Journal of Education and e-Learning Research
Vol. 11, No. 4, 708-718, 2024
ISSN(E) 2410-9991 / ISSN(P) 2518-0169
DOI: 10.20448/jeelr.v11i4.6098

Promoting innovation in Saudi public education schools: The perspective of school employees

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Abstract

The study aimed to identify effective innovation indicators in public education schools in the Kingdom of Saudi Arabia. A mixed-method sequential exploratory design was used starting with interviews of fourteen experts in the fields of talent, creativity and educational excellence. A questionnaire was developed that consisted of seven main innovation indicators, divided into 78 sub-indicators based on the results of these interviews. The questionnaire was administered to a sample of 694 participants including school principals, deputies and teachers. The findings revealed that the overall achievement of innovation indicators in public education schools was moderate. These results suggest that there is a moderate level of implementation of innovation indicators. Further efforts are needed to enhance their effectiveness in Saudi public schools. The study provides a valuable framework for educational policymakers and school administrators to promote innovation within educational environments. This framework can serve as a guide for future efforts to improve the innovative capacity of public schools and enhance their ability to achieve educational excellence. The study offers practical insights for fostering a culture of innovation that supports continuous improvement in the Saudi education system by focusing on strengthening the identified indicators.

Keywords: General education schools, Indicators for innovation, Promoting innovation, Saudi Arabia.

Citation | Sleemi, M. S. E., Jughaiman, A. M. A., & Fawzan, S. K. A. (2024). Promoting innovation in Saudi public education schools: The perspective of school employees. *Journal of Education and E-Learning Research*, *11*(4), 708–718. 10.20448/jeelr.v11i4.6098
History:
Received: 5 August 2024
Revised: 14 October 2024
Accepted: 28 October 2024
Published: 11 November 2024

Publisher: Asian Online Journal Publishing Group

Funding: This study received no specific financial support.
Institutional Review Board Statement: The Ethical Committee of the King Faisal University, Saudi Arabia has granted approval for this study on 1 May 2020 (Ref. No. KFU-REC-2022-MAY-ETHICS75).
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

Contents

Contribution of this paper to the literature

The current study can provide valuable insights into how innovation can be supported within the Saudi educational system. Exploring school staff's views highlights the challenges and opportunities for fostering a culture of innovation. The study may also offer practical recommendations for policymakers to develop educational policies and programs that encourage creativity and innovation in the school environment.

1. Introduction

The current era is witnessing a series of rapid changes along with a monumental knowledge and technological revolution that has led to the emergence of numerous problems in all institutions.

The importance of having indicators of creativity in schools provides a clear framework for measuring and evaluating the effectiveness of efforts to promote creativity among students and teachers. These indicators help identify strengths and weaknesses in educational programs allowing school administrations to make decisions based on accurate data to enhance educational environments. It also enhances the ability of schools to create a climate that encourages innovation by providing the necessary resources and appropriate support to teachers and students alike. In addition, creativity indicators contribute to developing students' critical thinking and problem-solving skills preparing them to face future challenges effectively and efficiently. The study aims to identify key indicators of innovation support in Saudi Arabian public schools from the perspective of experts and to assess the current state of these indicators as perceived by staff across different types of schools.

This requires addressing these issues through the resources available to these institutions, particularly the innovators, as they are responsible for providing innovative solutions to the challenges and problems. The ambitious sustainable plans of the United Nations for the year 2030 have drawn attention to this matter. In the past two decades, innovation has become an important presence in the discourse and practices of international development cooperation in various political contexts. This is evident from the establishment of innovation labs and the integration of innovation principles into their procedures and administrative methodologies aiming to generate new ideas and innovative solutions to current global challenges (Silva, 2021). The concept of innovation is no longer just a slogan but has become central to economic and social development, widely accepted and integrated into the national policies of many low- and middle-income countries. Multilateral organizations have also incorporated innovation programs into their policy-making processes (UNESCO, 2021). The Kingdom of Saudi Arabia has diligently sought to achieve excellence and innovation in its educational system since its inception by developing educational administration, adopting decentralized guidance, utilizing modern educational technologies, and enhancing a stimulating learning environment alongside increasing financial allocations (Abdelwadoud, 2019). The Institute of Public Administration has also shown special interest in supporting and promoting innovation internally within governmental practices with a focus on the innovative dimension in the Kingdom's Vision 2030. Vision 2030 serves as an ambitious roadmap aimed at achieving a transformative shift in all aspects of life, including education considering Saudi Arabia's growing emphasis on developing its educational system. The Vision aspires to build a knowledge-based society rooted in creativity and innovation where supporting innovation indicators in schools plays a critical role in this transformation. The focus on fostering innovation in education reflects the broader goal of preparing generations capable of adapting to rapid global changes and contributing effectively to the national economy. Therefore, this study aims to assess the reality of practicing innovation support indicators in public schools across the Kingdom and to provide insights that will enhance the educational environment in line with the objectives of Vision 2030. This study is crucial as it seeks to bridge the gap between theoretical insights from experts and the practical realities experienced by staff in public schools. This study can provide valuable recommendations for enhancing the educational environment and ultimately fostering a culture of innovation that aligns with Saudi Arabia's broader educational goals by identifying key indicators of innovation support and evaluating their implementation across various school types.

1.1. Study Problem

The current study highlights the importance of innovation in various fields including public education which represents a significant segment of society. Globally, UNESCO has developed a strategy for technological innovation in education for the years (2022-2025) and the United Nations General Assembly has declared April 21 as World Creativity and Innovation Day. Saudi Arabia is not far from this global trend; rather, it is among its priorities and vision for 2030 to support and encourage innovation. Al-Harbi and Ismail (2022) indicated that the Kingdom has taken steps to promote innovation such as establishing the "Research, Development, and Innovation Development Authority" and launching the "Idea as a Solution" platform to promote innovation among community members. Additionally, some researchers who work as directors in a public school through daily observations have identified the need to identify indicators for promoting and supporting innovation in public schools and understand the reality of these indicators from the perspective of their staff because what exists in the field are general trends and policies in addition to some individual efforts for specific cases within a school, administration or teacher. This was also mentioned by Dintersmith, an innovation expert, during his year-long tour of American schools where he found excellent innovative initiatives by teachers and administration but they were individual cases. The greatest challenge lies in how to bring innovative cultures to all schools and empower teachers to lead the way in reinventing education (Dintersmith, 2018). There are no previous studies within the limits of the researchers' knowledge that aimed to develop indicators for measuring the extent of innovation promotion in public schools or to identify the application of these indicators in public schools from the perspective of their staff despite the importance of having indicators for innovation in the educational field. It is necessary to answer the following questions to address this problem:

1.2. Study Questions

1. What are the indicators of innovation support in public schools in Saudi Arabia from the experts' perspective?

2. What is the reality of innovation support indicators in public schools in Saudi Arabia from the perspective of their staff? And do the responses of the study sample members to the innovation promotion indicators questionnaire vary according to the type of school (governmental, Royal Commission schools, Aramco-affiliated schools, private schools)?

1.3. Study Significance

- Theoretical Significance: Enriching Arabic literature with a theoretical framework on innovation, its requirements, importance, indicators, how to enhance it, and the factors influencing innovation in education.
- Practical Significance: Providing a list of indicators for promoting innovation in public schools and understanding their implementation in schools. This can be utilized in planning to attract, develop, and retain talented individuals among the staff of public schools, offering them better opportunities for growth to achieve the desired goals of educational institutions in line with the Kingdom's vision and strategy related to education and talented individuals.

2. Literature Review

2.1. Stages of Innovation in Addressing Educational Challenges

Innovation involves presenting unconventional solutions or ideas to deal with current problems and challenges, leading to new positive outcomes (Al-Salibi, 2015). Innovation goes through a series of stages, including generating new ideas defining the criteria used to select ideas, creating new products, redesigning production processes, managing knowledge, obtaining technologies from external sources, and developing products. Innovation can either be an update, improvement or modification of a product (Elias, Carayannis, Samara, & Bakouros, 2015). Innovation has become closely related to educational aspects, often invoked in education as an alternative to change when developing new products or technological solutions (Ellis, Souto-Manning, & Turvey, 2019). In the same context, Dede (2010) elucidated that innovation in education involves using innovative ideas and technologies to improve the educational process and achieve better outcomes for learners. This requires designing and implementing new methods and strategies for delivering information to students, using technologies and digital media in the educational process and developing conducive and stimulating learning environments.

Innovation in education plays a vital role in achieving success and excellence for educational institutions. Victoria and Borkovskaya (2014) argue that innovation improves the quality of education and helps in continuously meeting changing needs. The importance of innovation in education stems from the changing nature of education itself in the innovation era. We must help students discover their strengths, learn through work and creativity, and confront the increasingly complex real-world problems. It is no longer logical to provide students with a vast amount of knowledge for memorization and preparation for cognitive tests that were appropriate in the past (Ambrose, 2018).

2.2. Innovation in Education

Innovation in the educational field has garnered significant attention worldwide. For example, the United States has developed a national strategy for important technology, utilizing e-learning, virtual reality, and social network learning to be a global leader in technological innovation. Additionally, it has established innovation centers and laboratories such as the Harvard Innovation Lab and hosts conferences related to innovation such as the Innovative Education Conference and the National Conference on Educational Innovation (Serdyukov, 2017). Moreover, UNESCO has shown great interest in innovation in education especially after the world was hit by the COVID-19 pandemic. The organization has developed a strategy for technological innovation in education for the period from 2022 to 2025. UNESCO aims to utilize digital education technology, support countries in creating online learning platforms, enhance digital skills for girls, and build institutional capacities to implement integrated digital learning methods (UNESCO, 2021).

2.3. Innovation in Education Requires Meeting a Set of Basic Requirements

Innovation in education requires meeting a set of basic requirements as follows:

- According to Wong (2013) and Khalil (2015) organizational requirements include developing regulations and internal policies, updating organizational structures, fostering a positive environment that encourages communication and participation in decision-making, and establishing an electronic management system.
- Material requirements involve allocating budgetary resources to support innovation projects and produce innovative knowledge as well as providing incentive systems.
- According to Alsqour and Al-Shoubaki (2024) human requirements entail developing teachers through meetings, workshops and motivating them for continuous development and innovation.
- Educational requirements include formulating a vision and mission for the school that supports innovation, raising awareness of the importance of innovation, developing systems and policies related to innovation, and creating a stimulating learning environment.
- According to Al-Zamil (2022) cultural requirements involve fostering a culture of innovation, encouraging creativity, stimulating initiative towards innovation, and accepting risk for the sake of transformation for the better.

Numerous factors influencing innovation in education categorized by Dobni, Klassen, and Nelson (2015) and Al-Harbi and Ismail (2022) into two categories: internal and external factors. Internal factors include the institution's strategy, organizational culture, financial support, and leadership practices while external factors encompass political stability and technological advancements (Buske, 2018).

However, innovation enhancement faces several challenges including insufficient funding for innovation activities, inadequate physical infrastructure, a lack of high-quality educational programs and qualified teachers, the absence of policies to incentivize innovators and a lack of a culture of innovation within institutions.

Implementing these changes takes a considerable amount of time (Whitehead, 2024). Al-Saleh (2022) mentioned that the commitment to laws and instructions and lack of flexibility contribute to the major obstacles and challenges hindering the development of this culture within the organization leading to frustration and hesitation among employees.

The importance of talent management in promoting innovation in education becomes evident. It involves a set of policies and practices aimed at managing a relatively small proportion of employees that the institution considers essential for performance excellence. Talent constitutes a small percentage of the existing workforce and has a significant impact on organizational performance typically consisting of specialized technicians. Talent management focuses on attracting, developing, employing and retaining talents to overcome the challenges faced in today's business context characterized by globalization, technology, and social, economic, and demographic changes, all of which increase the necessity to focus on identifying, attracting, employing, developing, and retaining talents to overcome the challenges encountered (Gallardo-Gallardo, Thunnissen, & Scullion, 2020).

The talent management strategy plays a crucial role in fostering innovation in institutions in various forms to achieve the highest levels of performance and produce quality outputs that meet the needs of the labor market (Al-Khuraysat, 2020). Talent management requires the development and integration of new employees, retaining current employees, attracting highly skilled workers to the organization, and ensuring continuous training and development of high performance to undertake potential new roles, identify employees' knowledge gaps, and implement initiatives aimed at enhancing competencies among employees (Annakis, Dass, & Isa, 2014).

The role of innovative leadership in promoting innovation in education is undeniable. A study by Al-Kawnee, Al-Zubeir, and Ataa (2021) emphasizes the importance of encouraging teachers to present their ideas and providing them with both motivational and financial incentives. In this context, Al-Barhi and Al-Qasimia (2019) highlight the role of school principals in promoting a culture of innovation, providing support to teachers, and creating an environment conducive to innovation. According to Awn (2019) teachers also play a crucial role in promoting innovation among learners by using innovation and talent metrics within the classroom along with implementing new strategies and nurturing talented and innovative students.

The efforts of the Kingdom to promote innovation in public education schools are noteworthy. The launch of the "Enriching Innovation Space" program, the establishment of the National Center for E-Learning which launched the Education Innovation Award and the organization of a conference on innovation and artificial intelligence in education (Arab Organization for Quality Assurance in Education, 2022) all highlight the importance of this initiative. Additionally, the significance of these centers lies in the services they provide to innovators and inventors regarding innovation and patents aiming to enhance national innovation capacity and foster a culture of invention and innovation (Ministry of Education, 2021).

This aligns with Vision 2030 and a significant interest shown in a statement by the custodian of the Two Holy Mosques, King Salman bin Abdul-Aziz who said, "Investing in science, innovation, and technological development as well as human capabilities development represents an important pillar for sustainable development." This statement reflects the deep commitment of the custodian of the two holy mosques to future generations by nurturing them within the best educational system in the world, investing in talented students, and unleashing their talents and capabilities to serve the nation. Innovation in education has indicators. Chen, Hsiao, Chang, Shen, and Chou (2010) and Al-Masmoudi (2022) mentioned seven main indicators of innovation in education which include leadership innovation, administrative process innovation, student counseling and activity innovation, curriculum and teaching innovation, teachers, innovation application, and finally, building innovative schools.

Previous studies have addressed various variables related to innovation and education and mechanisms for promoting it such as Kamel (2019) who aimed to identify the reality of innovative education in the public education system in the United Arab Emirates. The study adopted a descriptive approach with the study tools being a questionnaire with a sample of 404 high school teachers. The results confirmed significant differences between the sample's responses to the questionnaire overall and its sub-dimensions according to the emirate variable. The study recommended conducting further research on the obstacles to achieving innovation in the UAE and the mechanisms for achieving it as well as conducting a comparative study between innovation in the UAE and that in an advanced country. Ovbiagbonhia, Kollöffel, and Brok (2019) conducted a study on education for innovation in the Netherlands, aiming to assess students' perceptions of the learning environment and their innovation competencies. They prepared a survey and administered it to 130 students across eight universities of applied sciences. One of the key findings was that students perceived the educational environment as not fully supportive of innovation competency and aimed at developing innovation competency to a limited extent. The study recommended universities focus on teaching and assessing innovation competency to improve the educational environment. Fuad, Musa, and Hashim (2020) conducted a systematic literature review to identify the criteria, beliefs, values, habits, and common behaviors in educational innovation cultures. Out of a total of 156 analyzed studies using descriptive analytical methodology, the study found several mechanisms to overcome traditional education and ensure alignment with current developments in the 21st century. These mechanisms included encouraging innovation in the educational context. The study recommended disseminating a culture of innovation in various educational stages based on its results. Al-Ruwaili (2020) conducted a study targeting the role of secondary school leaders in providing an enhanced environment for innovative learning and its requirements. The study used a descriptive survey methodology and applied a questionnaire to a randomly stratified sample of 940 teachers. The study found that curriculum, teaching methods, and innovation-enhancing activities were widely available. Moreover, a supportive school climate for innovation and innovative teachers were present. The study found no statistically significant differences between public and private schools in providing an enhanced environment for innovative learning and recommended enhancing the role of secondary school leaders in this regard.

Al-Shami and Al-Ghamdi (2022) conducted a study aimed at proposing a future vision for the roles of teachers in supporting modern technological innovation activities and meeting the requirements of the digital economy considering Vision 2030 in the Kingdom. They used a questionnaire as a study tool, targeting a sample of 233 teachers and supervisors of talented students. The study resulted in formulating a proposed future vision in the

field of technical innovation and its activities in ten areas clarifying the role of teachers in supporting technical innovation within each area while also addressing aspects related to achieving Vision 2030 associated with the thriving economy within the ten areas. The study recommended improving the recruitment, training, and qualification of teachers considering the changing requirements of the digital age and adopting technology and innovation as fundamental drivers of economic growth in education and society.

It is noted that they varied in their objectives but were linked to educational innovation through reviewing studies related to the current study's topic. Most previous studies used descriptive analytical methodology whereas this study differs in its objectives and methodology using a mixed methodology instead of the descriptive methodology commonly used in previous studies. Additionally, this study aims to understand the reality of promoting innovation in public schools in the Kingdom of Saudi Arabia. The current study aligns with previous studies in its focus on innovation in the educational field and agrees with them in using questionnaires and interviews to achieve the study's objectives. The current study benefited from previous studies in developing an initial concept for indicators of innovation promotion in public schools and in preparing the study's tools.

3. Research Methodology

3.1. Research Design

A mixed-methods research design was adopted in this study which combined qualitative and quantitative methods of analysis specifically the exploratory sequential design. This type of mixed research method is used when there is a desire to explore a topic before collecting quantitative data while also paying attention to following up on qualitative results through quantitative analysis. Researchers began by qualitatively exploring the phenomenon of the study followed by the quantitative aspect. Additionally, the study adopted a descriptive methodology suitable for its nature and objectives. It also employed the Delphi method to identify indicators for promoting innovation in public schools in Saudi Arabia. This method relies on collective opinion as it is considered superior to the sum of individual opinions (Creswell & Plano Clark, 2011).

3.2. Population and Sample

The study population consisted of 12,244 teachers, vice principals, and principals from public schools in the Eastern Province (Dammam, Khobar, Jubail and Qatif) including all types of schools (governmental, private, Aramco government schools, and Royal Commission schools) and all levels (primary, intermediate, and secondary). The study sample consisted of 694 staff members from schools in the Eastern Province of Saudi Arabia selected randomly while ensuring representativeness of the original population. Table 1 illustrates the distribution of study sample individuals according to the type of school.

Table 1. Distribution of study sample individuals according to school type.

School types	No	%
Private	95	13.69%
Governmental	421	60.66%
Royal commission	160	23.05%
Government-Aramco	18	2.59%

3.3. Data Collection Tools and Techniques

3.3.1. Study Tools

Researchers collected qualitative data through individual interviews and focus groups (a zero-round Delphi survey) with experts in the fields of innovation, quality, talent, and distinguished school principals. Fourteen highly qualified and experienced experts from various regions of Saudi Arabia were selected and all agreed to participate. Ten interviews were conducted, including eight individual interviews through Zoom at the participants' request and two focus group sessions (one in person and the other through Zoom) lasting between 25 and 65 minutes. The interviews were analyzed using Maxqda software leading to the creation of a list of innovation enhancement indicators in public schools in Saudi Arabia based on expert opinions. The questionnaire consisted of seven main indicators and 78 associated sub-indicators with four response options for each indicator (highly achieved, moderately achieved, weakly achieved and not achieved).

3.3.2. Validity and Reliability

To verify the face validity of the tool, it was presented to a group of 14 experts in the fields of innovation, quality, talent, and distinguished school principals through three rounds. The agreement coefficient among them reached 85.7% indicating the tool's validity.

3.3.3. Reliability of the Study Tool

Cronbach's alpha coefficient was used to verify the reliability of the study tool (see Table 2).

Table 2. Cronbach's alpha coefficients for the study instrument.

Main indicators	Cronbach's alpha coefficient	Number of sub-indicators
The role of the educational environment	0.928 **	9
The role of organizational structure	0.923 **	11
The role of school administration	0.919 **	18
The role of curriculum	0.932 **	10
The role of teachers	0.934 **	13
The role of students	0.926 **	9
The role of innovative outputs	0.927 **	8
Enhancing innovation as a whole	0.937 **	78

Note: **at (0.01) level.

3.3.4. Indicating a Significance Level of 0.01

Table 2 shows that Cronbach's alpha internal consistency values for all main indicators are statistically significant at the 0.01 level for both the total score and sub-dimensions with an overall reliability coefficient of 0.937 indicating high reliability of the study tool.

3.3.5. Validity of the Study Tool

The internal consistency validity of the tool was verified by calculating the correlation coefficient between each sub-indicator and the main indicator and between the main indicators and the total score as follows: The reliability coefficient for the role of the educational environment was 0.724. The role of the organizational structure was 0.811. The role of school administration was 0.798. The role of curriculum was 0.439. The role of the teacher was 0.906. The role of the student was 0.726. The role of innovative outputs was 0.901 and the overall indicators were 0.862 indicating the tool's reliability.

3.4. Statistical Processing

The SPSS software was used to perform several statistical procedures, including calculating Cronbach's alpha coefficient, descriptive statistics such as percentage extraction, measures of central tendency which included calculating arithmetic means and standard deviations and one-way ANOVA to detect differences in innovation promotion indicators to answer the study questions.

4. Study Results and Discussion

4.1. Study Results

The study results revealed a variation in the availability of innovation support indicators in public education schools in the Kingdom of Saudi Arabia as shown by the answers to study questions:

4.1.1. First Question

What are the indicators supporting innovation in public education schools in Saudi Arabia from the experts' perspective? Three rounds of discussions with experts resulted in a list of innovation indicators as shown in Table 3.

Table 3. Innovation promotion indicators in public education schools based on experts' opinions.

Primary indicators	Sub-indicators
The role of the educational environment in fostering innovation	1: There is an organizational environment in schools that embraces innovation, encourages acceptance of change instead of resistance and fosters the experimentation of new ideas.
	2: There is an attractive and stimulating environment for students, teachers, and administrators to innovate.
	3: The educational environment provides physical resources such as classrooms, interactive screens, laboratories, modern technologies, and safe internet usage in addition to the necessary financial resources to promote innovation.
	4: There is a technical educational environment that allows for activities that promote innovation, whether they are classroom-based or extracurricular.
	5: Transitioning from traditional environments to digital environments that utilize modern technology in the educational process such as artificial intelligence, computer applications, electronic programs, and digital platforms.
	6: The school environment includes innovation exhibitions to stimulate innovative ideas from students.
	7: The educational environment meets the diverse and evolving needs of school staff.
	8: The educational environment encourages teamwork and accepts calculated risks.
	9: There is a suitable climate for all school staff to demonstrate their innovative abilities in the educational environment.
The role of organizational structure in promoting innovation.	1: The organizational structure includes policies and regulations that protect the innovation system and create a conducive climate for it.
	2: The organizational structure incorporates mechanisms for patent registration and protection of innovative ideas and information.
	3: The organizational structure adopts innovation indicators in public education schools
	4: The organizational structure appoints innovative leaders who provide a futuristic vision to enhance innovation in educational institutions.
	5: The organizational structure establishes clear mechanisms to support research and innovations of educational stakeholders.
	6: The organizational structure builds an organizational climate in schools that fosters innovation.
	7: The organizational structure establishes administrative units dedicated to innovation, providing moral and material incentives for innovators, and transferring successful experiences and experiments locally and globally.
	8: The organizational structure has a strategy to ensure the full utilization of intellectual capital and promote innovation.
	9: The organizational structure focuses on increasing investment in intellectual capital to enhance innovative capabilities and the innovation growth rate.
	10: The organizational structure includes procedures and mechanisms to link innovation to sustainable development.
	11: The organizational structure develops regulations and laws in schools that are compatible with the current era's developments.
The role of school administration in	1: School management embraces the theme of innovation in its vision, mission, and goals, offering support to the talented and innovative.

Primary indicators	Sub-indicators
enhancing innovation	2: The school management develops short-term and long-term plans to promote innovation among its entire staff.
	3: The school management provides a supportive environment for transforming creativity into innovation.
	4: A flexible administrative structure exists within the school management, allowing all staff members the opportunity to showcase their innovations.
	5: The school management provides the necessary facilities for innovative students to engage in innovative activities.
	6: The school management continuously monitors innovation promotion activities within the schools.
	7: The school management encourages teachers to present innovative ideas.
	8: The school management attracts talented students and works on providing the necessary care.
	9: The school management supports positive competition among employees in the educational institution.
	10: The school management offers both moral and material incentives to teachers with innovative abilities.
	11: The school management allows its staff the opportunity to participate in decision-making.
	12: The school management establishes partnerships with parents to enhance innovation.
	13: The school management adopts a change policy in line with the digital transformation era to provide distinguished services.
	14: The school management efficiently and effectively manages human resources.
	15: The school management supports competitions and programs that promote innovation, develop students' capabilities, meet their needs, and open avenues for innovation.
	16: The school management organizes exhibitions to showcase technological innovations by young innovators to encourage them to study science and technology.
	17: The school management instills innovation as values, attitudes, and behaviors within the culture of the educational institution.
	18: The school management evaluates innovative projects that are of high quality, applicable, goal-oriented, innovative, providing solutions to problems, and having an impact on society, the environment, or the economy.
The role of curriculum in enhancing innovation	1: There is an organizational environment in schools that embraces innovation, encourages acceptance of change rather than resistance, and promotes the experimentation of new ideas.
	2: There is an attractive and stimulating environment for students, teachers, and administrators to innovate.
	3: The educational environment provides material resources such as classrooms, interactive screens, laboratories, modern technologies, and safe internet use in addition to the financial resources necessary to promote innovation.
	4: There is a technical educational environment that allows for activities that enhance innovation, whether they are classroom or extracurricular activities.
	5: Transitioning from traditional environments to digital environments that employ modern technology in the educational process, such as artificial intelligence, computer applications, electronic programs, and digital platforms.
	6: There are innovation exhibitions in the school environment to stimulate innovative ideas from students.
	7: The educational environment meets the diverse and evolving needs of school staff.
The role of teachers in enhancing innovation indicators	1: The teacher employs new innovative strategies that lead students towards innovative thinking, such as project-based learning.
	2: The teacher engages their students in innovative activities within the classroom.
	3: The teacher poses thought-provoking questions that stimulate innovative thinking.
	4: The teacher encourages students to research and investigate.
	5: The teacher motivates students towards adventure,
	experimentation, and testing.
	6: The teacher seeks innovation and development and looks towards the future.
	7: The teacher allows appropriate time for students to complete tasks.
	8: The teacher is committed to enhancing innovation through capacity building and performance development through training courses and sharing experiences with colleagues.
	9: The teacher designs and develops educational content that enhances innovation.
	10: The teacher contributes to developing students' interactive skills.
	11: The teacher fosters innovation among students and possesses knowledge management techniques.
	12: The teacher uses innovation and talent measures to identify gifted students.
	13: The teacher has the capability for exploring innovative potential, developing innovation, and evaluating innovative output.
The role of students in enhancing innovation	1: Students practice innovative thinking skills while solving innovative problem-solving.
	2: Students participate in innovation exhibitions with innovative products.
	3: Students continuously develop their innovative abilities.
	4: Students pose stimulating questions for innovation.
	5: Students eagerly engage in innovative activities.
	6: Students continuously engage in self-directed learning.
	7: Students can produce diverse innovative ideas.
	8: Students possess technological skills that qualify them to adapt to the developments of the era and benefit from Chat GPT.
	9: Students actively seek to build knowledge both inside and outside the school.

Primary indicators	Sub-indicators
Innovative outputs	1: Innovative outputs result in an increase in the rate of knowledge production and its application.
	2: Innovative outputs enhance and facilitate the educational services provided by schools to targeted groups.
	3: Innovative outputs increase the number of smart innovative schools in the Kingdom of Saudi Arabia.
	4: Innovative outputs increase the level of partnership with the external community and enhance satisfaction with the educational services provided to targeted groups.
	5: Innovative outputs refine the skills of teachers, administrative staff, and students.
	6: Innovative outputs increase investments in human capital contributing to the improvement of the quality of educational outcomes.

Table 3 reveals the presence of seven main indicators for promoting innovation in public education schools and 78 sub-indicators with the indicator of the school management role in innovation promotion leading at a percentage of 23.07% of the total indicators. The indicators for the teacher's role and organizational structure account for 14.1% of the total indicators. Subsequently, the indicators of the student, environment, and curriculum roles are equally rated at 11.5% of the total indicators. Lastly, the innovative output's role accounted for 10.2% of the total indicators.

4.1.2. Second Question

What is the reality of innovation support indicators in public education schools in Saudi Arabia from the perspective of their staff? To answer this question, arithmetic means and standard deviations were calculated for each main indicator and for the tool as shown in Table 4.

Table 4. Means and standard deviations for innovation promotion indicators and for the tool as a whole.

Rank	Number	Indicators	Means	Standard deviation	Degree of verification
1	7	The role of the educational environment	3.53	0.78	Large
2	3	The role of organizational structure	3.26	0.79	Medium
3	4	The role of school administration	3.12	0.72	Medium
4	5	The role of curriculum	2.88	0.65	Medium
5	2	The role of teachers	2.85	0.80	Medium
6	1	The role of students	2.79	0.59	Medium
7	6	The role of innovative outputs	2.66	0.64	Medium
-	-	Enhancing innovation as a whole	3.02		Medium

The preceding table illustrates that the arithmetic means for the main indicators ranged between 2.66-3.53 with the highest being the innovative outputs indicator with an arithmetic mean of 3.53 indicating significant achievement. Following that is the school management role with an arithmetic mean of 3.26 also achieving significantly. Next is the curriculum role with an arithmetic mean of 3.12 achieved moderately. Then, the teacher role with an arithmetic mean of 2.88 and the organizational structure role with an arithmetic mean of 2.85 both achieved moderately. Additionally, the environmental role had an arithmetic mean of 2.79 and the student role had an arithmetic mean of 2.66 both achieved moderately. The arithmetic mean for the entire tool was 3.02 also achieved moderately.

Regarding the ten sub-indicators that received the highest response from the study sample, their arithmetic means ranged between 3.47-3.57, all achieving significance. As for the ten sub-indicators with the lowest response from the study sample, their arithmetic means ranged between 2.65-1.48 with two indicators achieved low responses while the rest achieved moderately.

4.1.3. To Answer the Sub-Question

Do the responses of the study sample members to the innovation promotion indicators questionnaire vary based on the type of school (governmental, Royal Commission schools, Aramco-affiliated schools, private schools)?

A one-way ANOVA analysis was utilized and Table 5 illustrates the results.

Table 5. One-way ANOVA analysis for the reality of innovation promotion indicators varying by school type.

Indicators	School types	Numbers	Means	Standard deviation	F	Statistical significance
Enhancing innovation as a whole	Private	95	3.595	0.365	69.184	0.001
	Governmental	421	2.797	0.642		
	Royal commission	160	3.301	0.400		
	Governmental: Aramco building	18	2.786	0.686		
	Total	694	3.022	0.641		

The previous table indicates statistically significant differences at the significance level ($0.05 = \alpha$).

In the overall score of innovation promotion indicators attributed to the variable (school type), the "F" value was 69.184 with statistical significance less than 0.01 . The Scheffe post hoc test for pairwise comparisons was applied to understand the differences in the overall score of innovation promotion indicators (see Table 6).

Table 6. Scheffe post hoc test results for pairwise comparisons in the overall score of innovation promotion indicators by school type.

School types	Means	Private	Governmental	Royal commission	Governmental Aramco building
Private	3.595	-	0.798*	0.294*	0.809*
Governmental	2.797	-	-	0.504*	0.011
Royal commission	3.301	-	-	-	0.51*
Governmental Aramco building	2.786	-	-	-	-

Note: *Statistically significant at the significance level (0.05 = α).

The preceding table demonstrates statistically significant differences at the significance level (0.05 = α) in the overall score of innovation promotion indicators based on the variable (school type). The differences were observed between private and government schools in favor of private schools. Additionally, differences were noted between private and royal commission schools in favor of private schools. Similarly, differences were found between private and government-Aramco schools in favor of private schools. Furthermore, differences were observed between government and royal commission (schools in favor of royal commission schools. Additionally, differences were identified between royal commission and government Aramco schools in favor of royal commission schools. However, no statistically significant differences were found among other types of schools.

4.2. Study Discussion

The study results indicate the importance of adopting comprehensive strategies to enhance innovation in all types of schools in the Kingdom in line with Vision 2030. The pivotal role of school administration and teachers in activating innovation support indicators is highlighted. Experts emphasize the significant importance of school management, placing it at the forefront of the main indicators with a considerable margin compared to all other indicators. These results align with those of Awn (2019). Furthermore, the experts classified the teacher and organizational structure roles at the second level consistent with studies by Youssef (2019) and Al-Khuraysat (2020). Perhaps this can be attributed to the experts' focus on the importance of policies and educational leadership and their direct impact on the education system which has proven successful in many educational systems when aligned with other necessary factors and indicators.

In contrast, experts rated the main indicators related to curriculum, environment and student equally. This result is consistent with the study by Fuad et al. (2020). Concerning the curriculum, it aligns with the study while regarding the environment, it aligns with the studies by Awn (2019), Serdyukov (2017) and Al-Ruwaili (2020). Experts view these as related to policies and educational leadership which contribute to providing the appropriate curriculum and environment to foster innovation among staff when possessing a clear vision. The current study highlighted the importance of the student role and innovative outputs in promoting innovation in public education as they are the two most correlated indicators. These indicators are related to education in general and providing conducive conditions for students and sufficient support while these two indicators relate directly to the student himself and the innovations he produces because of the synergy of the previous factors. This has often been briefly mentioned in previous studies as supportive factors for promoting innovation in education.

The results indicated that innovation outputs had the highest mean scores from the perspective of school staff and were achieved to a significant extent. Researchers attribute these results to several reasons including the continuous increase in the number of innovative and talented students in public schools, ongoing programs and competitions sponsored by the Mawhiba Foundation that are open to all students and schools' focus on innovation outputs due to their connection with the school accreditation standards implemented by the Education Evaluation Authority. Consequently, schools are classified and there is a desire to enhance the Kingdom of Saudi Arabia's position in global innovation rankings which has indeed improved.

The results also highlighted the secondary role of school management attributed by researchers to the clear mechanisms established by school management to support the research and innovations of staff in the educational process. Moreover, school management provides moral and material incentives to innovative teachers. These findings align with those of Youssef (2019). Additionally, the results emphasized the advancement of the curriculum attributed by researchers to the Ministry of Education's introduction of new curricula to keep pace with the knowledge and technological revolution and develop curriculum activities that promote students' innovative thinking.

As for the roles of teachers, organizational structure, environment, and students, researchers attributed the moderate role of each in promoting innovation in education. Researchers attribute this to the importance of providing training courses for teachers in innovation providing educational guidance to teachers by educational supervisors in the field of innovation and guiding teachers to use innovation and talent scales within the classroom consistent with Al-Ruwaili's (2020) study. Regarding the organizational structure, researchers attribute these results to the flexibility of the organizational structure in public schools, creating a positive climate that encourages positive communication among all school staff, and continuously developing organizational structures, although it requires adopting indicators that promote innovation. Regarding the environment, researchers attribute these results to the continuous efforts of the Ministry of Education in Saudi Arabia to develop the educational environment to suit the digital transformation era and promote innovation in education by integrating new technology into education using interactive whiteboards, tablets, and digital devices in the classroom to enhance student learning and engagement, as observed in private and Royal Commission schools, with government schools needing support in this area. These results are consistent with Al-Ruwaili (2020).

Regarding the role of students, researchers attribute these results to encouraging students to present their innovative products and organizing innovation exhibitions regularly. Researchers indicate that the difference in the ranking of roles among the primary indicators does not negate their importance between experts' opinions in the first question and the perspective of school staff in the second question. The results of the former indicate the importance of these indicators in the subject of promoting innovation rather than their ranking in the field (Pietsch, Cramer, Brown, Aydin, & Witthöft, 2024).

Both parties emphasized the importance of all indicators and none of the indicators failed to achieve at least a moderate degree of verification. This indicates their importance but to varying degrees depending on the participants' perspectives. For example, school staff focused on innovative products to enhance the role of innovation which most schools aim to demonstrate through participation in exhibitions and competitions to improve their ranking (Dedering & Pietsch, 2023) while experts focused on the importance of management and policies in their view. Researchers see no conflict but rather different perspectives depending on the angle or focus of the participants, in addition to these outputs not appearing without the significant role of school management. This demonstrates the alignment between qualitative and quantitative results in the importance of these primary and secondary indicators in promoting the role of innovation in public schools where the primary indicators were achieved to a moderate or significant extent with the lowest mean score being 2.66. Similarly, for the secondary indicators, most of them were achieved to a moderate or significant extent as evidenced by the results related to the secondary indicators with only two secondary indicators achieved at a low level out of a total of 78 secondary indicators that were achieved to a moderate or significant extent. The results also showed differences in favor of the school type from the perspective of its staff and the results of the Scheffe test for pairwise comparisons showed differences in favor of private schools, followed by Royal Commission schools, then government schools, and finally government schools located in Aramco buildings. Researchers attribute these results to various reasons, including the establishment of advanced educational programs and applications in private schools and their difference from government schools in attracting teachers and student enrollment mechanisms. This reflects positively on the learning environment and helps stimulate innovation, according to a study (Lestari, Paidi, & Suwarjo, 2024). Additionally, the specificity of Royal Commission schools in school operation and budget allocation directly from the Royal Commission, not the Ministry of Education as well as the implementation of engineering projects based on the latest engineering and educational designs.

5. Findings Summary

This study provided a detailed examination of the state of innovation indicators in public schools in the Kingdom of Saudi Arabia offering a thorough analysis based on both qualitative and quantitative data. The study identified 78 innovation indicators that assess inputs, processes and outcomes related to the educational system in areas such as the innovation-supportive educational environment, organizational structures for innovation, school administration, curricula, teachers, students and innovative outputs. The findings revealed that the overall availability of these innovation indicators is moderate suggesting substantial opportunities for improvement and enhancement in creating innovative educational environments. Additionally, the study uncovered variations in the application of these indicators based on specific variables highlighting the need for further investigation into these differences and their underlying causes to advance education and encourage innovation in schools. These insights are particularly significant for the Kingdom's ongoing efforts to foster innovation in public schools by refining organizational structures and policies. They could have broader implications for other Arab countries with diverse educational systems.

6. Conclusion and Implementation

6.1. Conclusion

Innovation in general education schools can be enhanced by adopting a range of comprehensive and sustainable strategies. This can be achieved by developing organizational structures within schools to include units specialized in innovation and providing continuous training programs for teachers and administrators to raise their efficiency in applying innovative educational practices. In addition, the educational environment can be enhanced by providing the necessary technological resources and motivating students to think critically and creatively through innovative and exciting curricula. Collaboration with the local community and partnerships with educational and research institutions can also contribute to providing an environment supportive of innovation. All these efforts together contribute to creating an educational environment that stimulates creativity and prepares students to face the challenges of the future effectively and efficiently.

6.2. Recommendations

6.2.1. Recommendations for Academic Professionals

In light of the study results, the researchers recommend educational leaders and decision-makers focus on educational capital and employ it to enhance innovation in public education in a procedural manner that adopts the outcomes of the current study as well as benefiting from the experiences of leading countries in the field of innovation in the educational field. In addition, innovation exhibitions are being established in government schools throughout the Kingdom of Saudi Arabia because of their critical role in promoting the culture of innovation in schools.

6.2.2. Recommendations for Academic Professionals

To complement the current research, the researchers propose a number of studies, including developing a proposed framework to enhance innovation indicators in public schools and preparation. A proposed program to develop the innovative capabilities of employees in government schools in addition to studying the obstacles to encouraging innovation in government secondary schools.

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