and Innovation Capabilities as Drivers of Sustainable Innovation Performance: A Conceptual Framework for SMEs. *Tech Fusion Bus Soc*. 2021. 845–58.
2. Aguinis H, Ji HY, Joo H. Gender productivity gap among star performers in STEM and other scientific fields. *J Appl Psychol*. 2018;103(12):1283–306. <https://doi.org/10.1037/apl0000358>.
3. Al-Abdali NS, Al-Balushi SM. Teaching for creativity by science teachers in grades 5–10. *Int J Sci Math Educ*. 2016;14(Suppl 2):251–68. <https://doi.org/10.1007/s10763-014-9612-3>.
4. Al-refaei AAA, Abdulsamad A, Ali DA, Ibrahim A, Ateeq A, Balushi A, F. K. A conceptual framework for the impact of entrepreneurial leadership on innovation work behavior and sustainable innovation performance. *Entrepreneurship Innovation and Education for Performance Improvement*. IGI Global Scientific Publishing; 2024. pp. 577–98.
5. Alshuhumi S, Al-Hidabi D, Aldaba A, Ateeq A, Almuraqab N, Ibrahim S, Al-refaei AAA. Examining the impact of Omani primary school climate and teacher self-efficacy on innovative teaching practices: A structural equation modeling approach. *Front Educ*. 2025;10:1487857. <https://doi.org/10.3389/educ.2025.1487857>.
6. Alumran JIA. Learning styles in relation to gender, field of study, and academic achievement for Bahraini university students. *Individual Differences Res*. 2008;6(4):303–16.
7. Alzoraiki M, Rahman OB, Mutalib MA. (2018). The effect of the dimensions of transformational leadership on the teachers' performance in the Yemeni public schools. *Eur Sci J*, 14(4).
8. Atatsi et al. [Complete reference details to be supplied by the corresponding author from the reference library.]. 2020.
9. Bandura A. *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall; 1986.
10. Bass BM. *Leadership and performance beyond expectations*. Free; 1985.
11. Bellibas MS, Gümüş S, Chen J. The impact of distributed leadership on teacher commitment: The mediation role of teacher workload stress and teacher well-being. *Br Edu Res J*. 2024;50(2):814–36. <https://doi.org/10.1002/berj.3944>.
12. Bradshaw CP, Waasdorp TE, Debnam KJ, Johnson SL. Measuring school climate in high schools: A focus on safety, engagement, and the environment. *J Sch Health*. 2014;84(9):593–604. <https://doi.org/10.1111/josh.12186>.
13. Çimen İ, Belenkuyu C, Aksu M. Linking school principals' transformational leadership practices and teachers' innovative work behaviors in a centralized educational system. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*. 2023;23(4):2057–80. <https://doi.org/10.17240/aibuefd.2023-1334229>.
14. Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Lawrence Erlbaum Associates; 1988.
15. Creswell JW, Creswell JD. *Research design: Qualitative, quantitative and mixed methods approaches*. Sage; 2023.
16. De Jong J, Den Hartog D. Innovative work behavior: Measurement and validation. *EIM Bus Policy Res*. 2008;8:1–27.
17. Demirbas OO, Demirkan H. Learning styles of design students and the relationship of academic performance and gender in design education. *Learn Instruction*. 2007;17(3):345–57. <https://doi.org/10.1016/j.learninstruc.2007.02.007>.
18. Dewantara D, Asmony T, Nurmayanti S. The effect of organizational climate on innovative work behaviour with organizational learning behaviour as an intervening variable in employees of the West Nusa Tenggara Provincial Industry Office. *Int J Multicultural Multireligious Underst*. 2022;10(5). <https://doi.org/10.18415/ijmmu.v10i5.4732>.
19. Drew TL, Work GG. Gender-based differences in perception of experiences in higher education. *J Higher Educ*. 1998;69(5):542–55. <https://doi.org/10.2307/2649119>.

20. Dvir T, Eden D, Avolio BJ, Shamir B. Impact of transformational leadership on follower development and performance: A field experiment. *Acad Manag J*. 2002;45(4):735–44. <https://doi.org/10.2307/3069307>.
21. Eagly AH. Sex differences in social behavior: A social-role interpretation. Lawrence Erlbaum Associates; 1987.
22. Frank V, Nudque J. Instructional behavior, innovative teaching practices, work engagement, and self-efficacy of physical education teachers. *Int J Multidisciplinary Res Anal*. 2022. <https://doi.org/10.47191/ijmra/v5-i11-02>.
23. Ghumiem SH, Alawi NA, Abd A-A, A. R., Masaud KA. Corporate culture and its effects on organizational performance: Multi-group analysis evidence from developing countries. *Eur J Bus Manage Res*. 2023;8(2):142–8.
24. Gkontelos A, Vaiopoulou J, Stamovlasis D. Teachers' innovative work behavior as a function of self-efficacy, burnout, and irrational beliefs: A structural equation model. *Eur J Invest Health Psychol Educ*. 2023;13(2):403–18. <https://doi.org/10.3390/ejihpe13020030>.
25. Hair JF, Hult GTM, Ringle CM, Sarstedt M. A primer on partial least squares structural equation modeling (PLS-SEM). 3rd ed. Sage; 2022. <https://doi.org/10.1007/978-3-030-80519-7>.
26. Hakasa L, Metrovadi M, Novitawati N. The influence of principal transformational leadership, work culture on job satisfaction through self-efficacy of state elementary school teachers. *Int J Social Sci Hum Res*. 2023.
27. Henseler J, Ringle CM, Sarstedt M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J Acad Mark Sci*. 2015;43(1):115–35. <https://doi.org/10.1007/s11747-014-0403-8>.
28. Henseler J, Ringle CM, Sarstedt M. Testing measurement invariance of composites using partial least squares. *Int Mark Rev*. 2016;33(3):405–31. <https://doi.org/10.1108/IMR-09-2014-0304>.
29. Ibrahim A, Al-refaei AAA, Alshuhumi S, Al-Hidabi D, Ateeq A. The effect of entrepreneurial leadership on employee's creativity and sustainable innovation performance in education sector: A literature review. *Bus Dev via AI Digitalization: Volume*. 2024;2:143–54.
30. Ke W, Huang J. Relationship between Chinese college students' perceived transformational leadership by physical education teachers and their exercise adherence: The mediating role of physical self-efficacy. *Educational Res Reviews*. 2023;18(7):173–80. <https://doi.org/10.5897/ERR2023.4336>.
31. Kiliç AÇ, Polatcan M, Savaş G, Er E. How transformational leadership influences teachers' commitment and innovative practices: Understanding the moderating role of trust in principal. *Educational Manage Adm Leadersh*. 2024;52(2):455–74. <https://doi.org/10.1177/17411432221082803>.
32. Kline RB. Principles and practice of structural equation modeling. 5th ed. Guilford Press; 2023.
33. Kock N. Common method bias in PLS-SEM: A full collinearity assessment approach. *Int J e-Collaboration*. 2015;11(4):1–10. <https://doi.org/10.4018/ijec.2015100101>.
34. Kundu A, Roy DD. How do teachers innovate? Role of efficacy for innovation and school climate perception. *Psychol Sch*. 2023;60(12):4885–903. <https://doi.org/10.1002/pits.22987>.
35. Lecic MS, Milic B, Visnjic R, Culibrk J. Leadership, innovative behavior and the case of innovative climate — When the mediator becomes the mediated. *Behav Sci*. 2023;13(1):40. <https://doi.org/10.3390/bs13010040>.
36. Lin. [Complete reference details to be supplied by the corresponding author from the reference library. 2022.
37. Lip TK, Abd Wahab S, Yusoff T, Sohail N, Muthaya K, Abdulsamad A, Al-refaei AA A. Entrepreneurial knowledge and sustainable SMEs performance: The mediation role of strategic opportunity recognition. *Adv Social Sci Res J*. 2025;12(04):24–42.
38. Mahmood A, Huang X, Rehman N. Gender-based analysis of attitudes and challenges in ICT use for English teaching. *Qual Educ All*. 2025;2(1):460–88. <https://doi.org/10.1108/QEA-12-2024-0156>.
39. Meslec N, Aggarwal I. Learning not to underestimate: Understanding the dynamics of women's underestimation in groups. *Team Perform Manage*. 2018;24(7/8):380–95. <https://doi.org/10.1108/TPM-05-2018-0026>.
40. Mojdegan S, Rahiman H, Abbaspour A, Ahghar G, Taskouh AK. (2018). Design and validation of the transformational leadership model for elementary school principals.
41. Morley L, Leach F, Lugg R. Democratising higher education in Ghana and Tanzania: Opportunity structures and social inequalities. *Int J Educational Dev*. 2009;29(1):56–64. <https://doi.org/10.1016/j.ijedudev.2008.05.001>.
42. Muaydh AMA, Alawi NAM, Al-Refaei AAA, Al Balushi FK. The mediating role of innovation in the impact of TQM practices on corporate performance in the construction industry in Saudi Arabia. *Am J Econ Bus Innov*. 2024;3(3):155–62.
43. Nguyen TTN, Luu TMN. Linking transformational leadership and organizational performance: An empirical investigation of manufacturing firms in Vietnam. *Econ Sociol*. 2019;12(2):170–91. <https://doi.org/10.14254/2071-789X.2019/12-2/10>.
44. Pangestu DA, Putri Islami SA, Maylinda P. Transformational leadership and proactive personality on innovative behavior among high school teachers in Cirebon City. *J Res Social Sci Econ Manage*. 2024;3(9):1743–53. <https://doi.org/10.59141/jrs sem.v3i9.640>.
45. Schechter C, Qadach M, Da'as R. Organizational learning mechanisms for learning schools. *Learn Organ*. 2021;29(2):85–99.
46. Scott SG, Bruce RA. Determinants of innovative behavior: A path model of individual innovation in the workplace. *Acad Manag J*. 1994;37(3):580–607. <https://doi.org/10.2307/256701>.
47. Sodergren CD, Kettler T, Sulak T, Payne A. Teacher self-efficacy, innovativeness, and preparation to teach cross-curriculum skills. *Int J Contemp Educational Res*. 2023;10(1):197–209. <https://doi.org/10.33200/ijcer.1104747>.
48. Teferri D, Altbach PG. African higher education: Challenges for the 21st century. *High Educ*. 2004;47(1):21–50. <https://doi.org/10.1023/B:HIGH.0000009822.49980.30>.
49. Tschannen-Moran M, Woolfolk Hoy A. Teacher efficacy: Capturing an elusive construct. *Teach Teacher Educ*. 2001;17:783–805. [https://doi.org/10.1016/S0742-051X\(01\)00036-1](https://doi.org/10.1016/S0742-051X(01)00036-1).
50. Tura B, Akbasli S. Factors affecting innovative work behaviors of teachers from the perspective of organizational intelligence. *J Qualitative Res Educ*. 2022;29:203–34. <https://doi.org/10.14689/enad.29.8>.
51. Wahyuningtias AH, Nugroho SH. The influence of transformational leadership and person-organizational fit on innovative work behavior through knowledge sharing behavior in formal education units. *Pamator*. 2023;16(1):189–206. <https://doi.org/10.21107/pamator.v16i1.19024>.
52. Watkins KE, Marsick VJ. Sculpting the learning organization: Lessons in the art and science of systemic change. Jossey-Bass; 1993.
53. Widodo W, Aryan R, Gustari I. Innovative behavior: Antecedence and consequences in private higher education. *Journal of Xi'an University of Architecture & Technology*. 2020.
54. Xia et al. [Complete reference details to be supplied by the corresponding author from the reference library.]. 2022.

55. Xiaofeng S, Xiaoli J, Wenhe L, Anxin X, Qiujin Z. Organizational innovative climate and employees' improvisational behavior: The mediating role of psychological safety and the moderating role of creative self-efficacy. *SAGE Open*. 2022. <https://doi.org/10.1177/21582440221132526>.
56. You et al. [Complete reference details to be supplied by the corresponding author from the reference library]. 2022.
57. Yusoff T, Abdulsamad A, Muthaya K, Seraj AHA, Al-refaei AAA, Sohail N. SMEs sustainable growth model: The role of entrepreneurial intention, organizational culture, and networking capabilities. *Integrating Big Data and IoT for Enhanced Decision-Making Systems in Business: Volume 2*. Springer Nature Switzerland; 2025. pp. 239–50.
58. Yutian Y, Zhong H, Jiawei L, Youhan W, Ming X. The effect of organizational innovation climate on employee innovative behavior: The role of psychological ownership and task interdependence. *Front Psychol*. 2022. <https://doi.org/10.3389/fpsyg.2022.856407>.
59. Zainal MA, Matore MEEM. Factors influencing teachers' innovative behavior: A systematic review. *Creative Educ*. 2019;10(12):2869.
60. Zainal MA, Matore MEEM. The influence of teachers' self-efficacy and school leaders' transformational leadership practices on teachers' innovative. *Int J Environ Res Public Health*. 2021;18(12):6423. <https://doi.org/10.3390/ijerph18126423>.

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