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RECEIVED 03 October 2024

ACCEPTED 03 March 2025

PUBLISHED 17 March 2025

CITATION

El Sleemi M, Al Jughaiman A and Al
Fawzan S (2025) Student perceptions of
innovation indicators in general education:
insights for enhancing knowledge and
practice.
Front. Educ. 10:1502771.
doi: 10.3389/feduc.2025.1502771

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Student perceptions of innovation indicators in general education: insights for enhancing knowledge and practice

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This study explores the current practice of innovation-promoting indicators in general education schools in Saudi Arabia, specifically from the perspective of students. Using a descriptive approach, the study surveyed 1,717 high school students in the Eastern Region, including 1,595 regular students and 122 gifted students, who were selected through random sampling. A questionnaire was designed to assess the extent to which these innovation indicators are implemented. The findings revealed a moderate overall implementation of these indicators, with an average score of 2.77. The curriculum indicator ranked highest (3.14), while the educational environment indicator ranked lowest (2.56). Notably, there were significant differences between regular and gifted students regarding the overall innovation indicators, particularly in the areas of curriculum, the role of the student, and the educational environment, all favoring gifted students. However, no significant differences were observed between the two groups concerning the role of school administration and teachers in fostering innovation. This study underscores the importance of revising and enhancing curricula to better stimulate innovative thinking among students, thus strengthening their capacity for innovation. Its findings provide valuable insights for improving educational practices and policies, particularly in fostering environments that support creative and critical thinking.

KEYWORDS

innovation-promoting, indicators, general schools, students, student perceptions

1 Introduction

Innovation is a fundamental driver of educational transformation, enabling institutions to adapt to rapid societal changes, enhance learning experiences, and improve educational outcomes. In an era marked by technological advancements and evolving pedagogical needs, fostering innovation within the education system is no longer optional—it is essential for sustaining competitiveness and relevance (Ambrose, 2018). Effective innovation in education extends beyond the mere adoption of technology; it encompasses curriculum redesign, the integration of digital tools, and the implementation of student-centered learning approaches, such as inquiry-based and project-based learning. These innovations help address persistent challenges in traditional educational models, including high costs, resource limitations, and the need for more flexible, personalized learning pathways (Bouranta, 2024).

A strong innovation ecosystem in education relies on several key factors, including leadership commitment, teacher empowerment, institutional flexibility, and a culture that encourages experimentation and creative problem-solving. Schools that actively support innovation tend to exhibit characteristics such as dynamic professional development programs, collaboration with industry and research institutions, and policies that incentivize novel pedagogical approaches. Additionally, fostering an environment of psychological safety, where educators and students feel

encouraged to experiment without fear of failure, is crucial for sustaining innovation in the long term (Fullan, 2007).

Despite the recognized importance of innovation in education, there remains a significant gap in systematically evaluating the extent to which innovation is fostered in public schools, particularly within the Saudi Arabian context. While global discussions emphasize the integration of emerging technologies, competency-based learning, and interdisciplinary curricula, research on how these elements are operationalized in the Kingdom's general education system is still limited. Although Saudi Arabia has made substantial investments in educational reform as part of Vision 2030, including increasing autonomy for schools and integrating advanced technologies, there is limited empirical evidence on how these efforts translate into measurable innovation at the school level (Abdal-Wadood, 2019; Al-Breikan, 2022). To bridge this gap, this study aims to examine the key indicators of innovation support within Saudi public schools by exploring expert perspectives on the factors that facilitate or hinder educational innovation. Specifically, the study will assess how various components—such as leadership practices, curriculum design, teacher competencies, and institutional policies—contribute to fostering an innovative educational environment. By identifying the strengths and weaknesses of current innovation initiatives, this research will provide valuable insights for policymakers, educators, and school administrators seeking to enhance innovation within the Saudi education system and align it with global best practices.

1.1 Innovation in education

The development of human capital plays a crucial role in fostering innovation within educational institutions. This involves the continuous professional development of teachers through meetings and training workshops, motivating them for ongoing growth, and equipping them with new knowledge. Instilling a culture of innovation and excellence among all school staff is essential for enhancing their capabilities and ensuring the sustainability of innovative practices in education. Scholars such as Su-Chang et al. (2010), Aoun (2019), and Al-Masmoudi (2022) have identified seven key indicators of innovation, each encompassing a range of sub-indicators that collectively contribute to fostering innovation in schools.

Innovation Indicators: Innovation indicators refer to the measurement of innovation performance in countries through innovation inputs and outputs using a set of multiple indicators. Innovation inputs are measured based on institutions, the workforce, infrastructure, market development, and business development, while innovation outputs are measured based on knowledge and technology outputs (Daly et al., 2022). Operationally, innovation indicators in this study are defined as a set of indicators that measure the inputs, processes, and outputs related to the educational process in public schools in the Eastern Province across the following areas: innovation-supportive educational environment, school administration, curriculum, teacher, and students.

1.2 Key indicators of educational innovation

Leadership Innovation emphasizes visionary leadership in advancing school administration, fostering innovation awareness, and

encouraging participatory decision-making. Leaders play a crucial role in driving innovative initiatives. Administrative Process Innovation focuses on creating an innovative organizational culture by aligning employees with the institution's vision, continuously improving administrative processes, and enhancing operational efficiency. Student Guidance and Activity Innovation involves promoting student participation in innovation fairs, competitions, and creative guidance systems that develop problem-solving skills. Curriculum and Teaching Innovation integrates innovative thinking into curricula, encourages interdisciplinary learning, and establishes incentives for teachers to adopt innovative teaching methods. Teacher Innovation highlights the importance of attracting and developing innovative educators through continuous training, action research, and collaborative knowledge sharing. Innovation Applications involve leveraging advanced technologies like AI, virtual reality, and augmented reality to enhance learning environments and outcomes. Building Innovative Schools focuses on designing creative learning spaces, adapting classrooms to modern methodologies, and equipping teachers with tools that support innovation-driven education.

Empirical studies have examined various dimensions of educational innovation across different contexts. Kamel (2019) explored innovation education in the UAE, highlighting regional disparities in innovation support. Similarly, Ovbiagbonhia et al. (2019) found that Dutch university students rated their innovation competence highly but perceived inadequate institutional support for creative development. A systematic review by Fuad et al. (2020) analyzed 156 studies on innovative cultures in education, emphasizing teamwork, breaking traditional constraints, and fostering knowledge-sharing networks. Their findings reinforced the necessity of cultivating a culture of innovation across all educational levels.

The role of school leadership in fostering innovation has also been widely studied. Al-Ruwaili (2020) examined secondary school leaders in Riyadh, revealing that while curricula and teaching methodologies supported innovation, gaps persisted in school climate and teacher training. Similarly, Wadani (2020) highlighted deficiencies in teacher preparation for supporting gifted students and stimulating innovation. Technology integration in education has been another critical focus. Al-Shami and Al-Ghamdi (2022) proposed a future vision for teachers' roles in promoting technological innovation within Saudi Vision 2030, emphasizing the need for teacher preparation programs to align with the digital economy. In the higher education sector, Jemaa et al. (2023) analyzed Algeria's Global Innovation Index, identifying human capital, curriculum advancements, and increased funding as key drivers of innovation.

Collectively, these studies underscore the multifaceted nature of educational innovation, emphasizing the importance of leadership, adaptive administration, technology integration, and supportive learning environments. A holistic approach to these factors can enable institutions to foster a culture of innovation aligned with the best global practices and future workforce demands.

The discussion on educational innovation aligns closely with Rogers' Diffusion of Innovation Theory (Aivazidi and Michalakelis, 2022) which explains how new ideas, practices, and technologies spread within an organization or society. According to this theory, innovation adoption depends on five key attributes: relative advantage, compatibility, complexity, trialability, and observability. In the context of public schools, leadership practices, administrative structures, teacher competencies, and technological integration all influence how

innovation is perceived and implemented. Schools that offer strong leadership support, clear incentives, and professional development opportunities create an environment where innovation is more likely to be adopted and sustained. Moreover, Fullan's (2007) Educational Change Theory highlights that successful innovation in schools requires a combination of capacity building, shared vision, and sustained professional development (Evette, 2016). This perspective reinforces the need for a holistic approach that considers not only policies and resources but also the attitudes and competencies of educators. By applying these theoretical lenses, this study aims to assess the extent to which innovation is supported in Saudi public schools and identify the factors that enhance or hinder its diffusion.

Despite the growing recognition of the importance of innovation in education and the various initiatives aimed at fostering it, significant gaps remain in understanding how innovation is systematically supported within public schools. While previous studies have explored different aspects of educational innovation, there is limited empirical evidence on its implementation and effectiveness in the Saudi Arabian context. This gap highlights the need for a comprehensive assessment of the key indicators that facilitate or hinder innovation in public schools, providing a foundation for targeted improvements and policy development.

1.3 Study problem

The current study problem arises from the researchers' observations through their work in the public and higher education sectors, identifying a need to explore the topic of innovation indicators. Innovation is of great importance in all fields, including general education, which represents a significant segment of society. This global importance is highlighted by UNESCO's development of a technological innovation strategy in education for the years 2022–2025, as well as the United Nations General Assembly's declaration of April 21 as World Creativity and Innovation Day to raise awareness of their role in all aspects of human development (UNESCO, 2021). Saudi Arabia is also aligned with this global trend, prioritizing innovation and encouragement within its Vision 2030. Al-Harbi and Ismail (2022) pointed out that Saudi Arabia has taken some steps to enhance innovation, such as establishing the "Research, Development, and Innovation Authority" as part of the Kingdom's Vision 2030 to enrich the research ecosystem and promote innovation. Additionally, the "Fikra" platform was launched as a bridge to enhance the role of innovation among community members, improve the efficiency of national ideas, and attract innovative solutions while supporting innovators and the talented (Al-Harbi and Ismail, 2022). Moreover, one of the researchers works as a principal in a public school, and through daily observations, recognized the necessity of identifying innovative indicators in public schools and understanding the reality of their implementation from the perspective of gifted students. Despite the importance of having educational innovation indicators, there are, to the best of the researchers' knowledge, no previous studies aimed at developing indicators to measure the extent of innovation in public schools from the perspective of gifted students. To address this issue, the following questions must be answered:

- What is the degree of enhancement of innovation indicators in public schools in Saudi Arabia from the students' perspective?

- Do students' responses regarding the enhancement of innovation indicators in public schools in Saudi Arabia differ based on the type of student (regular/gifted)?

1.4 Study objective

The current study aims to understand the reality of innovation enhancement indicators in public schools in Saudi Arabia's Eastern Province from the perspective of students and to identify differences in the responses of the study sample.

1.5 Study importance and scope

This study holds both theoretical and practical significance. Theoretically, it enriches the Arabic library with a comprehensive framework on the concept of innovation, its significance, methods of enhancement, and key indicators. Practically, it provides a structured list of innovation enhancement indicators that can be utilized in educational planning to identify, develop, and retain both latent and visible talents among students, ultimately improving their performance and offering them better growth opportunities. This contributes to achieving the educational goals outlined in Saudi Arabia's Vision 2030, particularly in fostering education and talent. Furthermore, the study enhances understanding of the current state of innovation practices in public schools from the students' perspective.

1.6 Study scope

In terms of scope, the study focuses on innovation enhancement indicators in Saudi public schools. The human scope includes 1,717 high school students from the Eastern Province, comprising 1,595 regular students and 122 gifted students. Geographically, the study covers public schools in the Eastern Province, encompassing various school types such as government schools, private schools, Royal Commission schools in Jubail, and schools affiliated with Saudi Aramco.

2 Methodology

The study adopted a descriptive research methodology, as it aligns with the nature and objectives of the research. According to Creswell (2009), this approach aims to examine phenomena in their natural settings while providing a quantitative description of trends, attitudes, or opinions of individuals by analyzing a representative sample of the target population. This allows researchers to generalize findings to a broader context. The study population comprised all secondary school students in public education schools across the Eastern Province (Dammam, Khobar, Jubail, and Qatif), including different types of schools (public, private, Aramco public schools, and Royal Commission schools), with a total of 40,429 students. A sample of 1,717 students was selected using a methodology aimed at ensuring comprehensive representation across various school types while maintaining a balanced distribution that reflects the demographic

characteristics of the target population. This was achieved by distributing the electronic questionnaire through the Ministry of Education's centralized system, ensuring coverage of schools in the designated areas while maintaining a random selection of students within these schools. Additionally, the questionnaire was designed to prevent multiple responses from the same participant.

Regarding gifted students, the sample included 122 students out of a total of 176 identified gifted students in the Eastern Province. All gifted students were selected based on classification tests approved by the Saudi Ministry of Education and the King Abdulaziz and His Companions Foundation for Giftedness and Creativity. However, some incomplete responses led to the exclusion of certain participants, resulting in a final sample size representing 69.3% of the total identified gifted students. The following table shows the distribution of the study sample (students) according to the type of school. [Table 1](#) shows the distribution of the study sample (students) according to the type of school.

2.1 Development of the innovation indicators questionnaire

This step involved assessing the status of innovation indicators in public education schools using a questionnaire comprising five main indicators, each with multiple sub-indicators. Responses were categorized into four levels: Highly Achieved, Moderately Achieved, Slightly Achieved, and Not Achieved. To ensure content validity, the questionnaire was reviewed by 14 experts in innovation, quality, giftedness, and school leadership, who confirmed its suitability. A pilot test was then conducted on a sample of 79 participants from public schools in the Eastern Province to evaluate its psychometric properties. To verify internal consistency, the correlation coefficient was calculated between sub-indicators and their respective main indicators, as well as between the main indicators and the total score. The results showed strong correlations, with an overall coefficient of 0.862, indicating high reliability. The study utilized [Al-Sulaimi et al.'s \(2024\)](#) innovation enhancement framework, which includes indicators

related to the roles of the educational environment, school administration, curriculum, teachers, and students in fostering innovation. While exploratory (EFA) and confirmatory (CFA) factor analyses were not conducted at this stage, the tool's validity was reinforced through expert reviews and Cronbach's Alpha reliability analysis. These measures confirm its robustness and suitability for the study's objectives. The following table presents the Pearson correlation and Cronbach's Alpha coefficients for each main indicator and the overall tool ([Table 2](#)).

Regarding the data collection process using the electronic survey, measures were taken to ensure there were no biases in data gathering. The distribution process was continuously monitored to ensure the questionnaire reached the maximum number of participants. The data collection also involved checking the digital availability of participants to ensure all individuals could access and participate in the survey. Regarding participant consent, prior approval was obtained from the Ministry of Education according to the official procedures. Additionally, the confidentiality of the data was ensured, with the data being used solely for research purposes as one of the fundamental procedures when dealing with study participants. Ethical procedures were followed in data collection, adhering to all ethical regulations for protecting privacy and ensuring data confidentiality. It was also emphasized that the tool was designed to guarantee participants' confidentiality and privacy, with a strict commitment to maintaining the confidentiality of their information and obtaining prior consent for participation in this study. These considerations were considered to ensure the highest levels of security and accuracy in the results, reinforcing the reliability and validity of the methodology used in this study, which contributes to achieving precise and trustworthy outcomes.

3 Results and discussion

3.1 Results related to the first question

To assess the status of innovation promotion in public education schools from the students' perspective, the mean scores and standard deviations were calculated for each main indicator and the tool, as shown in [Table 3](#).

[Table 3](#) shows that the mean scores for the main indicators ranged between 2.56 and 3.14. The highest mean score was for the curriculum indicator, with a mean of 3.14, which is moderately achieved. This followed by the role of school management with a mean of 2.77, also moderately achieved, then the role of the teacher with a mean of 2.73, moderately achieved, the role of the student with a mean of 2.68, moderately achieved, and finally, the role of the educational environment with a mean of 2.56, moderately achieved. The overall mean score for the tool was 2.77, which is moderately achieved.

3.2 Results related to the second question

The study sample consisted of regular students and gifted students. To assess the homogeneity of the study sample, the Shapiro-Wilk and Kolmogorov-Smirnov tests were employed. [Table 4](#) presents these results, which indicate non-normal data distribution. This may be attributed to the sample consisting of both gifted and regular

TABLE 1 Distribution of study sample by school type.

Type of school	Category	Number	Total	Percentage
Private	Regular student	206	237	13.80%
	Gifted student	31		
Public	Regular student	1,039	1,093	63.66%
	Gifted student	54		
Royal commission	Regular student	240	265	15.43%
	Gifted student	25		
Government-Aramco	Regular student	109	122	7.11%
	Gifted student	13		
Total			1717	100%

TABLE 2 Psychometric properties of the tool.

Main indicator	Pearson correlation coefficient	Cronbach's alpha coefficient	Number of sub-indicators
Role of the educational environment in enhancing innovation	0.724**	0.928**	9
Role of school administration in enhancing innovation	0.798**	0.919**	18
Role of the curriculum in enhancing innovation	0.439**	0.932**	10
Role of the teacher in enhancing innovation	0.906**	0.934**	13
Role of the student in enhancing innovation	0.926**	0.926**	9
Total	0.862**	0.937**	78

**Statistically significant at a significance level of 0.01.

TABLE 3 Means and standard deviations of the main indicators for enhancing innovation from the students' perspective.

Rank	Serial number	Indicator	Mean	Standard deviation	Degree of verification
1	3	Role of the curriculum in enhancing innovation	3.14	0.64	Medium
2	2	Role of school administration in enhancing innovation	2.77	0.82	Medium
3	4	Role of the teacher in enhancing innovation	2.73	0.72	Medium
4	5	Role of the student in enhancing innovation	2.68	0.84	Medium
5	1	Role of the educational environment in enhancing innovation	2.56	0.88	Medium
Total			2.77	0.80	Medium

TABLE 4 Normality tests.

Student type	Kolmogorov-Smirnova	Shapiro-Wilk
	statistic	df
Role of the environment	Regular student	0.216
	Gifted student	0.208
Role of administration	Regular student	0.157
	Gifted student	0.186
Role of curriculum	Regular student	0.156
	Gifted student	0.163
Role of the teacher	Regular student	0.189
	Gifted student	0.139
Role of the student	Regular student	0.167
	Gifted student	0.225
Overall, tool	Regular student	0.150
	Gifted student	0.201
a. Lilliefors significance correction		

students, with the naturally smaller number of gifted students compared to regular students in the school context.

Therefore, the study utilized the Mann-Whitney test to explore the differences between the responses of gifted and regular students across the indicator domains. Table 5 presents these results.

The analysis revealed no statistically significant difference at the 0.05 level between the mean scores of regular students and gifted

students in the curriculum indicator, the role of school administration, the role of the teacher, and the role of the educational environment in promoting innovation. However, a statistically significant difference was found at the 0.05 level between the mean scores of regular students and gifted students in the student's role in promoting innovation, as well as in the overall innovation promotion indicators, both in favor of gifted students.

4 Discussion of results

The study results showed that the overall availability of indicators promoting innovation in public schools was moderate. The researchers attribute the results related to the curricula to the development of the current curricula and the introduction of new curricula related to new technical developments, which the Saudi Ministry of Education has worked to introduce to schools in general and to programs for gifted students in particular. Regarding school administration, the results are attributed to the use of electronic administration in performing various tasks. For the teacher, the results are due to the provision of training courses for teachers in the field of innovation, as well as educational guidance from educational supervision on innovation and directing teachers to use innovation and talent scales in the classroom. This aligns with Al-Ruwaili's (2020) study, which highlighted the importance of the teacher's role in promoting innovation.

As for the educational environment, the researchers attribute the results to Saudi Arabia's continuous efforts, through the Ministry of Education, to develop the educational environment to meet the demands of the digital transformation era and enhance innovation in education by integrating new technologies, such as interactive whiteboards and digital devices, in classrooms to boost student learning and engagement.

TABLE 5 Results of the Mann–Whitney Test for Differences between the Responses of Regular and Gifted Students.

Role of the environment	Role of administration	Role of curriculum	Role of the teacher	Role of the student	Overall, tool
Mann–Whitney U	91290.500	94412.500	94555.500	83895.000	43590.500
Wilcoxon W	1362505.500	1365627.500	1365770.500	1355110.000	1314805.500
Z	−1.303	−0.694	−0.676	−2.736	−10.436
Sig. (2-tailed)	0.192	0.488	0.499	0.006	0.000
a. Grouping variable: student type					

This is particularly evident in private schools and Royal Commission schools, although public schools still require more support in this area. These findings are consistent with [Aoun's \(2019\)](#) and [Al-Ruwaili \(2020\)](#) studies. Regarding the student's role, the researchers attribute the results to the encouragement given to students to showcase their innovative products and the regular organization of innovation exhibitions.

The lack of differences in the mean scores between regular students and gifted students regarding the curriculum indicator shows that all students exhibit an interest in creative and innovative aspects and their outcomes. This enhances their knowledge and interest, particularly in relation to the curriculum ([Harackiewicz et al., 2016](#)). Similarly, the role of the educational environment in promoting innovation did not show differences in responses between gifted and regular students, as all students, even those not classified as gifted, benefit significantly from a stimulating school environment. This also applies to administrative aspects and the roles assigned to teachers and school leaders, where the interests of gifted and non-gifted students are generally equal. Every student possesses different talents and interests, making teachers crucial in the efforts to develop these talents and interests among all students ([Chen and Cheng, 2023](#)). Teachers are essential in helping all students, without discrimination, to recognize, develop, and express their talents and interests. They can also appreciate the diversity of talents and interests that contribute to students' achievements ([Salsabilla and Amanda, 2023](#)). Therefore, it is important for teachers to continuously improve their understanding, skills, and practices in teaching to support the development of students' talents and interests.

Many studies indicate that the differences between regular and gifted students can be attributed to multiple factors, including personality traits, cognitive abilities, and the educational environment. According to a study by [Backman and Moin \(2018\)](#), gifted students exhibit higher levels of critical and creative thinking and benefit more from educational environments that promote innovation and support the development of higher-order thinking skills. On the other hand, [Peterson \(2020\)](#) study suggests that the differences between regular and gifted students can be explained by differences in how students respond to the learning opportunities presented to them. Gifted students show a greater ability to engage with curricula that require complex and independent thinking. Additionally, a study by [Alsamani \(2019\)](#) confirmed that innovation indicators, such as the ability to generate new ideas and solve problems in unconventional ways, play a crucial role in enhancing the academic performance of gifted students compared to regular students. [Şakar and Tan \(2025\)](#) study further showed that linking innovation indicators to broader educational trends, such as adopting flexible teaching methods based on deep understanding, significantly contributes to improving gifted students' outcomes, whereas these opportunities are lacking for regular students. Therefore, fostering educational environments that

celebrate innovation and aim to meet the needs of all students can help reduce the differences between regular and gifted students.

4.1 Summary of results

Students are the cornerstone of the educational process, and the focus of all educational systems. Students can acquire knowledge and learn from various sources, and they can also contribute to creating immersive learning environments that enable more effective and enjoyable knowledge acquisition ([Dickerson et al., 2021](#)). The results contribute to understanding the role of students in fostering innovation and raise questions about developing innovative knowledge in schools, which is particularly relevant in the context of general education.

4.2 Limitations

This study has several limitations that should be acknowledged. First, the reliance on self-report questionnaires may have introduced response bias, as students' perceptions could be influenced by social desirability. Second, the cross-sectional design restricts our ability to draw conclusions about causal relationships between innovation-promoting indicators and educational outcomes. Third, because the study was conducted exclusively in the Eastern Region of Saudi Arabia, the generalizability of the findings to other regions or educational contexts may be limited. Additionally, although the questionnaire underwent expert review for content validity, further validation through exploration and confirmatory factor analyses was not performed, which could affect the robustness of the instrument. Finally, the study did not account for potential moderating factors such as socioeconomic status or varying school resources that might influence students' perceptions of innovation. Future research should address these limitations to provide a more comprehensive understanding of innovative practices in general education settings.

5 Closing remark

In conclusion, this study highlights the critical role of fostering innovation as a key tool for enhancing the performance of both regular and gifted students. The connection between innovation indicators and prevailing global educational trends, such as adopting innovative teaching

methods focused on critical and creative thinking, serves as a fundamental step towards constructing future-oriented educational environments. Amid ongoing global transformations in education, which emphasize the integration of modern technologies and the enhancement of critical thinking skills, this study holds significant relevance for both regional and global application.

At the regional level, the findings of this study can guide educational policies in Saudi Arabia and the broader region, contributing to the development of advanced educational programs that cater to the needs of gifted students while nurturing their intellectual potential. On a global scale, the adoption of innovation-driven strategies in alignment with worldwide educational trends will enhance students' opportunities to engage with flexible and evolving learning environments, preparing them for a future characterized by creativity and innovation. This approach will not only contribute to the academic success of students but also to the broader goal of creating a knowledge-based society where education plays a central role in shaping global progress and innovation.

5.1 Recommendations and future directions

Based on the study's findings, it is recommended to revise current curricula in public education schools to foster innovation, organize targeted training programs for students and teachers, enhance the educational environment through artificial intelligence applications, and establish standards for selecting innovative leadership. For future research, the study suggests exploring factors that influence the culture of innovation from expert perspectives, assessing the impact of training programs on teachers' innovative competencies in gifted schools, examining obstacles to innovation in public secondary schools from staff viewpoints, and developing innovation indicators aligned with global standards.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

MS: Writing – original draft, Writing – review & editing. AJ: Writing – review & editing. SF: Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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