

**An Examination of Artificial Intelligence Integration within Kuwaiti Middle School
Computer Science Curricula: A Descriptive and Analytical Study**

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Abstract

This study meticulously investigated the extent to which artificial intelligence (AI) concepts and applications are integrated into the intermediate school (grades six through nine) computer science curricula within the State of Kuwait. Employing a quantitative descriptive methodology and content analysis, the research utilized a meticulously developed and validated content analysis card comprising 35 indicators across five fundamental AI domains: data analysis and structuring, AI applications, AI programming, physical computing, and machine learning and deep learning. The unit of analysis was the idea/topic, chosen for its suitability to the study's objectives. The sample encompassed eight computer science textbooks specifically designed for the intermediate level during the 2024/2025 school year. The findings of this research reveal a stark absence of AI topics, concepts, and applications within the examined computer science curricula for grades six through nine in Kuwait. Notably, the analysis indicated a 0.00% inclusion/integration rate across all five AI domains in all eight student textbooks. This demonstrates that the current computer science curriculum for the intermediate level entirely lacks any AI-related content. Based on these findings, the study offers several key recommendations: (1) Seamlessly incorporate AI concepts, applications, and ethical considerations into all computer science textbooks; (2) Revise textbooks in all subjects to integrate current technological advancements, with a particular focus on including the definition, practical applications, and ethical implications of AI; (3) Develop interactive digital/electronic content that leverages AI technologies for enhanced teaching and learning experiences; (4) Equip faculty with comprehensive knowledge of AI, its ethical considerations, and practical applications to cultivate an informed student body; (5) Provide thorough training for teachers and administrators on effectively integrating AI into teaching and learning practices; and (6) Allocate adequate resources and support for the successful integration of AI within the teaching and learning environment.

Keywords: artificial intelligence, AI, AI concepts, AI applications, AI ethics, AI integration/inclusion into curricula, computer science curricula, intermediate/middle school/stage, PreK-12 education, general education, State of Kuwait.

Introduction

The world is currently experiencing a profound and multifaceted knowledge revolution, often referred to as the Fourth Industrial Revolution, or the age of cyber-physical systems. This revolution seeks to transform all facets of human life by reshaping the interaction between machines and objects, as well as human thought processes, with a significant reliance on artificial intelligence (AI). Globally, efforts are focused on leveraging this substantial information revolution scientifically and economically by integrating AI technology and its diverse applications across all sectors (Abdulsalam, 2021; Al Darayseh, 2023; Alshidi & Alsaidi, 2022; Carlos et al., 2018; Safar, 2024a, 2024b, 2025).

AI empowers computers to develop/create intelligent machines and programs that mimic human intelligence, enabling them to perform traditional human tasks, often exceeding human capabilities, like thinking, understanding, solving problems, learning, reasoning, and making decisions (Al Hiary, 2023a; Bakr & Taha, 2019; Ghanaiem, 2023; Safar, 2024a, 2024b, 2025; Samili, 2023).

Key AI subfields include (Abd-Elraheem & Hassanein, 2022; Abdulsalam, 2021; Alfayez et al., 2021; Al Fifi, 2020; Alghamdi & Alfarani, 2020; Al Hiary, 2023a; Alsaidi et al., 2023; Bin Ibrahim, 2021; Fouad et al., 2012; Safar, 2024a, 2024b, 2025; Simhadri & Swamy, 2023):

1. Computer Vision: Enabling machines to “see” and interpret images/videos.
2. Pattern Recognition: Identifying patterns in data (images, sounds, text).
3. Expert Systems: Emulating human expertise in specific domains.
4. Knowledge Engineering: Formalizing human knowledge for AI use.
5. Artificial Neural Networks (ANNs): Brain-inspired systems for pattern recognition and learning.

6. Natural Language Processing (NLP): Enabling computer-human language interaction.
7. Machine Learning: Training AI to improve performance through data analysis.
8. Deep Learning: Advanced machine learning using deep neural networks.
9. Adaptive Learning: Personalized learning tailored to individual student needs.
10. Diagnosis, Analysis, and Prediction: AI-driven insights in fields like medicine and education.
11. Discourse Understanding: Enabling AI to understand nuances in human communication.
12. Human-Computer Interaction (HCI): Designing user-friendly interfaces for AI systems.
13. Problem-Solving: Applying AI to analyze and solve complex problems.
14. Data Mining and Analysis: Extracting insights from large datasets.
15. Cybersecurity: Using AI to protect systems from cyberattacks.
16. Business Optimization: Streamlining business functions and driving efficiency.

AI's technologies and applications are context-specific, adapting to the needs of diverse fields like healthcare, finance, education, and transportation, ultimately driving technological advancement and societal well-being. This transformative technology promises numerous benefits (Abd-Elraheem & Hassanein, 2022; Al Darayseh, 2023; Alfayez et al., 2021; Alsaidi et al., 2023; Al Shaibaniya, 2019; Ayanwale et al., 2022; Bin Ibrahim, 2021; Celik et al., 2022; Ferikoğlu & Akgün, 2022), including: reduced human effort through automation; increased time efficiency via faster processing; cost savings through process optimization; enhanced product quality due to advanced data analysis; and boosted productivity. This digital revolution has the potential to reshape economic, social, and cultural systems, fundamentally altering individual and societal behaviors.

Exploring the Roles and Significance of AI Integration in Education

UNESCO has underscored that the acknowledged interest in AI within the technical and vocational education and training (TVET) sector has not yet been broadly implemented at the institutional level. Although the international TVET community recognizes the prospective impact of AI on both the labor market and the education and training sector, a comprehensive understanding of how these systemic shifts will influence the operational practices of educational institutions remains limited (Bin Ibrahim, 2021).

The 2017 European Union Summit in Gothenburg, Sweden, emphasized the pivotal role of AI in contemporary society. This summit initiated the second Digital Education Plan, which articulated three primary objectives for the educational process (Alsaïdi et al., 2023; Tuomi, 2018): (1) optimizing the integration of digital technologies in pedagogy and learning; (2) prioritizing the cultivation of digital skills and competencies to align with ongoing digital transformation; and (3) improving educational practices through the analysis and evaluation of educational outcomes across European nations. The plan concluded that AI is anticipated to exert a significant influence on teaching and learning in the foreseeable future.

Educational systems are actively pursuing the integration of AI into pedagogical and learning frameworks by capitalizing on contemporary technologies to cultivate an environment conducive to both educator and learner adaptation to technological advancements. Safar (2024a, 2024b, 2025) and Alsaïdi et al. (2023) have delineated three primary domains for the application of AI in education:

1. **Cognitive Science Applications:** These applications involve the utilization of AI to analyze and model human cognitive processes, encompassing areas such as learning, memory, and problem-solving. The insights derived from this analysis

can inform the development of more efficacious teaching methodologies and learning resources.

2. **Intelligent Machine Applications:** This category pertains to the deployment of AI to engineer intelligent systems capable of providing multifaceted support to learners. This includes delivering personalized feedback, adapting to diverse learning preferences, and offering automated instructional assistance.
3. **Natural User Interface Applications:** These applications focus on leveraging AI to develop seamless and intuitive interfaces between educators/learners and technological tools. This aims to simplify access to and utilization of educational resources, while also enhancing the engagement and enjoyment of the teaching and learning processes.

The incorporation of these AI applications into educational curricula holds the potential to foster a more individualized, engaging, and impactful teaching and learning experience for all students (Alamri, 2023; Alghamdi & Alfarani, 2020; Alshidi & Alsaïdi, 2022; Ghanaïem, 2023).

The education sector has witnessed a notable surge in interest surrounding AI applications, largely propelled by the accelerated progress of AI technologies. Integrating AI into the educational process has become a crucial element in the evolution of educational systems as they adapt to the Fourth Industrial Revolution. AI-powered digital tools offer the potential to mitigate numerous structural obstacles that impede effective teacher outreach to all learners. Recognizing the multifaceted challenges confronting school systems, the significance of AI lies in its capacity to support schools in addressing these issues while simultaneously equipping students with the competencies required to navigate contemporary software (Abdulsalam, 2021; Al Darayseh, 2023; Celik et al., 2022; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2021).

AI applications are contributing to a significant evolution of teacher roles within educational environments, particularly in the domains of assessment, grading, and the development of student questions. Furthermore, AI plays a valuable role in enhancing the diagnosis and evaluation of student challenges, identifying learners' psychological states, and delivering pertinent feedback. This technology has the potential to facilitate a transition in the teacher's primary function from traditional lecturing and direct instruction towards the cultivation of active learning methodologies (Alamri, 2023; Al Darayseh, 2023; Bin Ibrahim, 2021; Borge, 2016; Celik et al., 2022). AI-driven educational programs are intentionally structured to address the diverse learning requirements of various student populations and to accommodate a broad spectrum of educational objectives. These programs also foster interaction among students, improve access to digital learning materials, and promote student engagement through a variety of interactive approaches (Abd-Elraheem & Hassanein, 2022; Alfayez et al., 2021; Al Kanaan, 2022; Alshidi & Alsaidi, 2022; Ayanwale et al., 2022; Woolf et al., 2013).

AI applications are revolutionizing educational management by substituting conventional systems with innovative AI-driven electronic platforms that improve both efficiency and quality. These advanced systems offer the capability to (Al Habib, 2022; Al-Sobhi, 2020; Mokatel & Hasni, 2021): (1) strategically allocate courses and schedules to educators based on their specific expertise and areas of interest; (2) proactively identify and provide tailored support for academically gifted students; (3) deliver individualized assistance to students encountering learning challenges; and (4) streamline electronic communication channels with parents.

The incorporation of AI applications into educational frameworks signifies a contemporary strategy aligned with the technological advancements of the Fourth Industrial Revolution, effectively leveraging modern technologies and communication tools

(International Telecommunication Union [ITU], 2020). Drawing upon the research of Safar (2024a, 2024b, 2025) and Alsaidi et al. (2023), several AI applications can be deployed within intelligent education systems, encompassing: (1) the development of intelligent systems; (2) knowledge representation; (3) optimistic experimentation; (4) machine learning; (5) deep learning; (6) the management of incomplete information; (7) problem-solving capabilities; (8) learning aptitude; (9) logic and inferencing capabilities; (10) natural language processing; (11) the handling of conflicting information; (12) learning from prior experiences; (13) the construction of models and perception; and (14) diagnosis, analysis, and prediction.

Advantages of AI Implementation in Education

The positive impacts of leveraging AI applications within the educational sphere are manifested in the following key areas (Abd-Elraheem & Hassanein, 2022; Akgun & Greenhow, 2022; Alamri, 2023; Al Darayseh, 2023; Alfayez et al., 2021; Al Habib, 2022; Al Hiary, 2023a; Alsaidi et al., 2023; Alshidi & Alsaidi, 2022; Ayanwale et al., 2022; Bin Ibrahim, 2021; Celik et al., 2022; Kim & Kim, 2022; Safar, 2024a, 2024b, 2025; Shaban, 2021; Simhadri & Swamy, 2023):

1. **Augmenting Cognitive Capabilities:** AI can be employed to simulate and model human cognitive functions through the analysis of extensive datasets, potentially transforming human-computer interaction paradigms.
2. **Automating Operational Processes:** AI facilitates the autonomous execution of tasks by robotic and digital systems, enabling the completion of complex and intricate activities previously considered beyond human capacity. This enhances productivity, minimizes human error, and supports informed decision-making through the transformation of administrative systems into electronic platforms

capable of intelligent analysis, such as identifying patterns indicative of gifted students.

3. **Facilitating Personalized Learning Pathways:** AI enables a departure from standardized educational approaches, allowing for learning experiences tailored to individual needs.
4. **Enabling Remote Operation and Accessibility:** AI facilitates the remote control of machinery and digital devices, thereby increasing efficiency and safety across diverse applications.
5. **Promoting Continuous Adaptive Learning:** AI empowers digital systems to learn autonomously, derive insights from data, and adapt to evolving circumstances with enhanced intelligence, fostering ongoing development and optimization that can surpass human cognitive limitations.
6. **Customizing the Educational Experience:** AI personalizes and optimizes the learning journey for each student by analyzing performance data to curate relevant resources and recommendations, thereby fostering individual growth and achievement.
7. **Supporting Lifelong Educational Engagement:** AI fosters a shift towards continuous learning by providing opportunities for educational and professional development throughout an individual's lifespan, equipping learners with the adaptability required to navigate the evolving modern world.
8. **Refining Assessment and Feedback Mechanisms:** AI offers the potential for more precise learner evaluation through accurate performance assessments and insightful feedback generation, enabling educators to gain deeper understanding of student strengths and weaknesses to tailor instruction and optimize learning outcomes.

9. Identifying Potential Challenges through Affective Computing: AI can assess students' emotional states by analyzing facial expressions, voice patterns, and written communication to identify potential indicators of anxiety, fatigue, or stress, enabling early intervention and support.
10. Optimizing Educational Workflows: AI automates numerous teaching, learning, and administrative tasks, thereby enhancing efficiency and reducing time demands for both educators and learners.
11. Expanding Educational Access: AI broadens access to educational opportunities for individuals in remote or underserved areas through online learning platforms and AI-powered instructional tools, overcoming geographical barriers.
12. Empowering Educator Effectiveness: AI provides teachers with a comprehensive suite of analytical tools and resources to assess learner performance and preferences, identify knowledge gaps, and deliver targeted support to maximize each student's potential.
13. Fostering Learner Autonomy: AI equips learners with a diverse set of tools that promote self-directed learning, enabling them to independently improve, refine, and sustain their educational pursuits, thereby cultivating ownership of their academic achievements.
14. Supporting the Identification and Resolution of Educational Challenges: AI can contribute to the development of solutions and proposals for educational problems and optimize learning experiences through AI-driven innovations.

AI represents a transformative technological advancement impacting diverse sectors, notably education. AI enhances both pedagogical delivery and learning acquisition, facilitates personalized educational experiences, and provides valuable support to educators throughout the learning process. AI and its applications possess the capability to simulate the dynamics

of individualized human instruction. Intelligent AI-driven education systems offer learning activities specifically designed to address students' cognitive requirements by analyzing their responses and adapting content delivery to align with their interests (Abd-Elraheem & Hassanein, 2022; Al Darayseh, 2023; Almalki, 2023; Alsaidi et al., 2023; Ayanwale et al., 2022; Bin Ibrahim, 2021; Celik et al., 2022; Ferikoğlu & Akgün, 2022; Florea & Radu, 2019; Mahmoud, 2020; Mokatel & Hasni, 2021; Safar, 2024a, 2024b, 2025; UNESCO, 2021; Zhang et al., 2023).

Potential Limitations of AI Implementation in Education

The advent of AI technologies and applications is instigating a fundamental transformation in educational delivery models. These AI-driven tools are significantly reshaping pedagogical approaches and learning methodologies. These intelligent technologies offer substantial potential to revolutionize the educational landscape by providing notable pedagogical benefits, including the capacity to personalize learning experiences, enhance student engagement, and deliver immediate feedback, thereby contributing to improved learning outcomes for a diverse student demographic. Nevertheless, the integration of AI in education warrants a critical evaluation of potential limitations, such as (Abdulsalam, 2021; Alghamdi & Alfarani, 2020; Al Hiary, 2023b; Celik et al., 2022; Ghanaïem, 2023):

1. **Substantial Financial Commitment:** The integration of AI technologies and applications within the educational sector necessitates a considerable financial investment.
2. **Potential for Faculty Redundancy:** The automation of specific instructional responsibilities through AI has the potential to result in workforce reductions and increased unemployment among educators.

3. **Vulnerability to Cyber Threats:** The deployment of robots, devices, and intelligent applications in education introduces potential vulnerabilities to unauthorized access and malicious software.
4. **Reduced Interpersonal Engagement:** An excessive reliance on AI-driven systems could diminish opportunities for direct interpersonal interaction, communication, and social development between educators and learners, potentially impeding the identification of individual student needs and the cultivation of essential social-emotional competencies.
5. **Risk of Student Disengagement:** Extensive utilization of automated systems may contribute to student boredom and a decline in learning motivation due to an overdependence on technology at the expense of established pedagogical approaches.
6. **Demand for Technical Expertise:** Effective utilization of automated systems, robotics, and AI applications may necessitate the acquisition of new technical proficiencies and skills by both educators and students.
7. **Potential for Social Isolation:** Over-reliance on AI could have adverse effects on human behavior by limiting opportunities for interpersonal interaction and social engagement.
8. **Susceptibility to Technological Disruptions:** The educational process may be vulnerable to disruptions arising from technological malfunctions, potentially causing temporary or permanent interruptions in learning.
9. **Critical Concerns Regarding Data Privacy and Security:** The increasing adoption of AI applications in education raises significant concerns regarding the privacy and security of personal student data and educational information that is collected and stored.

10. Complexities in Individualized Evaluation: AI systems may encounter limitations in accurately evaluating individual student progress and genuine comprehension of educational content, potentially impacting the efficacy of the teaching and learning processes.
11. Comprehensive Ethical Considerations: The implementation of AI in education necessitates careful consideration of a spectrum of ethical implications, including potential biases related to race and gender, dehumanization, manipulation of information/data, and even existential risks.

Challenges Associated with Integrating AI into Educational Settings

The integration of contemporary technologies and AI within education offers a transformative opportunity for pedagogical practices and learning acquisition. However, optimizing their effectiveness necessitates a strategic approach that recognizes and mitigates the following key challenges (Abd-Elraheem & Hassanein, 2022; Abdulsalam, 2021; Akgun & Greenhow, 2022; Al Habib, 2022; Al Kanaan, 2022; Alsaidi et al., 2023; Celik et al., 2022; Luchaninov, 2023; Safar, 2024a, 2024b, 2025; Shaban, 2021; Zhang et al., 2023):

1. Ensuring Digital Equity: Addressing the disparity in access to modern technology and infrastructure across educational institutions is crucial to prevent AI integration from exacerbating existing educational inequalities.
2. Developing Workforce Competencies: Implementing a comprehensive professional development strategy is necessary to equip educators, learners, and administrators with the requisite skills and competencies for the effective utilization and seamless integration of AI tools across all educational levels.
3. Creating Pedagogically Aligned Content: The development of engaging and impactful AI-powered educational content that adheres to established pedagogical principles remains a central area of focus.

4. Establishing Robust Data Protection Frameworks: Implementing stringent safeguards to protect the sensitive data, including Personally Identifiable Information (PII), of students, teachers, and administrators collected and processed through AI applications is paramount.
5. Optimizing the Balance Between Human Interaction and Technology: Ensuring a harmonious integration of AI-enhanced learning while preserving essential interpersonal interaction between educators and learners presents a critical challenge.
6. Advancing Educational Equity: Concerted efforts to bridge the digital divide and guarantee equitable access to modern technology for all stakeholders are essential to promote educational justice.
7. Refining Assessment Methodologies: Developing effective methods to accurately measure the true impact of AI on learning outcomes remains an ongoing challenge in educational research and practice.
8. Cultivating a Culture of Innovation: Overcoming potential resistance to change through targeted professional development initiatives and fostering a school culture that embraces innovation are key to successful AI integration.

The strategic integration of contemporary teaching/learning technologies and AI offers substantial prospects for the transformation of education. While recognizing the inherent implementation complexities, a steadfast commitment to continuous improvement and the establishment of comprehensive support frameworks is essential. By effectively leveraging the potential of these advancements, we can cultivate a dynamic teaching and learning ecosystem that empowers educators, learners, and educational leaders to attain enhanced levels of knowledge acquisition, skill and competency development, and overall educational effectiveness.

Literature Review

Previous Studies

(1) A study by Alfayez et al. (2021) investigated the integration of AI concepts and applications within the computer and information technology curricula for middle and secondary school students in the Kingdom of Saudi Arabia. Utilizing a descriptive-analytical quantitative approach based on content analysis, the study developed a content analysis card with five dimensions and 35 indicators, demonstrating a high reliability coefficient of 0.86. This instrument facilitated a detailed analysis of computer and information technology textbooks used in general middle and secondary education. The findings indicated a variable level of AI concept and application integration in middle school textbooks, with inclusion rates of 3.46%, 6.70%, and 10.00% for the seventh, eighth, and ninth grades, respectively. In contrast, secondary school computer and information technology textbooks showed more consistent inclusion rates, approximately 18.00% for Computer 1 (tenth grade) and Computer 3 (twelfth grade), and 15.00% for Computer 2 (eleventh grade). Based on these results, the study recommended a comprehensive review and enhancement of the computer and information technology curricula for both middle and secondary levels, advocating for a greater emphasis on AI concepts and applications that extends beyond traditional computing disciplines to the broader field of information and communication technology.

(2) The study conducted by Bin Ibrahim (2021) sought to determine the degree to which AI applications and ethical considerations are integrated into high school physics curricula. The research focused on secondary school physics textbooks as its population. To fulfill the study's objective, a descriptive and analytical approach utilizing content analysis was employed. The researcher utilized two content analysis checklists to assess the extent to which the physics curricula addressed AI applications and ethics. The findings revealed a "limited" incorporation of AI applications and ethical considerations within the physics

curricula. Consequently, the researcher recommended the development of a framework for integrating AI applications and ethics into high school physics curricula.

(3) The study by Alshidi and Alsaidi (2022) aimed to assess the degree of integration of AI concepts and applications within the mathematics curricula at the basic education level in the Sultanate of Oman. The research utilized a quantitative descriptive approach, employing an analytical instrument comprising 24 items across five domains. Following the verification of the instrument's validity and reliability, it was applied to the mathematics curriculum content for grades seven and eight in Oman, encompassing student textbooks and activity books. The study findings indicated a generally "low" level of AI concept and application integration within the mathematics curricula for grades seven and eight. The inclusion rates in the seventh-grade mathematics curriculum content were as follows: Student's Book (first semester) 3.50%, Student's Book (second semester) 0.70%, Activity Book (first semester) 1.70%, and Activity Book (second semester) 2.40%. For the eighth-grade mathematics curriculum content, the inclusion rates were: Student's Book (first semester) 0.70%, Student's Book (second semester) 8.80%, Activity Book (first semester) 2.00%, and Activity Book (second semester) 0.30%. The study recommended the importance of updating the mathematics curriculum through the effective integration of AI concepts and applications, as well as the necessity of training mathematics teachers on their utilization and integration within the teaching and learning processes.

(4) The study by Alamri (2023) aimed to evaluate teachers' perceptions of the integration level of innovation and AI attributes within early childhood education curricula in Saudi Arabia. The research employed a descriptive survey approach, collecting data through a researcher-designed questionnaire administered to a sample of 905 teachers from various regions across Saudi Arabia, including the Eastern, Western, Northern, Southern, and Riyadh areas. The findings indicated that the integration of innovation and AI characteristics in early

childhood curricula was perceived as “high” in the domain of activities and learning tools. However, it was considered “insufficient/weak” in the teaching methods/strategies and objectives domains, and “very insufficient/very weak” in the domains of assessment and content. Based on these results, the study proposed a framework for enhancing early childhood education curricula in Saudi Arabia, with a focus on incorporating innovation and AI attributes.

(5) The study by Alsaidi et al. (2023) examined the extent to which AI concepts and applications are present within the social studies curriculum for grades eleven and twelve in Omani basic education schools. Employing a quantitative descriptive-analytical approach, the research utilized a 24-statement data analysis tool that evaluated five domains: data analysis and structuring, AI applications, AI programming, physical computing, and deep learning. The findings indicated a “weak/limited” inclusion of AI concepts and applications within the curriculum and textbooks, with “low” percentages observed across all five domains. Specifically, the analysis showed that the inclusion reached a maximum of 6.55% in the twelfth-grade geography and modern technologies textbook. Conversely, the eleventh-grade social studies and Islamic civilization textbooks demonstrated minimal inclusion, at 0.86% and 0.24%, respectively. Based on these findings, the study recommends a more effective integration of AI concepts and applications into social studies curricula, as well as the provision of training programs to enhance social studies teachers’ awareness and understanding of the pedagogical value of AI applications and to improve their skills in teaching with AI and leveraging AI technologies and applications in the classroom.

(6) A study conducted by Safar (2025) investigated the degree to which AI concepts and applications are integrated into the computer science curricula for the fourth and fifth grades in primary schools within the State of Kuwait. Employing a quantitative descriptive methodology with content analysis, the researcher developed a content analysis card

comprising 35 measurement indicators across five core AI dimensions: data analysis and structuring, AI applications, AI programming, physical computing, and machine learning and deep learning. The “idea/topic” served as the unit of analysis. The study sample encompassed four computer science textbooks used for fourth and fifth graders during the 2023/2024 academic year, and the analysis was conducted across both semesters of that year. The findings revealed a complete “absence” (0.00% integration rate across all domains) of AI topics, concepts, and applications within the examined primary school computer science curricula. Specifically, the four student textbooks for the fourth and fifth grades did not contain any AI-related content. Based on these findings, the study recommends: (1) the seamless integration of AI concepts, applications, and ethics into all computer science textbooks; (2) the updating of textbooks across all subjects to reflect contemporary technology, including the definition, uses, and ethical implications of AI; (3) the development of interactive digital/electronic content utilizing AI technologies; (4) the provision of faculty with knowledge regarding AI, its ethical considerations, and practical applications to cultivate an informed generation; (5) the training of teachers and administrators to effectively incorporate AI into teaching and learning practices; and (6) the allocation of resources and support for the integration of AI in teaching and learning.

Commentary on Previous Studies

The findings of prior research studies underscore the significance of integrating AI within educational environments. A majority of these studies have affirmed the impact of AI technologies and applications on achieving educational objectives and fostering learning skills and competencies among students. The current study builds upon this existing body of knowledge by drawing upon their theoretical frameworks, methodologies, and research instruments. Furthermore, it has leveraged the results of previous studies in the development of the data analysis section. This research aligns with prior investigations by focusing on

various facets of AI in education, such as awareness, understanding, and integration within educational settings.

Nevertheless, the present study differentiates itself by being conducted in the post-COVID-19 pandemic context, thereby highlighting the pandemic's influence on the adoption of educational technology, particularly AI technologies and applications. This research also contributes uniquely to the existing literature by employing a robust methodology and providing a comprehensive assessment instrument for future studies in this domain. Furthermore, its longitudinal nature, spanning two consecutive academic terms and specifically focusing on the degree of integration (i.e., inclusion level) of AI concepts and applications within school curricula—a relatively underexplored area in current literature—sets it apart. The researchers also observed the limited number of Kuwaiti research studies investigating AI applications in education.

Given the aforementioned context, the significance of AI as a leading contemporary technological development becomes evident. AI is poised to play a critical role in the teaching and learning processes in the years ahead, particularly in light of the growing emphasis on leveraging digital technology within the educational process as a primary objective for teaching and learning in the twenty-first century (Milberg, 2024). This study aims to elucidate the extent to which AI concepts and applications are present within computer science curricula in general education in the State of Kuwait.

Problem of the Study

Kuwait's National Development Plan, Vision 2035—also known as New Kuwait—acknowledges the transformative potential of AI across various sectors, including education. This ambitious plan serves as a strategic roadmap for a prosperous and sustainable future, founded upon five key themes and nine focus pillars for investment. Notably, Pillar 4, “Empowering Citizens and Institutions”, underscores the importance of human capital

development. By investing in the knowledge, skills, and creativity of its populace, Kuwait aims to cultivate a competitive workforce for sustained success. A key objective of Vision 2035 is the modernization of the education system. This entails aligning educational outcomes with the evolving demands of the future job market, equipping students with essential skills and competencies for a rapidly changing world, and enhancing their competitiveness within a dynamic economic, social, and technological landscape. The Kuwaiti educational philosophy emphasizes the development of data analysis skills, the promotion of knowledge and technology production, and the cultivation of awareness regarding information and network security (New Kuwait, 2025).

Numerous research studies have addressed AI technologies and applications, along with their utility for digital transformation within the field of education, consistently highlighting the importance of integrating AI concepts, applications, and ethical considerations into educational curricula (Safar, 2024a, 2024b, 2025). However, a limited number of studies have specifically examined the level of availability (i.e., degree of inclusion) of AI concepts, applications, and ethics within the curricula for PreK-12 schools and higher education institutions. These include the studies by Alfayez et al. (2021), Bin Ibrahim (2021), Alshidi and Alsaidi (2022), Alamri (2023), Alsaidi et al. (2023), and Safar (2025). To the best of the researchers' knowledge, there are currently one Kuwaiti study that has focused on this particular topic.

Drawing upon the principal investigator experience in educational supervision, he observed a limited emphasis on the integration of AI within the Kuwaiti curriculum. This lack of attention could potentially impact on the preparedness of future graduates with the requisite knowledge, skills, and competencies to effectively navigate the era of the Fourth Industrial Revolution. Consequently, this study was undertaken to investigate the degree to

which AI concepts and applications are incorporated within the computer science curricula across intermediate schools in the State of Kuwait.

Research Questions

This current study attempted to answer the following questions:

1. To what extent are AI concepts and applications incorporated into the sixth-grade computer science curriculum in Kuwait?
2. To what extent are AI concepts and applications incorporated into the seventh-grade computer science curriculum in Kuwait?
3. To what extent are AI concepts and applications incorporated into the eighth-grade computer science curriculum in Kuwait?
4. To what extent are AI concepts and applications incorporated into the ninth-grade computer science curriculum in Kuwait?

Objectives of the Study

The current study aimed to achieve the following objectives:

1. To evaluate the degree of inclusion of AI concepts and applications within Kuwait's sixth-grade computer science curriculum.
2. To assess the degree of integration of AI concepts and applications in Kuwait's seventh-grade computer science curriculum.
3. To identify the degree of inclusion of AI concepts and applications within Kuwait's eighth-grade computer science curriculum.
4. To reveal the degree of integration of AI concepts and applications in Kuwait's ninth-grade computer science curriculum.

Significance of the Study

The significance of the study can be summarized as follows:

1. This study contributes original insights by exploring AI, a rapidly evolving yet under-researched domain, and its implications for educational systems.
2. The study investigates how AI concepts and applications are incorporated into computer science curricula, providing actionable insights to guide curriculum developers in enhancing educational effectiveness amid rapid technological advancements.
3. This research adopts a structured, systematic methodology to identify and analyze the integration of AI concepts and applications within computer science curricula.
4. The study's narrowed scope—centered on select grades and textbooks—supports a granular assessment of AI integration, yielding detailed insights into prevailing trends and instructional approaches.
5. By offering practical recommendations, this study empowers curriculum designers and educators to refine computer science education, ensuring alignment with the evolving demands of an AI-centric landscape.
6. Contributing to the evolving scholarship on AI in education, the study delivers practical recommendations to strengthen computer science curriculum design.

Limitations of the Study

The limitations of the study can be categorized as follows:

1. Objective limitations: This study's scope is limited to analyzing the integration of AI concepts and applications within computer science textbooks for grades six through nine.
2. Spatial limitations: The study was confined to the intermediate general education schools across Kuwait.
3. Temporal limitations: The study was conducted during the first and second semesters/terms of the 2024/2025 school year.

4. Scientific limitations: This challenge arises due to the limited availability of academic research on this crucial topic in our region.

Terminologies of the Study

Here are some of the concepts and terms presented in this study, along with detailed definitions and explanations, including:

1. Artificial intelligence (AI): AI leverages computer and digital technologies to develop machines, devices, robots, or applications that replicate specific facets of human intelligence. These include language comprehension, image recognition, problem-solving, machine learning, logical reasoning, and knowledge acquisition from past experiences. AI systems are engineered and programmed to perform a variety of tasks, functions, and operations traditionally executed by humans, thereby exhibiting intelligent behavior (Al Hiary, 2023a; Celik et al., 2022; Ghanaieem, 2023; Safar, 2024a, 2024b, 2025).
2. AI concepts: AI concepts encompass a diverse array of scientific principles that form the foundation for developing and applying AI systems. These include established domains such as machine learning, deep learning, natural language processing (NLP), computer vision, robotics, and reasoning/problem-solving methodologies. Equally critical are the ethical considerations inherent in AI development. While these represent the core tenets of AI, the field is inherently evolving, with new paradigms continually emerging. Nevertheless, a solid grasp of these fundamental concepts provides learners with the necessary framework to navigate the complexities and expansive possibilities of AI (Alfayez et al., 2021; Alshidi & Alsaidi, 2022; Alsaidi et al., 2023; Bin Ibrahim, 2021).
3. AI applications: AI software comprises a comprehensive suite of tools and platforms designed to facilitate the creation and implementation of intelligent

applications. These solutions enable organizations and individuals to leverage AI for task automation, data analysis, predictive modeling, and addressing complex challenges across multiple sectors. Scholarly perspectives from Alshidi and Alsaidi (2022) and Bin Ibrahim (2021) characterize AI applications as advanced educational programs capable of performing human-like functions, including learning, reasoning, instruction delivery, and decision-making through structured, scientific processes. The researchers practically define it as a set of applications that are incorporated into computer science curricula, imparting digital skills and competencies to students, and are assessed/measured through/by an analysis card.

4. Computer science curricula: The researchers define them as the sixth, seventh, eighth, and ninth-grade computer science materials/contents for general education, which include student textbooks and activity books used in general education schools in Kuwait.
5. General education schools: These institutions encompass both government and private schools that provide compulsory education, free of charge for Kuwaiti nationals and on a fee-paying basis for non-Kuwaiti nationals, for students from the first through the twelfth grade, adhering to government curricula.

Methodology

Research Design

The study adopted a quantitative descriptive research design, utilizing content analysis as the primary data analysis technique. Consistent with Al-Assaf's (2012, p. 217) definition, content analysis involves the systematic examination and interpretation of recurring units within a specific content source. These units may include words, themes, topics, ideas, characters, or other quantifiable elements. This methodology enables the objective and systematic extraction of information based on predefined criteria and is

particularly useful for describing the current status of a phenomenon, identifying potential problems, and providing a foundation for future inquiry and strategic decision-making (Abou-Allam, 2021; Alamri, 2023; Alfayez et al., 2021; Alsaidi et al., 2023; Alshidi & Alsaidi, 2022; Bin Ibrahim, 2021; Creswell & Creswell, 2018; Fraenkel et al., 2019; Johnson & Christensen, 2020). The study's objective of evaluating the incorporation of AI concepts and applications in Kuwaiti intermediate school computer science curricula necessitated the use of content analysis as the most fitting methodological approach.

Population and Sample

The population for this study included the complete set of computer science textbooks prescribed for students in the general education system within the State of Kuwait during the 2024/2025 school year, consisting of 18 student textbooks. The study sample, strategically selected from this population, comprised eight computer science textbooks specifically designed for students in grades six, seven, eight, and nine within the intermediate education level for the 2024/2025 school year. Table 1 provides a comprehensive overview of the textbooks included in the study sample.

Table 1. Distribution of computer science textbooks by grade level for the 2024/2025 school year.

Educational Stage	Grade Level	Textbook	School Term	Type	Edition	No. of Units	No. of Pages	No. of Ideas/Topics
Intermediate	Grade 6	The world of technology - Part 1	First	Student textbook	1st 2024/2025	3	150	53
		The world of technology - Part 2	Second	Student textbook	1st 2024/2025	3	139	50
	Grade 7	The world of technology - Part 1	First	Student textbook	1st 2024/2025	3	147	51
		The world of technology - Part 2	Second	Student textbook	1st 2024/2025	3	129	57
	Grade 8	The world of technology - Part 1	First	Student textbook	1st 2024/2025	3	192	73
		The world of technology - Part 2	Second	Student textbook	1st 2024/2025	3	212	46

Grade 9	The world of technology - Part 1	First	Student textbook	1st 2024/2025	3	205	69
	The world of technology - Part 2	Second	Student textbook	1st 2024/2025	3	205	56

Instrument

To address the study's objectives, a content analysis card was developed based on a review of educational literature and pertinent prior research. This instrument was adapted from the work of Touretzky et al. (2019), Alfayez et al. (2021), Alshidi and Alsaïdi (2022), and Alsaïdi et al. (2023). The finalized content analysis card, following validation and reliability testing, comprised 35 measurement indicators organized across five comprehensive domains. These domains focused on fundamental aspects of AI, specifically: data analysis and structuring, AI applications, AI programming, physical computing, and machine learning and deep learning. The idea/topic was selected as the unit of analysis due to its appropriateness for the study's nature and objectives.

Instrument Validity

The content validity of the study tool (content analysis card)—the degree to which it accurately reflects the targeted constructs—was established through expert judgment. The card was submitted to a panel of experienced and qualified professionals in the relevant field to gather their expert insights, opinions, feedback, guidance, suggestions, and recommendations. The researchers carefully considered all input received and implemented necessary modifications, including deletions, revisions, and additions, resulting in the finalized and formalized content analysis card.

Instrument Reliability

The reliability of the content analysis card—its consistency in producing comparable results upon repeated use—was assessed using the test-retest method. The card was applied twice, with a 20-day interval, to a randomly selected sixth-grade computer science textbook (first semester/term). Pearson's correlation coefficient was calculated to determine the

relationship between the two administrations, yielding a reliability coefficient of 0.991. This “very high” positive correlation demonstrates a strong level of internal consistency within the tool, confirming its suitability for research and academic application and supporting its use for data collection.

Data Collection

With the validity and reliability of the research instrument (the content analysis card) confirmed, the study was implemented throughout the first and second semesters/terms of the 2024/2025 school year. The following procedures were strictly observed:

1. Identification of relevant computer science curricula: The computer science curricula pertinent to the sixth, seventh, eighth, and ninth grades of intermediate school were identified and subsequently selected for analysis. This analysis was systematically conducted using the content analysis card. The selected curricula collectively comprise eight distinct student textbooks.
2. Extraction of ideas/topics from selected textbooks: Each selected computer science student textbook underwent a thorough examination to identify relevant ideas and topics. This comprehensive analysis encompassed the following elements: cognitive content (information), images, drawings, figures, tables, activities, exercises, applications, thinking boxes, and guiding prompts. The cover, index, and book key were explicitly excluded from the analysis to prevent redundancy of content.
3. Categorization framework: Based on the AI concepts and applications identified within the content analysis card, the analysis categories were defined. These categories were subsequently grouped into five distinct dimensions: data analysis and structuring, AI applications, AI programming, physical computing, and machine learning and deep learning.

4. Content analysis of selected textbooks: Content analysis was performed on the selected computer science curriculum textbooks using the aforementioned analysis tool. This process was conducted meticulously to determine the frequency of occurrence of the phrases or indicators defined in the analysis card within the identified ideas/topics.

Methods of Analysis

Following the successful implementation of the study and the collection of data, the researchers utilized several sophisticated statistical techniques for data processing and analysis. These methods were specifically chosen to answer the research questions and comprised:

1. Pearson correlation coefficient: The Pearson correlation coefficient was utilized as a statistical measure to evaluate the reliability of the study tool by calculating the linear correlation between analyst ratings or scores recorded across time.
2. Frequency counts: The study utilized frequency counts to quantify the total number of instances of each phrase (indicator) within the content analysis card as it appeared throughout the computer science curriculum student textbooks for the sixth, seventh, eighth, and ninth grades in Kuwait.
3. Percentages: The degree of inclusion for all indicators (phrases) on the content analysis card was represented by calculating percentages. The inclusion rate for each indicator within a specific student textbook was determined using the formula: $(\text{Number of occurrences of the indicator or phrase} / \text{Total number of ideas/topics in the textbook}) * 100$. This calculation reflects the proportion of the textbook content related to each indicator.

Interpretation of the calculated inclusion rate percentages was guided by the statistical benchmark presented in Table 2.

Table 2. The established statistical benchmark for interpreting inclusion rate percentages.

Range of Inclusion Percentages	Degree of Inclusion
80.0-100.0	Very high
60.0-79.0	High
40.0-59.0	Medium
20.0-39.0	Low
0.0-19.0	Very low

Results and Discussion

The Results for Research Question No. 1

Research question no. 1 was stated as follows: To what extent are AI concepts and applications incorporated into the sixth-grade computer science curriculum in Kuwait? To address this inquiry, the number of occurrences (repetitions/frequencies) and corresponding inclusion percentages for all domains/dimensions of the content analysis card were extracted, along with the overall inclusion percentage, as detailed in Table 3.

Table 3. Degree of inclusion of AI concepts and applications in intermediate school sixth grade computer science curricula.

Domain	No.	Phrase/Indicator	G6 Student Textbook - Part 1		G6 Student Textbook - Part 2	
			No. of Occurrences	Inclusion Percentage %	No. of Occurrences	Inclusion Percentage %
First: Data Analysis and Structuring	1	The content discusses the processes of storing, searching, retrieving, modifying, and deleting data to feed AI systems.	0	0.00	0	0.00
	2	The content presents data representation and coding systems for feeding AI systems.	0	0.00	0	0.00
	3	The content discusses computational and logical operations in computers for building AI-based applications or intelligent systems.	0	0.00	0	0.00
	4	The content assists in identifying causal relationships between data and predicting outcomes.	0	0.00	0	0.00
	5	The content reviews methods of reorganizing, analyzing, and classifying data using appropriate	0	0.00	0	0.00

Second: AI Applications		software and tools to feed AI systems.				
	6	The content discusses big data and its applications in the field of AI.	0	0.00	0	0.00
	Total Percentage of Inclusion of 1st Domain		0	0.00	0	0.00
	1	The content explores real-world applications of AI to solve everyday problems.	0	0.00	0	0.00
	2	The content discusses the foundations and concepts of AI and its relationship to other sciences.	0	0.00	0	0.00
	3	The content explores the privacy implications of using AI applications.	0	0.00	0	0.00
	4	The content provides examples of intelligent tutoring systems that offer learning activities tailored to students' cognitive needs and provide feedback.	0	0.00	0	0.00
	5	The content discusses AI algorithms used in natural language processing (NLP) and semantic modeling.	0	0.00	0	0.00
	6	The content reviews the stages of designing, creating, assembling, and operating robots.	0	0.00	0	0.00
	7	The content discusses machine learning (ML) concepts and applications that aid in decision-making.	0	0.00	0	0.00
Third: AI Programming	8	The content explores AI-based games.	0	0.00	0	0.00
	Total Percentage of Inclusion of 2nd Domain		0	0.00	0	0.00
	1	The content discusses the creation of intelligent algorithms (that generate and test other algorithms) to accomplish open-ended tasks.	0	0.00	0	0.00
	2	The content reviews the steps involved in designing and building programs using programming languages to control AI devices.	0	0.00	0	0.00
	3	The content discusses debugging and troubleshooting techniques for AI devices.	0	0.00	0	0.00
	4	The content discusses comparing the performance of multiple algorithms used to solve a particular problem.	0	0.00	0	0.00
	5	The content reviews various models that explain how AI	0	0.00	0	0.00

		applications work as a system to accomplish tasks.				
Total Percentage of Inclusion of 3rd Domain			0	0.00	0	0.00
Fourth: Physical Computing	1	The content simplifies the design and analysis of combinational and sequential digital circuits.	0	0.00	0	0.00
	2	The content explains the physical hardware components of AI devices.	0	0.00	0	0.00
	3	The content provides a functional overview of AI hardware units.	0	0.00	0	0.00
	4	The content explains the principles of interactive systems using software and hardware that can sense the world.	0	0.00	0	0.00
	5	The content explores innovative systems for understanding the relationship between humans and the digital world.	0	0.00	0	0.00
	6	The content discusses sensors and microcontrollers for electromechanical control.	0	0.00	0	0.00
Total Percentage of Inclusion of 4th Domain			0	0.00	0	0.00
Fifth: Machine Learning (ML) and Deep Learning (DL)	1	The content discusses the analogy between the workings of human brain cells (neurons) and electrical networks for information processing.	0	0.00	0	0.00
	2	The content explores machine learning theories and principles.	0	0.00	0	0.00
	3	The content reviews techniques that mimic the way the human brain performs a particular task.	0	0.00	0	0.00
	4	The content discusses neuro-linguistic programming concepts and the application of computational techniques for analyzing and understanding text content.	0	0.00	0	0.00
	5	The content discusses examples of image processing and pattern recognition methods.	0	0.00	0	0.00
	6	The content explores AI systems for knowledge inference and representation.	0	0.00	0	0.00
	7	The content reviews the mathematical model for information processing based on the	0	0.00	0	0.00

	connectionist approach in computing.				
8	The content explores machine learning techniques and applications, and how to leverage this concept to achieve optimal results.	0	0.00	0	0.00
9	The content supports the derivation of high-level abstractions by analyzing massive datasets using linear and nonlinear transformations.	0	0.00	0	0.00
10	The content discusses some current scenarios for envisioning the application of machine learning techniques.	0	0.00	0	0.00
Total Percentage of Inclusion of 5th Domain		0	0.00	0	0.00
Overall Total Percentage of Inclusion of All Domains/Dimensions		0	0.00	0	0.00

As indicated in Table 3, the overall level of inclusion (integration) of AI concepts and applications within the content of the sixth-grade intermediate computer science textbooks in Kuwait is “very low”. Specifically, both the “World of Technology - Part 1” textbook for the first semester/term and the “World of Technology - Part 2” textbook for the second semester/term registered an inclusion rate of 0.00%. Further analysis revealed that this complete absence of AI content (0.00% inclusion) was consistent across all domains or dimensions of the content analysis card. This finding demonstrates that the two student textbooks constituting the sixth-grade computer science curriculum entirely lack any AI concepts or applications, a deficiency that is likely to impede alignment with international standards and trends in AI integration, as emphasized by Safar (2025) and Touretzky et al. (2019) regarding the importance of AI inclusion across all educational levels.

The Results for Research Question No. 2

Research question no. 2 was stated as follows: To what extent are AI concepts and applications incorporated into the seventh-grade computer science curriculum in Kuwait? To address this inquiry, the number of occurrences (repetitions/frequencies) and corresponding

inclusion percentages for all domains/dimensions of the content analysis card were extracted, along with the overall inclusion percentage, as detailed in Table 4.

Table 4. Degree of inclusion of AI concepts and applications in intermediate school seventh grade computer science curricula.

Domain	No.	Phrase/Indicator	G7 Student Textbook - Part 1		G7 Student Textbook - Part 2	
			No. of Occurrences	Inclusion Percentage %	No. of Occurrences	Inclusion Percentage %
First: Data Analysis and Structuring	1	The content discusses the processes of storing, searching, retrieving, modifying, and deleting data to feed AI systems.	0	0.00	0	0.00
	2	The content presents data representation and coding systems for feeding AI systems.	0	0.00	0	0.00
	3	The content discusses computational and logical operations in computers for building AI-based applications or intelligent systems.	0	0.00	0	0.00
	4	The content assists in identifying causal relationships between data and predicting outcomes.	0	0.00	0	0.00
	5	The content reviews methods of reorganizing, analyzing, and classifying data using appropriate software and tools to feed AI systems.	0	0.00	0	0.00
	6	The content discusses big data and its applications in the field of AI.	0	0.00	0	0.00
Total Percentage of Inclusion of 1st Domain			0	0.00	0	0.00
Second: AI Applications	1	The content explores real-world applications of AI to solve everyday problems.	0	0.00	0	0.00
	2	The content discusses the foundations and concepts of AI and its relationship to other sciences.	0	0.00	0	0.00
	3	The content explores the privacy implications of using AI applications.	0	0.00	0	0.00
	4	The content provides examples of intelligent tutoring systems that offer learning activities tailored to students' cognitive needs and provide feedback.	0	0.00	0	0.00
	5	The content discusses AI algorithms used in natural	0	0.00	0	0.00

		language processing (NLP) and semantic modeling.				
	6	The content reviews the stages of designing, creating, assembling, and operating robots.	0	0.00	0	0.00
	7	The content discusses machine learning (ML) concepts and applications that aid in decision-making.	0	0.00	0	0.00
	8	The content explores AI-based games.	0	0.00	0	0.00
Total Percentage of Inclusion of 2nd Domain			0	0.00	0	0.00
Third: AI Programming	1	The content discusses the creation of intelligent algorithms (that generate and test other algorithms) to accomplish open-ended tasks.	0	0.00	0	0.00
	2	The content reviews the steps involved in designing and building programs using programming languages to control AI devices.	0	0.00	0	0.00
	3	The content discusses debugging and troubleshooting techniques for AI devices.	0	0.00	0	0.00
	4	The content discusses comparing the performance of multiple algorithms used to solve a particular problem.	0	0.00	0	0.00
	5	The content reviews various models that explain how AI applications work as a system to accomplish tasks.	0	0.00	0	0.00
	Total Percentage of Inclusion of 3rd Domain		0	0.00	0	0.00
Fourth: Physical Computing	1	The content simplifies the design and analysis of combinational and sequential digital circuits.	0	0.00	0	0.00
	2	The content explains the physical hardware components of AI devices.	0	0.00	0	0.00
	3	The content provides a functional overview of AI hardware units.	0	0.00	0	0.00
	4	The content explains the principles of interactive systems using software and hardware that can sense the world.	0	0.00	0	0.00
	5	The content explores innovative systems for understanding the relationship between humans and the digital world.	0	0.00	0	0.00

Fifth: Machine Learning (ML) and Deep Learning (DL)	6	The content discusses sensors and microcontrollers for electromechanical control.	0	0.00	0	0.00
	Total Percentage of Inclusion of 4th Domain		0	0.00	0	0.00
	1	The content discusses the analogy between the workings of human brain cells (neurons) and electrical networks for information processing.	0	0.00	0	0.00
	2	The content explores machine learning theories and principles.	0	0.00	0	0.00
	3	The content reviews techniques that mimic the way the human brain performs a particular task.	0	0.00	0	0.00
	4	The content discusses neuro-linguistic programming concepts and the application of computational techniques for analyzing and understanding text content.	0	0.00	0	0.00
	5	The content discusses examples of image processing and pattern recognition methods.	0	0.00	0	0.00
	6	The content explores AI systems for knowledge inference and representation.	0	0.00	0	0.00
	7	The content reviews the mathematical model for information processing based on the connectionist approach in computing.	0	0.00	0	0.00
	8	The content explores machine learning techniques and applications, and how to leverage this concept to achieve optimal results.	0	0.00	0	0.00
	9	The content supports the derivation of high-level abstractions by analyzing massive datasets using linear and nonlinear transformations.	0	0.00	0	0.00
	10	The content discusses some current scenarios for envisioning the application of machine learning techniques.	0	0.00	0	0.00
Total Percentage of Inclusion of 5th Domain			0	0.00	0	0.00
Overall Total Percentage of Inclusion of All Domains/Dimensions			0	0.00	0	0.00

The data presented in Table 4 indicate a “very low” overall level of AI concepts and applications inclusion in Kuwaiti seventh-grade intermediate computer science textbooks. Both the first-semester textbook, “World of Technology - Part 1”, and the second-semester textbook, “World of Technology - Part 2”, exhibited a 0.00% inclusion rate across all domains of the content analysis card. This complete lack of AI content in the seventh-grade computer science curriculum is likely to hinder the adoption of international standards and trends in AI integration, a crucial aspect highlighted by Safar (2025) and Touretzky et al. (2019) who advocate for AI incorporation from kindergarten through university.

The Results for Research Question No. 3

Research question no. 3 was stated as follows: To what extent are AI concepts and applications incorporated into the eighth-grade computer science curriculum in Kuwait? To address this inquiry, the number of occurrences (repetitions/frequencies) and corresponding inclusion percentages for all domains/dimensions of the content analysis card were extracted, along with the overall inclusion percentage, as detailed in Table 5.

Table 5. Degree of inclusion of AI concepts and applications in intermediate school eighth grade computer science curricula.

Domain	No.	Phrase/Indicator	G8 Student Textbook - Part 1		G8 Student Textbook - Part 2	
			No. of Occurrences	Inclusion Percentage %	No. of Occurrences	Inclusion Percentage %
First: Data Analysis and Structuring	1	The content discusses the processes of storing, searching, retrieving, modifying, and deleting data to feed AI systems.	0	0.00	0	0.00
	2	The content presents data representation and coding systems for feeding AI systems.	0	0.00	0	0.00
	3	The content discusses computational and logical operations in computers for building AI-based applications or intelligent systems.	0	0.00	0	0.00
	4	The content assists in identifying causal relationships between	0	0.00	0	0.00

Second: AI Applications		data and predicting outcomes.				
	5	The content reviews methods of reorganizing, analyzing, and classifying data using appropriate software and tools to feed AI systems.	0	0.00	0	0.00
	6	The content discusses big data and its applications in the field of AI.	0	0.00	0	0.00
	Total Percentage of Inclusion of 1st Domain		0	0.00	0	0.00
	1	The content explores real-world applications of AI to solve everyday problems.	0	0.00	0	0.00
	2	The content discusses the foundations and concepts of AI and its relationship to other sciences.	0	0.00	0	0.00
	3	The content explores the privacy implications of using AI applications.	0	0.00	0	0.00
	4	The content provides examples of intelligent tutoring systems that offer learning activities tailored to students' cognitive needs and provide feedback.	0	0.00	0	0.00
	5	The content discusses AI algorithms used in natural language processing (NLP) and semantic modeling.	0	0.00	0	0.00
Third: AI Programming	6	The content reviews the stages of designing, creating, assembling, and operating robots.	0	0.00	0	0.00
	7	The content discusses machine learning (ML) concepts and applications that aid in decision-making.	0	0.00	0	0.00
	8	The content explores AI-based games.	0	0.00	0	0.00
	Total Percentage of Inclusion of 2nd Domain		0	0.00	0	0.00
	1	The content discusses the creation of intelligent algorithms (that generate and test other algorithms) to accomplish open-ended tasks.	0	0.00	0	0.00
	2	The content reviews the steps involved in designing and building programs using programming languages to control AI devices.	0	0.00	0	0.00
	3	The content discusses debugging and troubleshooting techniques for AI devices.	0	0.00	0	0.00
	4	The content discusses comparing the	0	0.00	0	0.00

Fourth: Physical Computing		performance of multiple algorithms used to solve a particular problem.				
	5	The content reviews various models that explain how AI applications work as a system to accomplish tasks.	0	0.00	0	0.00
	Total Percentage of Inclusion of 3rd Domain		0	0.00	0	0.00
	1	The content simplifies the design and analysis of combinational and sequential digital circuits.	0	0.00	0	0.00
	2	The content explains the physical hardware components of AI devices.	0	0.00	0	0.00
	3	The content provides a functional overview of AI hardware units.	0	0.00	0	0.00
	4	The content explains the principles of interactive systems using software and hardware that can sense the world.	0	0.00	0	0.00
Fifth: Machine Learning (ML) and Deep Learning (DL)	5	The content explores innovative systems for understanding the relationship between humans and the digital world.	0	0.00	0	0.00
	6	The content discusses sensors and microcontrollers for electromechanical control.	0	0.00	0	0.00
	Total Percentage of Inclusion of 4th Domain		0	0.00	0	0.00
	1	The content discusses the analogy between the workings of human brain cells (neurons) and electrical networks for information processing.	0	0.00	0	0.00
	2	The content explores machine learning theories and principles.	0	0.00	0	0.00
	3	The content reviews techniques that mimic the way the human brain performs a particular task.	0	0.00	0	0.00
	4	The content discusses neuro-linguistic programming concepts and the application of computational techniques for analyzing and understanding text content.	0	0.00	0	0.00
	5	The content discusses examples of image processing and pattern recognition methods.	0	0.00	0	0.00
	6	The content explores AI systems for knowledge	0	0.00	0	0.00

	inference and representation.				
7	The content reviews the mathematical model for information processing based on the connectionist approach in computing.	0	0.00	0	0.00
8	The content explores machine learning techniques and applications, and how to leverage this concept to achieve optimal results.	0	0.00	0	0.00
9	The content supports the derivation of high-level abstractions by analyzing massive datasets using linear and nonlinear transformations.	0	0.00	0	0.00
10	The content discusses some current scenarios for envisioning the application of machine learning techniques.	0	0.00	0	0.00
Total Percentage of Inclusion of 5th Domain		0	0.00	0	0.00
Overall Total Percentage of Inclusion of All Domains/Dimensions		0	0.00	0	0.00

Table 5 illustrates a “very low” level of AI concepts and applications integration within the Kuwaiti eighth-grade intermediate computer science textbooks. With both the first and second-semester “World of Technology” textbooks registering 0.00% inclusion across all measured domains, it is evident that the current eighth-grade computer science curriculum entirely neglects AI-related content. This significant absence is likely to impede the achievement of international benchmarks and the adoption of global trends in AI integration, underscoring the importance of incorporating AI concepts and applications at all educational levels, as noted by Safar (2025) and Touretzky et al. (2019).

The Results for Research Question No. 4

Research question no. 4 was stated as follows: To what extent are AI concepts and applications incorporated into the ninth-grade computer science curriculum in Kuwait? To address this inquiry, the number of occurrences (repetitions/frequencies) and corresponding inclusion percentages for all domains/dimensions of the content analysis card were extracted, along with the overall inclusion percentage, as detailed in Table 6.

Table 6. Degree of inclusion of AI concepts and applications in intermediate school ninth grade computer science curricula.

Domain	No.	Phrase/Indicator	G9 Student Textbook - Part 1		G9 Student Textbook - Part 2	
			No. of Occurrences	Inclusion Percentage %	No. of Occurrences	Inclusion Percentage %
First: Data Analysis and Structuring	1	The content discusses the processes of storing, searching, retrieving, modifying, and deleting data to feed AI systems.	0	0.00	0	0.00
	2	The content presents data representation and coding systems for feeding AI systems.	0	0.00	0	0.00
	3	The content discusses computational and logical operations in computers for building AI-based applications or intelligent systems.	0	0.00	0	0.00
	4	The content assists in identifying causal relationships between data and predicting outcomes.	0	0.00	0	0.00
	5	The content reviews methods of reorganizing, analyzing, and classifying data using appropriate software and tools to feed AI systems.	0	0.00	0	0.00
	6	The content discusses big data and its applications in the field of AI.	0	0.00	0	0.00
Total Percentage of Inclusion of 1st Domain			0	0.00	0	0.00
Second: AI Applications	1	The content explores real-world applications of AI to solve everyday problems.	0	0.00	0	0.00
	2	The content discusses the foundations and concepts of AI and its relationship to other sciences.	0	0.00	0	0.00
	3	The content explores the privacy implications of using AI applications.	0	0.00	0	0.00
	4	The content provides examples of intelligent tutoring systems that offer learning activities tailored to students' cognitive needs and provide feedback.	0	0.00	0	0.00
	5	The content discusses AI algorithms used in natural language processing (NLP) and semantic modeling.	0	0.00	0	0.00
	6	The content reviews the stages of designing,	0	0.00	0	0.00

Third: AI Programming		creating, assembling, and operating robots.				
	7	The content discusses machine learning (ML) concepts and applications that aid in decision-making.	0	0.00	0	0.00
	8	The content explores AI-based games.	0	0.00	0	0.00
	Total Percentage of Inclusion of 2nd Domain		0	0.00	0	0.00
	1	The content discusses the creation of intelligent algorithms (that generate and test other algorithms) to accomplish open-ended tasks.	0	0.00	0	0.00
	2	The content reviews the steps involved in designing and building programs using programming languages to control AI devices.	0	0.00	0	0.00
	3	The content discusses debugging and troubleshooting techniques for AI devices.	0	0.00	0	0.00
	4	The content discusses comparing the performance of multiple algorithms used to solve a particular problem.	0	0.00	0	0.00
Fourth: Physical Computing	5	The content reviews various models that explain how AI applications work as a system to accomplish tasks.	0	0.00	0	0.00
	Total Percentage of Inclusion of 3rd Domain		0	0.00	0	0.00
	1	The content simplifies the design and analysis of combinational and sequential digital circuits.	0	0.00	0	0.00
	2	The content explains the physical hardware components of AI devices.	0	0.00	0	0.00
	3	The content provides a functional overview of AI hardware units.	0	0.00	0	0.00
	4	The content explains the principles of interactive systems using software and hardware that can sense the world.	0	0.00	0	0.00
	5	The content explores innovative systems for understanding the relationship between humans and the digital world.	0	0.00	0	0.00
	6	The content discusses sensors and microcontrollers for electromechanical control.	0	0.00	0	0.00

Total Percentage of Inclusion of 4th Domain		0	0.00	0	0.00	
Fifth: Machine Learning (ML) and Deep Learning (DL)	1	The content discusses the analogy between the workings of human brain cells (neurons) and electrical networks for information processing.	0	0.00	0	0.00
	2	The content explores machine learning theories and principles.	0	0.00	0	0.00
	3	The content reviews techniques that mimic the way the human brain performs a particular task.	0	0.00	0	0.00
	4	The content discusses neuro-linguistic programming concepts and the application of computational techniques for analyzing and understanding text content.	0	0.00	0	0.00
	5	The content discusses examples of image processing and pattern recognition methods.	0	0.00	0	0.00
	6	The content explores AI systems for knowledge inference and representation.	0	0.00	0	0.00
	7	The content reviews the mathematical model for information processing based on the connectionist approach in computing.	0	0.00	0	0.00
	8	The content explores machine learning techniques and applications, and how to leverage this concept to achieve optimal results.	0	0.00	0	0.00
	9	The content supports the derivation of high-level abstractions by analyzing massive datasets using linear and nonlinear transformations.	0	0.00	0	0.00
	10	The content discusses some current scenarios for envisioning the application of machine learning techniques.	0	0.00	0	0.00
Total Percentage of Inclusion of 5th Domain		0	0.00	0	0.00	
Overall Total Percentage of Inclusion of All Domains/Dimensions		0	0.00	0	0.00	

As presented in Table 6, the overall degree of inclusion (integration) of AI concepts and applications within the content of the ninth-grade intermediate computer science textbooks in Kuwait is “very low”. Specifically, both the “World of Technology - Part 1”

textbook for the first semester/term and the “World of Technology - Part 2” textbook for the second semester/term demonstrated an inclusion rate of 0.00%. Further analysis revealed that this complete absence of AI content (0.00% inclusion) was consistent across all domains or dimensions of the content analysis card. This finding underscores that the two student textbooks comprising the ninth-grade computer science curriculum entirely lack any AI concepts or applications, a deficiency that is likely to impede alignment with international standards and trends in AI integration, as emphasized by Safar (2025) and Touretzky et al. (2019) regarding the importance of AI incorporation throughout all educational levels.

Discussion of the Results

This study reveals a significant deficiency within Kuwait’s educational system: the lack of explicit integration of AI into the curricula (Safar, 2024a, 2024b, 2025). The current educational philosophy, as well as the objectives of the computer science curriculum across all grade levels, do not incorporate AI concepts and applications within student textbooks. This omission marginalizes essential AI education within the broader educational framework, resulting in curriculum content that is misaligned with the demands of the 21st century’s digital transformation and the imperative to develop AI-based knowledge, skills, and competencies. Notably, computer science textbooks currently lack any indicators or references to AI concepts and applications. This absence is particularly concerning, as computer science curricula should ideally be at the forefront of introducing emerging technologies such as AI to learners. The limited integration of AI across the curriculum, especially within computer science, is likely to impede the achievement of educational goals in the context of the ongoing Fourth Industrial Revolution, where AI is a critical driver.

The complete lack of AI integration observed in this study resonates with the findings of Safar (2025), who reported a 0.00% integration rate of AI topics, concepts, and applications in the primary school computer science curricula he analyzed, with no AI

content identified in the four textbooks for grades four and five. The “low/weak” integration levels of AI concepts and applications found by Alsaïdi et al. (2023) in Omani 11th-grade social studies curricula (ranging from 0.24% to 2.88%) and by Alshidi and Alsaïdi (2022) in middle school (grades 7-8) mathematics curricula (ranging from 0.30% to 8.80%) also demonstrate a degree of consistency with the generally low levels of AI integration identified in the present research.

The results of this study diverge somewhat from those of Alfayez et al. (2021), who found a “low” degree of AI concepts and applications integration (3.46% - 18.00%) in Saudi Arabian intermediate and high school computer science and information technology curricula. Their study reported inclusion rates of 3.46% to 10.00% for middle school and 15.00% to 18.00% for high school, representing a “low” level of integration. However, the inclusion rates identified in the current study are considerably lower than these reported ranges.

The present study’s findings diverge from those of Bin Ibrahim (2021), whose analysis of Saudi Arabian high school physics curricula revealed a “low” degree of AI concepts, applications, and ethics integration, ranging from 8.30% to 9.20%. Despite being classified as “low”, this level of integration is markedly higher than the integration rate identified in the current research. Additionally, the “low/weak” inclusion of innovation and AI characteristics (reaching 2.1 on a five-point Likert scale) in Saudi Arabian kindergarten curricula, as reported by Alamri (2023), also indicates a considerably greater level of inclusion than that found in this study.

Conclusion and Recommendations

The computer science curriculum in general education plays a fundamental role in enabling students to comprehend core principles of computer science and information and communication technology, as well as navigate the intricacies of the contemporary digital

world. With the rapid and pervasive advancement of AI impacting diverse aspects of society, the integration of its concepts, applications, and ethical dimensions into the computer science curriculum, and indeed throughout the broader academic landscape, is now essential. This integration is vital for developing learners' skills, competencies, and capabilities, providing them with the requisite knowledge for future engagement. Therefore, examining the degree to which AI concepts and applications are embedded within school curriculum textbooks across various subjects, with a particular focus on computer science at all educational levels, is a topic of significant importance for the future trajectory of education (teaching and learning).

Findings from the current study indicate a significant gap in the inclusion of AI topics, concepts, and applications within the intermediate-stage computer science curricula in Kuwait. This gap may stem from several key factors:

1. Limited awareness among curriculum developers regarding the growing importance of AI and its diverse technologies in modern education.
2. The absence of clear directives from the Ministry of Education on integrating AI into school curricula.
3. There is a shortage of qualified educators with the necessary expertise to teach AI effectively in schools.

Based on the study's findings, the following key measures are recommended to address the critical gap in integrating AI into school curricula. These steps are vital to equipping students with the knowledge, skills, and competencies needed to succeed in an increasingly AI-driven world:

1. Curriculum Enhancement: Comprehensively revise computer science textbooks across all grade levels to systematically integrate foundational AI concepts, real-world applications, and ethical considerations in an age-appropriate manner.

2. Curriculum Modernization: Update subject-matter textbooks across disciplines to reflect contemporary technological advancements, including:
 - a. Clear, accessible definitions of AI and its core concepts
 - b. Relevant real-world applications within each subject area
 - c. Ethical considerations for AI adoption and usage
3. Create AI-driven educational tools featuring adaptive learning, intelligent feedback, and progress analytics.
4. Launch educator AI training initiatives covering technical fundamentals, ethical use, and classroom applications to build institutional AI readiness.
5. Implement an AI competency program for educators and administrators, covering technical proficiency, ethical application, and pedagogical integration of AI technologies.
6. Develop an AI implementation support program including funding, infrastructure, technical assistance, and quality assurance mechanisms.
7. Establish formal AI education networks connecting schools, universities, specialized bodies, organizations, and industry partners to share resources and coordinate AI initiatives.
8. The Ministry of Education, the Ministry of Higher Education and Scientific Research, and educational institutions should prioritize the adoption of robust plans and strategies to motivate faculty, administrators, and learners to embrace the integration of AI technologies in education (teaching and learning).
9. Future research should expand upon the current findings through replication studies with diverse samples, variables, and methodologies across different communities. Furthermore, experimental studies are recommended to evaluate the effectiveness of AI-based teaching and learning programs. Additionally, research

should employ descriptive survey and analytical methods to identify barriers to the effective utilization of AI technologies in education.

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