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Exploring the factors influencing innovative teaching practices in Moroccan primary schools: an exploratory study

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ABSTRACT

In education, pedagogical innovation is crucial for improving student learning outcomes, but teachers' adoption of innovative practices is influenced by various sociodemographic factors, which remain underexplored. This study aims to investigate how factors such as age, gender, education level, and prior training shape teachers' engagement with innovative teaching methods. A quantitative analysis of 110 teachers from multiple schools was conducted, utilizing multiple correspondence analysis (MCA) to identify distinct teacher profiles based on their innovation practices. The findings revealed four key profiles: non-innovative teachers, who rely on traditional methods; active teachers, who adopt active learning strategies; untrained teachers, who work without formal training; and innovative teachers, who integrate information and communication technologies (ICT) and blended learning techniques. The study concludes that sociodemographic factors significantly impact the adoption of pedagogical innovation. To address this, targeted professional development and tailored policies are needed to support teachers in overcoming barriers and adopting innovative practices. By promoting a more inclusive and adaptive approach to teacher training, this research offers valuable insights to improve teaching effectiveness and ultimately enhance student engagement and learning outcomes.

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1. INTRODUCTION

In the dynamic realm of education, pedagogical innovation stands as a pivotal catalyst for enhancing learning outcomes [1], [2]. At the heart of this transformation lie teachers, continuously refining their instructional approaches to foster meaningful student engagement and learning [3]–[5]. The influence of sociodemographic factors on teachers' pedagogical innovation emerges as an increasingly pertinent and intriguing area of inquiry within the educational domain [6], [7]. To delve into this multifaceted dynamic, our study employs a quantitative methodology, integrating techniques to explore the intricate interplay between sociodemographic variables and teachers' innovative practices [8]–[10].

Moreover, the pedagogical innovation exhibited by teachers epitomizes a dynamic facet of their educational endeavors, characterized by a perpetual readiness to assimilate and implement novel techniques, technologies, and instructional strategies within their classroom milieu [11]. This adaptive capacity assumes paramount significance within the constantly evolving educational sphere. Wherein educators assume a pivotal role in equipping learners with the requisite skills and insights to navigate the complexities and prospects of modern society [12].

The realm of pedagogical innovation transcends mere technological integration within the classroom. It encompasses a spectrum of endeavors, ranging from pioneering curriculum design to the seamless integration of digital resources [13], [14]. Innovative educators undertake a holistic reevaluation of their teaching methodologies, striving to deepen students' comprehension of subjects, engender active participation, and cultivate the cultivation of critical 21st-century competencies [15], [16].

Viewed through this lens, the design of inventive curricula emerges as a fundamental aspect of pedagogical innovation. Educators endeavor to craft educational frameworks that transcend mere content delivery, aiming to instigate curiosity, foster exploration, and inspire creativity among students. This endeavor often entails the integration of diverse pedagogical approaches, including project-based learning, experiential learning, and the utilization of digital educational tools and resources [17].

Innovative educators engage in continual introspection regarding their teaching methodologies, constantly striving to tailor their approaches to accommodate diverse learning styles among students. Embracing the concept of differentiated instruction, they adeptly customize their teaching to suit individual learner needs, while also fostering collaborative learning environments that promote peer interaction and knowledge sharing. Furthermore, these educators judiciously harness the power of emerging technologies, integrating them seamlessly into their instructional practices to amplify educational efficacy and engagement [18].

Simultaneously, pedagogical innovation extends to the assessment strategies employed by educators. Moving beyond conventional evaluation methods, forward-thinking teachers are delving into dynamic and authentic approaches to gauge student comprehension [2], [19], [20]. Prioritizing formative assessments, hands-on projects, and methodologies that foster profound reflection over rote memorization, these educators endeavor to cultivate a deeper understanding and application of knowledge among their students [21], [22].

Indeed, the integration of digital tools stands as a pivotal component of pedagogical innovation [23]. Educators harness educational technologies to enhance learning journeys, broaden access to diverse resources, and equip students with the digital competencies essential for thriving in an ever-evolving digital landscape [11], [24]. In essence, teacher pedagogical innovation embodies a comprehensive ethos, reshaping educational paradigms to align with contemporary exigencies while nurturing students' intrinsic drive for lifelong learning [25]–[27].

With this perspective in mind, 21st-century education is tasked with navigating towards the correct trajectory, at an appropriate pace, to effectively address the diverse challenges and opportunities presented by the knowledge society. Consequently, we can posit that there must exist a symbiotic relationship between learning and the ongoing innovation of educators. In this regard, it becomes imperative to delve into the myriad factors influencing teachers' aptitude for innovation, with the ultimate aim of enhancing the quality of education [28]–[30].

Socio-demographic variables encompass a wide array of personal attributes, including age, gender, number of classes taught, average class size, level of education and type of teacher training. These variables hold considerable sway over how educators navigate pedagogical innovation. For instance, younger teachers might demonstrate greater proficiency in incorporating technology into their instructional practices, whereas seasoned educators might lean towards more traditional methodologies [6], [7]. Additionally, gender can exert its influence on teaching styles, with men and women often exhibiting differing approaches to education [21], [31].

Recent research findings suggest complex relationships between teachers' socio-demographic characteristics and their innovative pedagogical practices. Analyses reveal significant gender differences that female teachers tend to use digital tools more frequently for administrative tasks, while male teachers are more likely to use them for professional purposes. Professional experience also appears to have an influence, though in a non-linear fashion. While younger teachers are generally more comfortable with information and communication technologies (ICT), increasing age and resistance to change may slow down technology adoption. Furthermore, personal attitudes toward technology such as an interest in learning and confidence in digital skills strongly affect the integration of ICT into teaching practices. These findings align with the work of Fennema and Franke [34], who note the challenges older teachers face in acquiring new technical skills. Several studies [10], [32], [33] further emphasize the role of teachers' beliefs and emotions in ICT adoption.

Older teachers generally exhibit lower levels of ICT adoption than their younger counterparts [34]. This disparity may be attributed to factors such as a preference for traditional teaching methods and limited opportunities for professional development. However, the influence of age is nuanced and can be moderated by variables such as gender, class size, and educational level [35]–[37].

The intersection of sociodemographic variables with pedagogical innovation poses crucial questions:

i) Do certain demographic groups exhibit a greater inclination towards adopting innovative teaching methodologies?
ii) How do personal backgrounds and cultural influences shape a teacher's readiness and ability to innovate?

This study is dedicated to probing these inquiries, aiming to elucidate the nuanced dynamics between sociodemographic factors and various dimensions of teacher pedagogical innovation. By delving into these complexities, we aspire to offer deeper insights into how sociodemographic variables intersect with and impact innovative practices within educational contexts [31].

2. METHOD

2.1. Participants

The study included a final sample of 110 teachers from three schools, chosen based on inclusion criteria to ensure diverse representation in terms of resources, school culture, and teacher demographics, all of which could influence teachers' approaches to pedagogical innovation. The selection included one private and two public schools to capture varied educational settings. Six participants were excluded due to incomplete responses. The sample was predominantly female (65.4%), with an age between 25 and 34 years for 48% and an age between 45 and 54 years for 21%. Regarding education, 63.46% held a Master's degree, and 36.53% held a Bachelor's degree.

2.2. Design

The comprehensive design of this study, which aimed to investigate the influence of sociodemographic variables on teachers' pedagogical innovation, was conducted with strict adherence to ethical considerations under the oversight of an ethics committee. Prior to commencing the research, the study protocol underwent a thorough review and approval process by the ethics committee, ensuring the strict observance of ethical standards and prioritizing the well-being and rights of all participants involved. The study adopted a quantitative-methods approach.

2.3. Instrument

The study conducted a quantitative analysis using precisely designed questionnaires to investigate the complex relationships between socio-demographic variables and the dynamics of educational innovation. We developed a questionnaire. The content validity of the questionnaire was assessed by six expert judges who received a copy of the instrument and, based on their expertise, rated each statement as relevant, relevant, and clear.

This questionnaire was then administered to a larger cohort of teachers, with the primary aim of collecting relevant information on their sociodemographic characteristics. These included age, gender, number of classes taught, average class size, teacher's education level, and type of teacher training. Additionally, we meticulously examined their current teaching methods to better understand the correlation between these practices and their individual characteristics. This questionnaire served as an essential instrument to improve our understanding of the complex relationship between teachers' sociodemographic profiles and their involvement in innovative teaching approaches.

2.4. Procedure

The data collected was carefully processed and analyzed using R statistical software. At this stage, the main objective was to identify any correlations or trends that might emerge, in order to shed light on the relationship between teachers' socio-demographic characteristics and their involvement in innovative teaching practices. To this end, methods such as multiple correspondence analysis (MCA) and hierarchical ascending classification (HAC) were used. These approaches enabled relationships between different variables to be explored holistically, examining the underlying structures of the data and identifying similarities and differences between groups of teachers based on their socio-demographic characteristics and pedagogical practices. These analyses were essential for understanding the complex dynamics between the variables studied, and for gaining significant insights into the factors influencing teachers' adoption of innovative pedagogical practices.

3. RESULTS AND DISCUSSION

3.1. Typology of innovative teachers

Based on the number of classes taught, average class size, teachers' level of education, type of teacher training and respondents' socio-demographic variables, a typology of innovative teaching methods is developed. MCA on these variables enabled us to create a scatter diagram of individuals on two factorial axes, as shown in Figure 1. Two thirds of the total inertia can be explained by this representation. This indicates that design accounts for 25.32% of the overall variability of people (or variables) in the cloud.

The Chi-square distance between various variable categories and respondents is used to find associations between variables. To visualize the relationships between variables, data is plotted as points in Euclidean space. 180 degrees apart variables have a negative association, orthogonal variables are independent, and variables near to each other on the graph's periphery have a positive association. The stronger the correlation between the variables, the closer we approach the periphery.

The variables that contribute most to the construction of the first dimension are average class size, number of classes, and teacher university degree, while the variables that contribute most to the construction of the second dimension are average class size and type of teacher training (Figure 1). These are the square correlation ratios of the variables on the two dimensions. A thorough depiction of the categories is necessary for a deeper comprehension of these relationships, as seen in Figure 2.

The typology of teachers who employ innovative methods is derived from a comprehensive analysis of all socio-demographic variables, including type of training. Utilizing MCA on these variables, we generated a scatter plot of individuals across two factorial axes (Figure 2). This graphical representation accounted for 25.32% of the overall inertia, indicating that 25.32% of the total variability among individuals (or variables) in the dataset is explained by the design.

Associations between variables are identified by computing the Chi-square distance between various categories of variables and respondents. These data points are then plotted in Euclidean space to visualize the relationships between variables. Variables located close together towards the periphery of the graph denote a positive association, while orthogonal variables indicate independence. Conversely, variables positioned 180 degrees apart suggest a negative association. As variables approach the periphery, the strength of their association increases. The MCA graph highlighted similar groups of response categories and inverse associations between certain variables, reflecting subtle dynamics within the sample.

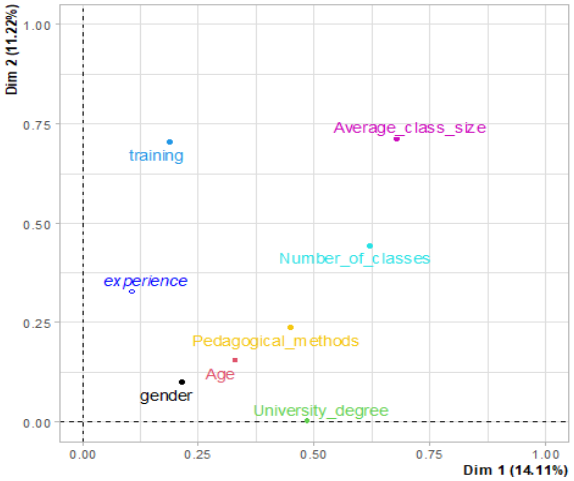

Figure 1. Map of categorical variables

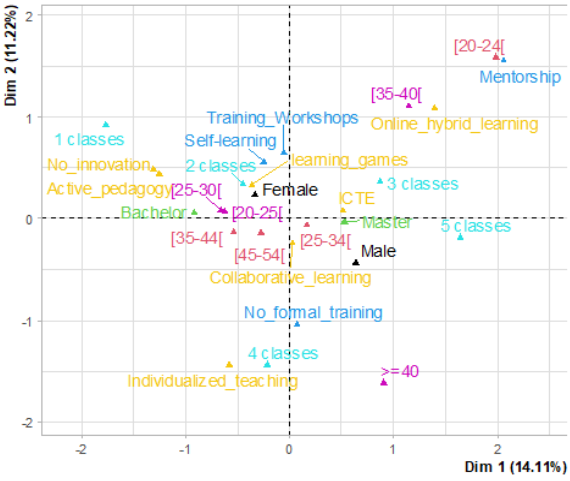

Figure 2. Visualization of MCA

3.1.1. Dimension 1

a. Group 1

In this group, teachers are mainly associated with classes of over 40 pupils, and the majority have no formal training. Men dominate numerically, and most hold a Master's degree. However, female teachers are under-represented, as are holders of Bachelor's degrees. Medium-sized classes, with an average number of pupils between 35 and 40, are less common, as is teacher participation in training workshops and self-study. A minority of teachers have only two classes, and classes with an average number of pupils between 25 and 30, as well as between 20 and 25, are rare in this group.

b. Group 2

The main characteristics of this group of teachers are their average class size, with an average number of pupils between 35 and 40, and their widespread use of teaching methods incorporating ICT. They are predominantly young, aged between 20 and 24, and generally hold a Master's degree. In addition, they frequently benefit from mentoring and actively participate in training workshops for their professional development. On the other hand, they are less likely to have no formal training, have larger classes, hold Bachelor's degrees, and belong to the 35-44 and 45-54 age groups. A minority of teachers have exactly four classes, and classes with an average number of pupils between 25 and 30 are less common in this group.

c. Group 3

In this group, teachers mainly have characteristics such as a Bachelor's degree, often teach in medium-sized classes with an average number of pupils between 25 and 30, and are predominantly aged between 35 and 44, with a predominance of women. What is more, many of them have exactly two classes, and frequently use active teaching methods or avoid innovation in their pedagogical approaches. On the other hand, teachers with a Master's degree are less frequently observed, the use of pedagogical methods involving ICT, the presence of male teachers, as well as larger or smaller class sizes, and different numbers of classes, notably three or five. In addition, younger teachers, aged between 25 and 34, are less represented in this group.

3.1.2. Dimension 2

a. Group 1

Teachers in this group are mainly characterized by their teaching in medium-sized classes, with an average number of pupils between 35 and 40, and by the widespread use of pedagogical methods incorporating ICT. They are generally young, aged between 20 and 24, and most have a Master's degree. In addition, they frequently benefit from mentoring and actively participate in training workshops for their professional development. On the other hand, they are less likely to have no formal training, have larger classes, hold Bachelor's degrees, and belong to the 35-44 and 45-54 age groups. A minority of teachers have exactly four classes, and classes with an average number of pupils between 25 and 30 are less common in this group.

b. Group 2

teachers in this group are mainly characterized by teaching large classes, with over 40 pupils, and by the fact that a large majority of them have no formal training. These teachers are also predominantly male, and most hold a Master's degree. On the other hand, female teachers are less represented, as are holders of Bachelor's degrees. Medium-sized classes, with an average number of pupils between 35 and 40, are less common, as are participation in training workshops and self-study. Moreover, a minority of teachers in this group have only two classes, and classes with an average number of pupils between 25 and 30, as well as between 20 and 25, are rare.

3.2. Hierarchical ascending classification

Following HAC, the formation of homogeneous classes resulted in the selection of four classes with distinct profiles, as illustrated in Table 1 and Figure 3. These classes include: non-innovative teachers, active teachers, untrained teachers and innovative teachers.

Table 1. Results of the HAC

Variable labels		Characteristic features	% of class in modality	Probability
CLASSE 1/4	Average_class_size	20-25	70.37	0.000
	Age	45-54	68.18	0.000
	University_degree	Bachelor	52.63	0.000
	Pedagogical_methods	No_innovation	100.00	0.000
	Training	Training_Workshops	60.00	0.000
	Number_of_classes	2 classes	37.93	0.000
CLASSE 2/4	Average_class_size	25-30	67.57	0.000
	Pedagogical_methods	Active_pedagogy	100.00	0.000
	Gender	Female	44.12	0.000
	Number_of_classes	2 classes	46.55	0.000
	Training	Self-learning	47.50	0.000
	Pedagogical_methods	learning_games	77.78	0.000
	Age	35-44	50.00	0.000
CLASSE 3/4	Training	No_formal_training	65.00	0.000
	Average_class_size	>=40	100.00	0.000
	Number_of_classes	4 classes	88.24	0.000
	Gender	Male	44.44	0.000
	Pedagogical_methods	Individualized_teaching	75.00	0.000
	Number_of_classes	5 classes	53.85	0.000
CLASSE 4/4	Average_class_size	35-40	86.36	0.000
	University_degree	Master	31.82	0.000
	Age	20-24	100.00	0.000
	Pedagogical_methods	ICTE	34.69	0.000
	Training	Mentorship	100.00	0.000
	Number_of_classes	3 classes	50.00	0.000
	Training	Training_Workshops	40.00	0.000
	Number_of_classes	5 classes	46.15	0.000
	Pedagogical_methods	Online_hybrid_learning	100.00	0.000

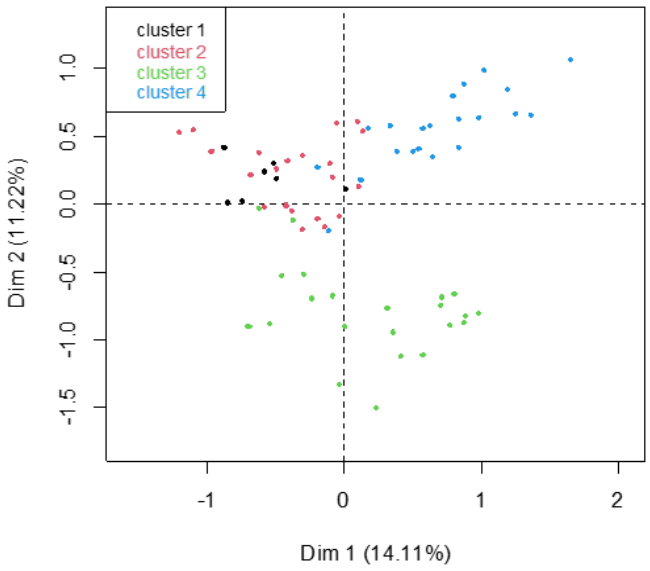

Figure 3. HAC

3.2.1. Class 1: non-innovative teachers

This group represents educators who maintain conventional teaching approaches with limited integration of modern pedagogical innovations. Their methodology tends to be lecture-based and curriculum-driven, often prioritizing content delivery over student engagement. The key characteristics include:

- Traditional use of pedagogy: the majority of teachers in this class prefer traditional teaching methods to innovative approaches.
- Class size: classes are generally of medium size, typically between 20 and 25 students.
- Age range: the average age of the teachers in this class is between 45 and 54, which may suggest a certain resistance to change or a preference for tried-and-tested methods.
- University degree: most teachers have a bachelor's degree, which can influence their teaching approach.
- Participation in training workshops: although a significant proportion of these teachers attend training workshops, this does not necessarily translate into the adoption of innovative methods in their teaching practices.
- Number of classes: in general, these teachers have a small number of classes, mainly two, which may give them fewer opportunities to experiment with new methods or technologies.

3.2.2. Class 2: active teachers

These educators demonstrate a progressive approach by implementing interactive, student-focused teaching strategies. They actively seek professional development opportunities to enhance their instructional techniques. The distinctive traits include:

- Class size: classes in this class are slightly larger, generally between 25 and 30 students, which may require more dynamic teaching approaches.
- Pedagogical methods: the teachers in this class prefer pedagogical methods centered around active teaching and learning games. These methods likely entail increased engagement and direct participation of students in the learning process.
- Gender: there is a high proportion of female teachers in this class, which can influence pedagogical choices and class dynamics.
- Participation training: teachers in this class are more likely to participate in self-learning programs, which may indicate a commitment to ongoing professional development.
- Age range: participants in this class are generally between 35 and 44 years old, which may correspond to a period when teachers are more open to experimentation and the adoption of new teaching methods.

3.2.3. Class 3: untrained teachers

This group consists of educators who enter the teaching profession without formal pedagogical training, resulting in unique classroom challenges and adaptations. Their instructional approaches are often shaped by practical experience rather than theoretical foundations, leading to highly individualized teaching styles. The combination of large class sizes, heavy teaching loads, and lack of formal training creates distinct

pressures that influence their classroom management and student engagement strategies. The key characteristics include:

- Formal training: teachers in this class generally lack formal training in education or pedagogy, which can influence their teaching methods.
- Larger class size: classes in this class are larger, averaging 40 or more students, which can pose unique challenges in terms of classroom management and individualized attention.
- Male dominance: this class is predominantly male, which can influence class dynamics and teacher-student interactions.
- Pedagogical methods: the teachers in this class prefer individualized teaching methods, which may involve adapting teaching to the individual needs and abilities of the students.
- Number of classes under load: there is a significant load on courses with four or five classes, which may require different teaching strategies to manage a larger number of students over a longer period of time.

3.2.4. Class 4: innovative teachers

This group represents the most technologically adept and pedagogically progressive educators, characterized by their strong integration of digital tools and modern teaching methodologies. As early-career professionals with advanced academic qualifications, they demonstrate exceptional adaptability to educational innovations and student-centered approaches. Their active participation in professional development programs and comfort with larger class sizes highlight their ability to balance quality instruction with technological integration. The key characteristics include:

- Class size: classes in this class are slightly larger, mainly between 35 and 40 students, which may require adapted teaching approaches.
- Younger teachers: teachers in this class tend to be younger, aged between 20 and 24, which may be associated with greater openness to new teaching methods and technologies.
- Master's degree: many teachers in this class hold a Master's degree, which may indicate a higher level of education and a better understanding of advanced pedagogical concepts.
- Use of ICT and blended online learning: pedagogical methods such as ICT and blended online learning are commonly used in this class, reflecting a modern approach to teaching.
- Participation in mentoring programs and training workshops: teachers in this class actively participate in mentoring programs and training workshops, demonstrating their commitment to ongoing professional development and the enhancement of their teaching skills.
- Number of classes in charge: the number of classes is evenly distributed between three and five classes, enabling teachers to benefit from a variety of experiences and perspectives.

3.3. Discussion

This study aimed to explore how sociodemographic factors influence teachers' adoption of innovative teaching practices. The findings indicate that sociodemographic variables, such as age, gender, education level, and prior training, significantly shape how teachers engage with innovative pedagogies. The identification of four distinct teacher profiles: non-innovative teachers, active teachers, untrained teachers and innovative teachers, provides valuable insights into the diversity of teaching approaches and highlights the challenges and opportunities for fostering innovation within the education system.

The results align with existing literature suggesting that teachers with higher levels of education and training are more likely to adopt and implement innovative practices [38]. Younger teachers, in particular, are more inclined to integrate ICT and blended learning, which support the results of previous studies, that younger, tech-savvy teachers tend to embrace modern teaching tools [39], [40]. Conversely, older teachers or those with less formal training often remain more resistant to innovation, relying on traditional methods. This highlights the importance of targeted professional development programs designed to address the specific needs of these teachers, as they may require additional support to overcome barriers to innovation.

Gender also plays a role in teachers' adoption of active learning strategies. Our findings that female teachers are more likely to engage in active learning practices suggesting that female teachers may be more open to engaging students through interactive and student-centered methods. However, this trend may also reflect broader societal expectations or cultural factors, which should be explored in future research to better understand the gender dynamics at play in educational innovation.

The study also underscores the significance of prior training, particularly in terms of providing teachers with the tools and knowledge needed to implement innovative practices effectively. Teachers who have received formal training are more likely to adopt ICT and other modern teaching methods. In contrast, untrained teachers, who are often placed in larger class sizes, may struggle with the integration of innovative practices due to a lack of support and resources. These findings suggest that professional development

programs should not only focus on content knowledge but also emphasize strategies for managing larger, more diverse classrooms while implementing innovative methods.

Overall, the study emphasizes the critical need for tailored professional development programs and policies that account for the diverse needs of teachers. By recognizing the barriers faced by certain teacher groups such as older, less trained, or male teachers educational systems can better support teachers in adopting innovative practices that ultimately enhance student learning outcomes. Future research should focus on the effectiveness of these professional development initiatives and explore how best to facilitate the integration of innovative practices across all teacher profiles.

4. CONCLUSION

This study set out to explore quantitatively the influence of socio-demographic variables on teachers' pedagogical innovation. By analyzing the links between teachers' age, gender, level of education and training with their innovative pedagogical practices, it aims to deepen our understanding in the field of education. Recognition of the impact of these socio-demographic factors on teachers' propensity to innovate is of great importance for professional development, educational program design and the development of policies to further support teachers in their drive to improve student learning outcomes.

The typology of teachers, established on the basis of socio-demographic variables and type of training, was carried out using MCA. This approach revealed several distinct groups, offering valuable insights into the profiles of innovative teachers. In particular, these groups reveal trends such as the association of gender with teaching methods and the importance of formal training in the adoption of innovative teaching practices.

However, the classification methodology simplifies the breakdown into four distinct groups, allowing us to highlight the specific characteristics of each group in terms of age, training, and teaching methods. This classification provides a clear picture of the different profiles of innovative teachers, ranging from young self-taught individuals to experienced teachers using advanced pedagogical approaches. These results have direct implications for the development of targeted in-service training strategies and for the formulation of educational policies favoring pedagogical innovation. In sum, this study enriches our understanding of the factors influencing teachers' pedagogical innovation by highlighting the links between sociodemographic variables and innovative teaching practices. These findings can guide the development of educational policies and in-service training programs aimed at encouraging the adoption of innovative pedagogical practices and thus improving student learning outcomes.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [KL].

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