TPM Vol. 32, No. S4, 2025
ISSN: 1972-6325
https://www.tpmap.org/

GRADUATE STUDENTS' PERCEPTIONS OF THE ROLE OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN ACHIEVING SPENDING EFFICIENCY IN PUBLIC SCHOOLS IN SAUDI ARABIA

SAUD GHASSAN ALBESHIR[1*], KHALID MOHAMMED ALQUHAIZ[2], ABDULELAH ABDULLAH ALRUWAITEA[3], AMAL SAER ALOTAIBI[4], EBTESAM SAAD ALQAHTANI[5], FAHAD JABBAR ALMUTAIRI[6], MARIAM MUKHAILEF ALDHAFEERI[7], RAKAN ABDULAZIZ ALDUWAYS[8], SAAD MOHAMMED ALDAWOOD[9], TAIF HARBI ALMUDYANI[10]

[1,2,3,4,5,6,7,8,9,10]ASSISTANT PROFESSOR, DEPARTMENT OF EDUCATIONAL ADMINISTRATION, COLLEGE OF EDUCATION, KING SAUD UNIVERSITY, SAUDI ARABIA,

Abstract

The study aimed to explore the perceptions of graduate students in education disciplines regarding the role of artificial intelligence applications in enhancing spending efficiency in public schools in Saudi Arabia. The study employed qualitative methodology suitable for the study's objectives, and conducted individual interviews with 28 graduate students who work in education and are enrolled in one of the graduate programs at a Saudi public university. After analyzing and categorizing the information, the study results found that participants have very positive perceptions toward the role of artificial intelligence in achieving many benefits for the education sector. The study also found that participants believe that artificial intelligence, through its multiple applications, can contribute to achieving spending efficiency in Saudi public schools by improving the educational system and raising its quality, where artificial intelligence applications contribute effectively to reducing school dropout rates, increasing school discipline, and considering individual differences among learners. The study results also indicate that participants believe that school facilities contribute significantly to raising the education bill in the country, and that introducing artificial intelligence applications would ultimately lead to achieving spending efficiency through rationalizing energy consumption and maintenance in school facilities. The study also provided a number of recommendations.

Keywords: spending efficiency, education financing, spending rationalization, public schools in Saudi Arabia, economics of education

INTRODUCTION

Education is the path to developing societies and the way to invest in human resources and equipping them with useful knowledge and skills, leading them to develop nations and elevate them. The Saudi government has believed in the importance of education for citizen advancement since the beginning, as King Abdulaziz established a Directorate of Education even before completing the unification of all regions of the Kingdom in 1926. The government of Saudi Arabia pays great attention to education, working to develop it, encourage scientific research, nurture the gifted, develop professional skills, and is committed to combating illiteracy (Al-Bashar, 2020: Ministry of Education, 2025). The education budget in the Kingdom for 2023 amounts to approximately 185 billion Saudi riyals (Ministry of Finance, 2023). The number of schools in Saudi Arabia has also exceeded 35 thousand schools with nearly 7 million students.

Education budgets witness continuous increases in Saudi Arabia. For example, the budget allocated for education in 2006 was less than 64 billion riyals, compared to approximately 185 billion riyals for 2023. This constitutes significant pressure on the state budget; therefore, thinking about finding alternative funding sources for basic education and post-secondary education has become an important issue occupying all those interested in the education sector, whether researchers or decision-makers, especially in light of rising education costs in the country and the direct increase in education-related expenses. The government allocated 136 billion riyals as an education budget in 2023. In light of the continuously rising education budget, other items of the state budget are affected, so it requires the existence of alternatives and non-traditional sources that lead to relieving the burden on the government and activating other funding alternatives that contribute to providing financial revenues for Saudi educational institutions. The government budget in Saudi Arabia has long relied heavily on oil revenues, making it always vulnerable to positive and negative fluctuations in the oil market; therefore, the Saudi leadership recently announced an ambitious vision, Vision 2030, which among its basic goals is to liberate the national economy from dependence on oil revenues and diversify income sources to ensure continuity and sustainability of development (Vision 2030, 2016).

Spending efficiency in the education sector represents a strategic requirement in light of economic challenges and financial pressures facing governments, especially in countries seeking to achieve sustainable development and comprehensive digital transformation, such as Saudi Arabia (Al-Bashar et al., 2024). Public schools are considered one of the most prominent sectors that consume a large percentage of government budgets, necessitating thinking about innovative solutions to raise their operational and educational efficiency and ensure achieving the best results with the least possible resources. In this context, artificial intelligence emerges as one of the modern technical tools that possess promising potentials for bringing qualitative change to the education environment. Artificial intelligence is no longer merely an accompanying technology but has transformed into an active element capable of providing customized educational solutions, improving output quality, and rationalizing resources, especially in public education environments characterized by numerical density and increasing operational challenges.

Problem Statement

Public schools in Saudi Arabia face multiple challenges in achieving spending efficiency, especially in light of increasing student numbers, rising operational costs, and weak employment of modern technological solutions. Some studies indicate the existence of financial waste in the education sector, whether at the level of low education quality or poor management of school facilities. In light of these challenges, artificial intelligence emerges as a promising tool that may contribute to improving the quality of the educational process on one hand, and raising the efficiency of resource and facility management on the other (Al-Anzi, 2024; Al-Azab, 2022; Al-Tahriowi, 2025; Qutb, 2023; Shili, 2022). However, the employment of this technology remains limited and unorganized, necessitating a study of specialists' and practitioners' perceptions regarding the feasibility of using it to achieve spending efficiency in public schools (Al-Bashar et al., 2024). This qualitative study stems from the need to explore the perceptions of specialized graduate students working in the field of education regarding the possible role that artificial intelligence technologies can play in achieving spending efficiency in Saudi public schools, whether through improving education quality and reducing educational waste and loss, or through raising the efficiency of operating and maintaining school facilities. The study also aims to analyze the current reality and provide recommendations that contribute to enabling decision-makers to adopt policies based on realistic data and practical experiences. Thus, the study seeks to fill a knowledge gap in Saudi literature.

Research Question

What is the role of artificial intelligence applications in enhancing spending efficiency in Saudi public schools?

Study Objectives

• Identify participants' perceptions about the role of artificial intelligence in achieving spending rationalization on educational processes in public schools • Reveal participants' perceptions about the role of artificial intelligence in achieving spending efficiency on technical aspects in public schools • Identify participants' perceptions about the role of artificial intelligence in achieving spending efficiency on material aspects in Saudi public school

Theoretical Framework and Previous Studies

Overview of Artificial Intelligence Development

The journey of artificial intelligence began in the middle of the last century, and British doctor and mathematician Alan Mathison Turing is considered one of the founders of artificial intelligence science in the 1950s. Despite the doctor's deviant tendencies that led to his trial and conviction, he contributed to establishing the concept of artificial intelligence, and the British scientist proposed the famous Turing test as a measure of machine intelligence. This era - often referred to as the "birth of artificial intelligence" - witnessed the establishment of basic concepts related to this science such as symbolic thinking and early neural network models. However, progress was slow due to limitations on computational capacity and data availability, and questions always revolved around the ethics of artificial intelligence and its impact on humans. This field has witnessed a new renaissance in recent decades, characterized by important milestones such as Deep Blue computer developed by IBM's victory over Garry Kasparov in chess in 1997. It is worth noting that Russian Garry Kasparov was the world chess champion at that time, and the journey of developing deep learning algorithms continued, especially with the introduction of convolutional neural networks in image recognition tasks. Breakthroughs in hardware - such as graphics processing units - accelerated neural network training, leading to rapid progress in various artificial intelligence applications, including natural language processing, robotics, and autonomous vehicles. The emergence of companies like Google, Facebook, Chat GPT, and Gemini has enhanced research and development in artificial intelligence, pushing it to the forefront of technological innovation (Rasheed et al., 2024; Kaul et al, 2020; Haenlein, M., & Kaplan, 2019; Wooldridge, 2021). Saudi Arabia has also shown great interest in artificial intelligence, establishing the Saudi Authority for Data and Artificial Intelligence (SADAIA) by royal decree issued in 2019, directly linked to the Prime Minister (SADAIA, 2024). Saudi Arabia ranked first globally in the Government Artificial Intelligence Strategy Index in 2023, awarded by Tortoise Intelligence (Saudi Press Agency, 2023).

Previous Studies

Al-Fayez and Al-Sadhan (2021) conducted a study titled: "Improving Spending Efficiency Through Merging Low-Enrollment Government Schools." The study aimed to review global best practices in merging schools in areas with low population densities, and also aimed to present proposals for raising the efficiency of low-enrollment schools in Saudi Arabia. The study used qualitative analytical methodology, and the researchers analyzed documents and reviewed countries' experiences in merging low-enrollment schools, and also interviewed 20 experts. The researchers studied the experiences of eleven countries in dealing with low-enrollment schools, including the United States, Norway, Finland, Canada, and China. Among the prominent results revealed by the study when reviewing countries' experiences in attempting to reduce student costs in low-population areas were: merging low-enrollment schools, merging similar grades within the same school, and establishing network schools which involve appointing one main school to manage several small neighboring schools within the same educational district, allowing sharing of human and material resources in more than one location. Also among common practices found by the study was merging educational districts to reduce spending and operational expenses. The study also presented a proposal for addressing low-enrollment schools in Saudi Arabia.

Al-Baqiya and Al-Sharif (2021) conducted a descriptive study titled "Privatization and Its Role in Improving Education Outcomes from School Leaders' Perspective." The study sample consisted of 61 school principals. The study results found that privatization has a role in improving education from technical, social, and economic aspects. The study also found several obstacles to privatization success in Saudi schools. The study recommended several suggestions including: working to prepare the administrative organizational environment in general education schools for private sector work, focusing on reducing administrative work centralization in general education schools, and establishing controls to limit rising tuition fees resulting from public education privatization.

Al-Haqqan (2023) conducted a study titled: "Artificial Intelligence and Its Effectiveness in Developing Interior Design Skills." The descriptive study aimed to identify the role and effectiveness of artificial intelligence in interior building design. The study found that the interior design field has benefited from artificial intelligence applications and helped designers create multiple variables and produce huge numbers of models and designs. The researcher reviewed several artificial intelligence applications in the design field, including computer vision, where designers can capture images of design elements to be furnished, then visual search and comparison are performed by artificial intelligence, as well as natural language processing and augmented reality programs. The study reviewed design applications enhanced by artificial intelligence technology and mentioned details about each of the five applications. The study results concluded that artificial intelligence helps interior designers in creating different designs, analyzing problems with high

accuracy and speed, and enhances creativity. The study also recommends introducing artificial intelligence into curricula for interior design students.

Al-Asmari (2023) conducted a study aimed at revealing the relationship between spending efficiency in primary education schools and improving education quality in one of the educational regions in southern Saudi Arabia, discovering the need for financial spending efficiency in some primary schools, and identifying the main difficulties and how to achieve spending efficiency. To achieve research objectives, the researcher employed descriptive analytical methodology by applying a questionnaire of 23 items as a data collection tool, then analyzed the data, reaching several results: the total score for the first axis (education spending indicators) had a relative weight of 62.56%, while the total score for the second axis (education quality) had a relative weight of 65.66%. The results confirmed that there is an impact of education spending reflected on education quality - the more efficient education spending increases, the better education quality becomes.

Al-Sayed (2024) conducted a study titled: "Artificial Intelligence and the Future of Education." This descriptive study aimed to provide analytical information about the importance of artificial intelligence and the roles it plays in education. The researcher believes that artificial intelligence represents a major transformation in humanity's future and will change many concepts, as there are artificial intelligence models that have already contributed to changing reality in many service and industrial organizations such as smart robots, self-driving vehicles, and other artificial intelligence capabilities to predict potential scenarios and future crises. The researcher believes that artificial intelligence has the ability to transform traditional classrooms into smart classrooms that provide scientific content while considering individual differences among learners, whether through individualized education or changing teaching and communication methods. The researcher adds that artificial intelligence-assisted education is more effective and equitable, with many useful artificial intelligence applications in this regard: augmented reality applications, virtual reality applications, and artificial intelligence applications including chatbots, expert systems, and intelligent learning systems. The research presents several uses or fields for artificial intelligence in education. The first field is using artificial intelligence as educational material, meaning that artificial intelligence sciences themselves become a course that students learn. The second field is using artificial intelligence as a teaching and learning tool, where teachers benefit from employing artificial intelligence applications as educational tools, such as using expert systems by students to solve problems and train. The third field is using artificial intelligence in educational administration, where artificial intelligence applications help school principals and administrators accomplish many administrative tasks, especially using effective expert systems that contribute to making complex administrative decisions, designing study schedules, making student decisions, and diagnosing school reality. The fourth field is using artificial intelligence for evaluation purposes, benefiting from intelligence in preparing tests objectively and helping correct tests. Artificial intelligence applications can consider individual differences among students in test design methods, unlike traditional testing methods. The fifth field is supporting students with disabilities through artificial intelligence, where artificial intelligence applications contribute to helping students with visual and hearing disabilities master learning through augmented and virtual reality technologies, and smart robots teach students facing health or physical problems. The study details ways artificial intelligence contributes to education, and the researcher suggests greater reliance on artificial intelligence in schools as they are capable of responding to rapid changes in today's world.

Commentary on Previous Literature

The current study benefited from previous studies in deepening concepts in the study topic, and this scientific paper benefited from previous literature in deepening knowledge about artificial intelligence in general and benefits of artificial intelligence applications in education in particular. Previous studies also contributed to formulating the research question and choosing methodology. The current study distinguished itself from previous studies by being a qualitative study, and it is the first Saudi study published in English - according to the researchers' knowledge - about artificial intelligence using qualitative research methodology. The study topic is also new of its kind, as there is no published study - according to the researchers' knowledge - about the role of artificial intelligence in achieving spending efficiency in public schools.

Sample and Methodology

The study sample was selected using purposive sampling method, consisting of 28 male and female graduate students from one of the colleges in Saudi Arabia who work in education. After obtaining consent from the study sample, the first researcher conducted interviews with the study sample via Zoom program in 2024, and interviews were recorded to ensure information accuracy. Audio interviews were converted to written texts, and peer review was used to confirm the credibility and reliability of qualitative information, which is

always subject to debate. The study used qualitative methodology suitable for research objectives, and qualitative research helps understand many topics more deeply through qualitative information collection tools including interviews. The study adopted phenomenological methodology in qualitative research as a research methodology for this research, and phenomenological methodology as a qualitative research methodology focuses on highlighting ideas about the studied phenomenon away from concern with generalizing results (Al-Rashidi, 2018). The study adopted the information analysis methodology proposed by (Bingham, 2023) consisting of five stages: In the first stage, interview data were organized and coding for common themes was created. In the second stage, data sorting was done. In the third stage, data understanding was done. In the fourth stage, data interpretation was done, identifying patterns and themes. In the fifth and final stage, data explanation was done.

RESULTS

Results were divided into two patterns or themes: **Theme One:** The role of artificial intelligence applications in achieving financial efficiency through improving educational quality **Theme Two:** The role of artificial intelligence technologies in achieving spending efficiency through improving school facility quality

First: Theme One: The Role of Artificial Intelligence Applications in Achieving Financial Efficiency Through Improving Educational Quality

Participants agreed that educational quality is an important element for educational organizations and that declining educational quality leads to major losses in various aspects including economic aspects. Participants explained that failure or academic delay is the biggest obstacle to school excellence, and increasing failure rates leads to significant waste in financial resources allocated to the education sector. They confirmed that failure and school dropout have significant economic impacts on individuals and society, and participants unanimously agreed that low academic achievement is one of the most important causes of school dropout and failure in Saudi schools. Study results indicated that participants believe there are multiple reasons for failure and dropout, but there was no consensus on one single reason. Most attributed failure and dropout to family-related factors such as family disbelief in education or weak supervision and monitoring of students' academic achievement due to parents' illness or family breakdown due to divorce. Participants added that due to weak family supervision, children are exposed to bad companions and friends who often prevent educational excellence, and their influence may cause many to fail in education. Some participants like participant number (4) said: The main reason for failure and dropout is the educational system, as there is overcrowding in classrooms, poor teacher qualification, and schools do not perform their main role well, so children do not learn properly in government schools. Participant number (9) also commented that many children have hidden disabilities that prevent them from learning normally, so they need a type of special education and treatment, which does not happen in many schools, leading to academic difficulties. All participants agreed that dropping out of the educational system has a negative economic impact on individuals and society. Participant number (11) added: Problems and crimes often originate from people who lack education, as we rarely hear of organized crime led by a university graduate, but criminal organizations involved in theft and distributing prohibited substances are always from the uneducated category, ending with a large percentage behind bars. Having these people in prisons will not solve the problem but will worsen it economically, as society loses many human resources at productive age due to staying in prisons. Also, prisoners require security, health, and nutritional care, which is economically costly as prisons are funded by government sources. Some participants confirmed that people who did not complete their education often join jobs with low salaries, exposing them to living below the poverty line.

Participants agreed that artificial intelligence helps solve many issues related to weak academic achievement, which is the main cause of repeating academic stages multiple times, or perhaps leads some students to leave school entirely. Eight participants confirmed that artificial intelligence applications have the ability to consider individual differences among students and give each student a study plan and exercises that consider their current level and try to develop them and move them to a higher level, contributing to improving students' academic achievement and reducing failure and dropout rates. Participants agreed that it is difficult for teachers to effectively consider individual differences among learners due to limited time and effort and many students in classrooms. Given education ministries' keenness in Arab countries on the importance of reducing operational expenses, especially those related to teacher compensation that consumes most financial allocations for education ministries, it is unlikely in the near and medium term to reduce class sizes and student numbers per teacher to rationalize expenses. Therefore, educational artificial intelligence applications

come as a significant alternative to teachers, and applications using artificial intelligence have begun taking their place in educational organizations. The intelligent teacher has become a good option for students suffering from challenges in traditional education or those with above-average abilities. Artificial intelligence can consider all individual differences among learners at the speed desired by the learner. Therefore, among suggestions is that the Ministry of Education design artificial intelligence applications to teach students in the Kingdom, which will save many expenses for families that usually have to bring an expensive private teacher as a solution to compensate for the lack of academic achievement of their children due to not understanding lessons well. Therefore, participants believe that artificial intelligence applications will save much money if relied upon as an aid to learning.

Results indicated that artificial intelligence applications are capable of compensating for educational loss due to students being absent from school due to illness, moving to a new school, or other circumstances, which are also prominent causes of academic failure. Artificial intelligence applications consider the educationally delayed situation, and teachers may not be able to compensate for educational loss for all students due to limited time and effort, and schools cannot provide an additional teacher due to many financial obligations. Therefore, artificial intelligence will contribute to compensating for educational loss in students, leading to reducing grade repetition, which will have a significant cost on the national economy as students will stay an additional year in school, in addition to the labor market losing a production element, negatively reflecting on development. Study results found that among causes of educational waste that artificial intelligence can reduce is schools' lack of educational aids and laboratories. Many schools may not have modern educational aids that increase student interaction and bring concepts closer to them. Therefore, using artificial intelligence will contribute to improving students' academic achievement through presenting information and concepts on one hand, and artificial intelligence has the ability to reduce significant financial costs related to materials used in scientific laboratories. For example, artificial intelligence allows students to conduct scientific experiments through it without needing to buy many chemical materials, having a positive impact on reducing expenses on one hand and preserving environmental and student health and safety on the other.

Several participants stated that artificial intelligence applications help teachers and schools identify students' strengths and weaknesses through virtual tests and other assessment methods, providing good information for school administration and teachers to make quick decisions to address causes that may lead to low academic achievement or perhaps students not achieving sufficient grades to pass. Artificial intelligence applications are characterized by abundant and diverse assessment methods, and activating the use of these applications and school subscription to services provided by smart applications will contribute to school development and activating its role properly. Artificial intelligence applications also help make decisions without human bias, leading to greater acceptance by all school members, as artificial intelligence knows no bias except to information, having a positive reflection on work environment and also on developing student performance and achievement, preventing their failure.

Artificial intelligence applications can help school administration improve education quality by reducing failure and dropout rates through providing preventive and therapeutic indicators for students most likely to fail or drop out of school. In case schools activate student attendance systems through artificial intelligence applications applied in many private schools worldwide, whether those that recognize student faces and mark attendance, and in case of delay or absence, an electronic notification is sent via email to the guardian, contributing to enhancing school discipline and reducing absenteeism likelihood. Artificial intelligence contributes to analyzing information and building perceptions away from human intervention to address problems including tardiness or absence issues that are frequent among academically struggling students, where the likelihood of leaving their seats without return increases. Participant number 8 adds that artificial intelligence has a role in enhancing student discipline and knowing if a student repeatedly comes late, is absent, or escapes from classrooms or school through artificial intelligence applications that provide massive information about student discipline status and behaviors. Artificial intelligence can analyze information and compare it to reach conclusions that help identify students most likely to drop out or struggle academically due to frequent absences. Participants also added that artificial intelligence may contribute to detecting students with emergency health or family problems by comparing student attendance throughout the academic year. A student may be more disciplined at the beginning of the year but start frequent absences mid-year, possibly indicating emergency problems for the student whether economic or social such as family problems. Then school administration and educational counselor can directly intervene to try isolating these problems' impact on the student and minimize negative effects as much as possible, which is difficult to detect without artificial intelligence technologies.

Second: Theme Two: The Role of Artificial Intelligence Technologies in Achieving Spending Efficiency Through Improving School Facility Quality

Participants agreed that artificial intelligence has an important role in improving spending efficiency in school buildings and facilities as well as their maintenance. Participants also agreed that generative artificial intelligence is still in its early stages and will have tremendous effects that cannot be imagined in various fields including school facilities. Although artificial intelligence is still in its early development, participants believed that artificial intelligence has a role in spending efficiency in facilities and their maintenance in schools. Participants number 7 and 9 commented: Artificial intelligence is a good tool for determining options to compare suitable offers when planning to build a new school or build new facilities for an existing school. Artificial intelligence can help make appropriate decisions without human bias in reviewing competitions to win school construction contracts for contracting companies. Artificial intelligence can compare suitable offers, appropriate building materials, and appropriate engineering design that significantly saves energy consumption. There are many modern designs that consider environmental aspects by emphasizing use of heat-insulating windows, enhancing sunlight entry into the building, contributing to reducing electrical waste and providing lighting, using solar panels to generate clean energy, and determining the geographical location of the school, confirming spending efficiency in new schools. Therefore, artificial intelligence is considered a helpful tool when planning to build new facilities and can help with many construction-related options. Artificial intelligence has the ability to analyze millions of data worldwide regarding construction, which will contribute to making sound decisions that save huge amounts of money.

Most participants mentioned that artificial intelligence can help existing schools reduce many operational expenses related to buildings in existing schools. Electricity consumption for schools in Saudi Arabia - whether public or private schools - is often high due to the need for air conditioning and ventilation units in most school facilities due to high temperatures most of the academic year, as well as needing heating means in winter inside classrooms and administrative rooms, consuming much electrical current and inevitably leading to rising school expenses. Lighting may also be a source of waste in schools, as many facilities are lit even without student presence, and old bulbs that consume energy significantly are used, as well as water coolers and water heaters in bathrooms raising electricity bill amounts. Participant number 3 commented that due to his work as a teacher, he noticed when arriving early to school that there are air conditioning units and lighting that remained working since the end of yesterday's work until this morning due to some school maintenance workers' negligence in turning them off, representing significant electrical waste on one hand and reducing cooling unit lifespan due to excessive consumption, especially since these devices - whether educational aids, air conditioning, or lighting means - have a lifespan estimated in hours, and lighting means may be damaged after completing certain hours. Participants agreed that artificial intelligence can improve spending efficiency in school facilities regarding electrical consumption. Installing electrical sensors with artificial intelligence that turn off electrical current for air conditioning, lighting, and modern educational aids when no human element is present for ten minutes or so will save thousands of riyals annually from school budgets on one hand, in addition to apparent effects of reducing electrical consumption on environment and reducing carbon emissions, especially since Saudi Arabia cares about environment and has the Saudi Green Initiative aimed at reducing harmful carbon emissions for life. Participants also added that activating artificial intelligence in reducing electrical consumption also benefits extending the lifespan of electrical devices inside schools from air conditioning units, computers, smart boards, projectors, lighting, water heaters, water coolers, printing and copying machines. Artificial intelligence will contribute to electronically turning off electrical current for most of these devices outside working hours and holidays without needing human intervention.

Some participants believed that water consumption is high in Saudi schools compared to Western schools for several reasons including high temperatures, and Saudi students are Muslims who perform noon prayer in schools, especially male students, leading to water consumption due to ablution for prayer, as well as using water for personal hygiene purposes, which distinguishes Muslims from others. Participants agree that high water waste is observed in existing schools, whether through leaks in water pipes and tanks due to age and poor maintenance or due to not closing water taps in bathrooms due to negligence or deliberate action by some students leaving taps wasting liters of water, which is significant environmental waste especially for a desert country like the Kingdom, where the government spends huge amounts on water desalination. Participants believe that artificial intelligence technologies can reduce water waste, reflecting on reducing water bills. Water devices using artificial intelligence can control water ratios and sense if there is abnormal water waste due to water pipe explosion or water tap being open for a long time and similar problems. Smart

taps that work and close automatically when seeing human hands also contribute to reducing waste in water energy. Artificial intelligence can intelligently shut off water pumping to facilities after the end of the school day automatically, ensuring no water leaks occur. Artificial intelligence technologies also help school administration schedule periodic maintenance for plumbing and school facilities and electronically remind school administration of this. Therefore, applying artificial intelligence will improve spending efficiency on water in schools.

Several participants mentioned that artificial intelligence and its applications can preserve the building and school facilities in general and extend the school building's lifespan for the longest possible period by ensuring optimal energy use and ensuring no recurring problems regarding water and sewage. Many buildings decrease in quality due to recurring water leaks, leading to erosion of several building materials and cracks appearing on buildings and floor and school furniture deterioration, possibly reducing school building lifespan, as well as frequent changes in school furniture and decorations due to damage. It is highly likely that applying artificial intelligence will increase schools' expected lifespan by ensuring appropriate ventilation and temperature degrees, especially since many modern educational aids, educational screens, and school furniture will be damaged in case of increasing temperatures, in addition to wall cracks. Artificial intelligence will also limit water leaks, which is healthy for concrete buildings as water is harmful to them. Participants added that artificial intelligence can extend the building's expected lifespan also by scheduling periodic maintenance appointments and alerting school administration to perform maintenance at its specified time. Extending school building lifespan will lead to spending efficiency, so instead of using the building for 30 years, it will be used for 50 years, God willing, which will reduce student cost in Saudi Arabia.

Summary and Discussion of Study Results

Study results revealed good awareness among participants about the importance of educational quality in reducing financial waste and enhancing spending efficiency. Participants unanimously agreed that academic failure and dropout represent direct manifestations of educational resource waste and reflect weak academic achievement that may arise from educational, family, psychological, and social factors. Statement results showed that these phenomena' effects are not limited to the educational system only but extend to society as a whole through causing loss in productive workforce and increases in unemployment, crime, and poverty rates, ultimately leading to additional financial burdens on the state. In this context, participants confirmed that artificial intelligence applications represent a strategic opportunity to improve education quality and address causes leading to failure and dropout. They pointed to these applications' ability to consider individual differences among learners and provide customized educational plans suitable for their levels and abilities, which is difficult for traditional teachers to achieve in light of classroom overcrowding and limited resources. Results also showed that artificial intelligence can be employed to compensate for educational loss resulting from absence, illness, or moving between schools, by providing flexible digital educational environment considering temporal and cognitive differences, contributing to reducing grade repetition with direct savings in educational costs. Among notable points, participants' reference to artificial intelligence's role in improving educational aids, especially in laboratories, by providing digital simulation environments for experiments, reducing need for expensive and dangerous chemical materials, thus achieving financial savings and improving environmental safety level inside schools. Smart applications also distinguished - according to participants' statements - by their role in accurately diagnosing students' academic reality through using advanced technological assessment tools enabling teachers and school administrations to make data-based educational decisions, away from impressions or personal biases, enhancing justice and effectiveness in educational interventions. Among prominent contributions related to spending efficiency is what relates to attendance and departure tracking applications, which allow monitoring early absence cases and sending immediate alerts to parents, enhancing school discipline and helping identify students at risk of dropout or those facing health or social difficulties affecting their regularity, all contributing to reducing dropout and failure costs in the long term.

Participants also highlighted another dimension of spending efficiency represented in school facility management. Their opinions agreed that artificial intelligence can play a crucial role in improving resource consumption (electricity, water, infrastructure), especially in light of climatic challenges and high energy consumption facing Saudi schools. Several participants indicated that artificial intelligence contributes to rationalizing electricity consumption through smart systems that automatically turn off lighting and air conditioning when not in use and control device operation scheduling, leading to reduced electricity bills and extended device lifespan. Similarly, artificial intelligence's ability to reduce water waste was highlighted through sensing and automatic operation technologies for water taps, in addition to tracking leaks and

scheduling maintenance work, contributing to protecting expensive water resources in a desert country like the Kingdom. From a construction perspective, participants' statements showed that artificial intelligence can be used in planning and building new schools through analyzing construction offers and comparing them, providing energy-saving designs considering environmental considerations, enhancing decision effectiveness and reducing error and financial waste likelihood. Participants also indicated that these technologies can contribute to extending school buildings' expected lifespan through preventive monitoring of maintenance work and reducing deterioration resulting from negligence or delayed maintenance, achieving significant long-term financial savings by reducing need to build new schools or conduct expensive renovations.

Recommendations

- Expand the use of artificial intelligence technologies in educational buildings
- Develop artificial intelligence applications specific to the Ministry of Education to ensure these applications' safety from hacking and theft
- Conduct additional studies on artificial intelligence's role in planning and engineering design of educational buildings
- Conduct a study following mixed qualitative and quantitative methodology on artificial intelligence technologies' role in enhancing spending efficiency in buildings affiliated with the Saudi Ministry of Education
- Conduct studies on artificial intelligence applications' impact on students' academic achievement
- Conduct studies on artificial intelligence applications' impact on reducing failure and dropout rates

REFERENCES

1. Al-Bashar, Saud, Al-Shehri, A, Ibrahim, H, Adisa, A, Al-Rowaita, A, Al-Shamri, A, Awatara Karim. (2024). Proposals to enhance spending efficiency on general education in Saudi Arabia in light of Saudi Vision 2030. International Journal of Humanities and Social Sciences. Issue 58
2. Development for Studies and Research (JSD), 6(21), 12_25-12_25.
3. Al-Asmari, Iman. (2023). Spending efficiency in some primary education schools to improve education quality in Balsamer region. Arab Journal of Specific Education, 7(25), 45-56.
4. Al-Baqiya, Mohammed & Al-Sharif, Munira. (2021). Privatization and its role in improving education outcomes from school leaders' perspective. Journal of Arts, Literature, Humanities and Social Sciences, (74), 141-167.
5. Al-Haqqan, Nada. (2023). Artificial intelligence and its effectiveness in developing interior design skills. Journal of Arts, Literature, Humanities and Social Sciences, (88), 117-126.
6. Al-Rashidi, Ghazi. (2018). Qualitative Research in Education. Al-Falah Library for Publishing and Distribution. Kuwait
7. Al-Sayed, M. (2024). Artificial intelligence and the future of education. Journal of Artificial Intelligence and the Future of Education. Volume 2 Issue 3.
8. Shili, Ilham. (2022). Using electronic educational platforms to activate artificial intelligence. International Journal of Artificial Intelligence in Education and Training, 2(2), 1-12.
9. Al-Tahriowi, Murad. (2025). The role of artificial intelligence in education. Journal of Scientific Development for Studies and Research (JSD), 6(21), 12_25-12_25.
10. Abdel Rahman, Said Hassan, Mohammed, Duaa Abdel Rahman, Abdel Aziz, & Sara Yahya. (2018). Sustainable interior design and its impact on school buildings. Journal of Architecture, Arts and Humanities, 3(Issue 12 (1)), 242-252.
11. Al-Azab, Aghada. (2022). Artificial intelligence and its reflections in education. International Journal of Artificial Intelligence in Education and Training, 2(2), 13-30.
12. Al-Anzi, Maryam Ayed. (2024). Artificial intelligence in education: A systematic review. Arab Journal of Educational and Psychological Sciences, 8(39), 451-472.
13. Al-Fayez, Fayez & Al-Sadhan, Abdullah. (2021). Improving spending efficiency through merging low-enrollment government schools. Scientific Journal of King Faisal University
14. Faraj, M. (2024). Artificial intelligence and the future of education. Journal of Artificial Intelligence and the Future of Education. Volume 2 Issue 3.
15. Qutb, Jolin. (2023). Research on artificial intelligence tools and their application fields in scientific research writing. Journal of Arts, Literature, Humanities and Social Sciences, (98), 443-469.