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Secondary Science Curriculum Standards, Sustainability, and National Development in the Saudi Arabian Context

Amani Khalaf. Hamdan Alghamdi: *Department of Curriculum and instruction, College of Education, Imam Abdulrahman Bin Faisal University, Saudi Arabia.*
E-mail: amani.k.hamdan@gmail.com

Tahani Alkalaf: *College of Education and Art Sohar University, Oman.*
E-mail: talkalaf@su.edu.om

ABSTRACT: *An exploratory, descriptive research design entailed a content analysis that explored Saudi Arabia's new science standards to judge their potential to prepare adolescents to become mature adults who can contribute to achieving the Kingdom's national development plan (Vision 2030). Findings and their interpretation may help improve future science education standard development according to the requirements of the modern era, the fourth industrial revolution, and a knowledge-based economy. We concluded that Saudi Arabia's secondary science standards served "moderately well" in ensuring future adults' contributions to a thriving economy and an ambitious nation. The standards especially reflected the development of learners' balanced personality, self-confidence, independence, leadership, and cognitive/intellectual/reasoning abilities. The science standards implied respect for human capital, decision-making, and innovation. Future revisions of these standards, with sustainability in mind, should ensure that secondary science education concerns (a) decision-making for nation-building; (b) the importance of human capital in national development; and (c) the preparation of citizens to take initiative and innovate so Saudi Arabia can successfully transition to the fourth industrial revolution as a knowledge-based economy grounded in principles of sustainability.*

Key words: *Adolescents, Fourth industrial revolution, National development, Saudi Vision 2030, Science education standards, Sustainability.*

1. Introduction

Ensuring that science curriculum standards support sustainability is almost de rigour these days. Handayani et al. (2019) focused on elaborating Indigenous knowledge in the science curriculum to ensure cultural sustainability. Salam and Selim (2019) explored integrating sustainable development requirements into high school chemistry curriculum. This paper proposes that science curriculum standards should also support national development, which is dependent on sustainability (Stauffer, 2020), and uses the Kingdom of Saudi Arabia (KSA) as a working example. KSA aspires toward progress and growth through advancement in science, and it depends on education (including curricular standards) as a cornerstone of this goal (United Nations Department of Economic and Social Affairs, 2018).

In its 2016 national development plan (*Vision 2030*), KSA envisioned transitioning from an oil-based to a knowledge-based economy. In fact, the nation is undergoing unprecedented rapid educational reform to that end (al-Soudeir, 2020). Makhlouf (2021) asserted that *Vision 2030* stressed the link between education and a competitive economy with education regarded as a primary agent of enacting this reform. Research and experience have shown that the education system is key to preparing adolescents and youth to contribute to a knowledge economy with science education especially important (Stauffer, 2020).

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Email: amani.k.hamdan@gmail.com

KSA aims “to create a more diverse and sustainable economy” (2016, p. 13). Alghamdi and El-Hassan (2020) said Saudi secondary curricula (which includes science) should be kept relevant and current. This evergreening principle automatically applies to science curriculum standards. This paper thus explores KSA’s new secondary school science curricular standards to judge their potential to prepare future adults to contribute to KSA’s national development and sustainability imperative.

Njeng'ere (2014) recognized the “opportunities and challenges that exist within the school curriculum to foster national cohesion [and development]” (p. 2). We support teaching Saudi secondary science students so they mature into adults who can contribute to achieving *Vision 2030*. Other Saudi scholars are similarly interested in the importance of developing science curricula to keep pace with *Vision 2030.* Alhomairi (2018) called for developing fifth and sixth grade science curricula. Al-Harbi (2018) did the same for the intermediate stage. Al-Matrafi (2020) concluded that the intermediate stage science curriculum was highly related to *Vision 2030*.

As a preamble to presenting our findings from analyzing Saudi’s secondary science curriculum, an overview of KSA’s (2016) *Vision 2030* is presented followed with a summary of recent changes to Saudi’s secondary science curricular standards. The literature review concludes with a discussion of the role of education in national development, especially children and adolescents’ education. Within this context, we were interested in the potential for these standards to prepare adolescents (specifically secondary science students) to become mature adults who can contribute to achieving KSA’s national development vision predicated on sustainably transitioning away from oil.

2. Literature Review

2.1. KSA’s National Development Plan – Vision 2030

Like many other nations, the KSA seeks to achieve the requirements of the fourth industrial revolution (4IR) as it transitions to a knowledge-based economy. The term *fourth industrial revolution* (2000 onward) is used to describe how manufacturing and production have evolved over time. The first industrial revolution mechanized production with water and steam power. The second created mass production (electric power) followed by the third, which automated production using electronics and information technology (IT) (David, 2016; Ezell, 2018; Schwab, 2016).

The fourth revolution (technology revolution) is digitizing production by using computers to fuse technologies in a time rife with never-before-seen societal transformation due to exponential evolutions in artificial intelligence (AI) and pervasive (invasive) digital intelligence (e.g., the Internet, social media, the Cloud) (David, 2016; Ezell, 2018; Schwab, 2016). 4IR is “characterized by a fusion of technologies in economic, social, and human environments” (Abdulrahim & Mabrouk, 2020, p. 291).

At the national-development level, governments are grappling with how to move their economies forward in a climate of exponential innovation, disruptions, skepticism, and shifting manufacturing, business, and organizational models and forms. Industry is facing the phenomenal “velocity, scope, and systems impact” (Schwab, 2016, para. 3) of digitized technological innovations and is struggling to keep up or be left behind. Efforts to ensure the workforce evolves accordingly are complicated but cannot be avoided (Rotatori, Lee, & Sleeva, 2021) and involves science education (Marr, 2019).

This is especially challenging the KSA. For nearly a century, since the discovery of oil in the 1930s (Philby et al., 2023), the KSA has been an oil-based economy but is now striving to diversify and become knowledge-based. In a knowledge-based economy, knowledge-intensive activities (i.e., the creation, accumulation, or dissemination of knowledge) inform production with these intellectual activities generating a rapid pace for technological advancement and *scientific innovation* (Powell & Snellman, 2004).

In a momentous shift in policy, the KSA released a new national development plan in 2016 called *Vision 2030*. The intent is to bolster society, the economy, and the entire nation, so it can thrive in the 4IR by keeping pace with the requirements of a modern era and a knowledge-based economy in the context of globalization and digitization. One way to attempt this is through educational changes including curricular innovations (Emaikwu, 2011), which is the focus of this paper with its interest in Saudi secondary science education. Indeed, Marr (2019) opined that science education “must improve across the board” (para. 4) if nations hope to prepare for the 4IR, which is an impetus of *Vision 2030*.

Vision 2030 is an 85-page national document (available in English and Arabic) that was approved by the Saudi Council of Ministers. It is organized into several sections: a foreword by the Chairman of the Council of

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Economic and Development Affairs; an introduction around why the plan is necessary; three themes – vibrant society, thriving economy, ambitious nation; and a section on how to achieve the vision (KSA, 2016). *Vision 2030* frames the nation thus: "Saudi Arabia is heart of the Arab and Islamic world, the investment powerhouse, and the hub connecting three continents" (KSA, 2016, p. 9).

The vision revolves around three axes that are considered complementary and coherent (i.e., a unified whole): a vibrant society, a thriving economy, and an ambitious nation. (a) A vibrant society concerns a society with strong roots, strong foundations, and citizens with fulfilling lives. The intent is to promote the Islamic principle of moderation and the value and pride of national identity and ancient cultural heritage. (b) A thriving economy focuses on providing opportunities for all through an educational system linked to labour market needs and developing opportunities for everyone from entrepreneurs and small enterprises to large companies. (c) An ambitious nation focuses on the public sector where efficiency, transparency and accountability are promoted and performance is encouraged to enable resource mobilization and human empowerment. The nation would be effectively governed with all citizens responsibly enabled and engaged (KSA, 2016).

In short, the government aspires to care for and support citizens in a solid family structure via a comprehensive system of health, social, and educational care that is linked to the labor market, which is dependent on the development of human capital and resources via education. *Vision 2030* further strives to achieve global competitiveness, provide work and education opportunities for all members of society, and enhance the role of children and women in national development (Alghamdi et al., 2022; Almudara, 2019; KSA, 2016).

The KSA's *Vision 2030* is considered a professional turning point in the history of the Kingdom. It strives to link the authenticity of society with its prosperous present and ambitious future. It also acts as a new comprehensive development reform plan adopted by the government in its endeavor to (a) keep pace with the era's requirements and (b) achieve skills conducive to a productive, ambitious future. The architects proposed that this can be partially achieved within the hands of its children (youth and adolescents). The vision stresses building the personality of learners who are balanced, have the support of a strong family, have models of good behavior, have initiative and a leading personality, are healthy and safe (personal and community), and are open to encouragement to participate in decision making for the good of the nation (KSA, 2016).

Vision 2030 emphasized the need for (a) effective investment in human capital, (b) developing learners' creative capabilities and (c) education that contributes to refining a student's personality and cultivating their self-confidence. The vision statement especially valued children's education claiming they are "the architects of our future" (KSA, 2016, p. 6). Cognizant of this aspect of *Vision 2030*, the Saudi science curriculum was revised (to be discussed) to a standards-based learning perspective often used in countries that aspire to raise their educational system's efficiency (Education and Training Evaluation Commission [ETEC], 2018, 2019a). These explicit guidelines explain what students are *expected* to know and do as demonstrated through understanding or mastery of curricular content. Their learning (i.e., knowledge gained) must meet specific, agreed-to-beforehand levels of academic attainment (i.e., standards) that differ by grade level (Glossary of Education Reform, 2017).

2.2. Saudi Secondary Science Education Standards and Vision 2030

"At the heart of achieving the grand targets set out by *Vision 2030* is building an education system that equips Saudi's youth with the skills and knowledge needed to drive innovation, entrepreneurship and ultimately, economic growth" (Pearson, 2016, para. 3). To that end, the KSA government has started to focus on developing standards-based education to (a) raise the efficiency of its educational system; (b) shape the identity and character of future learners; and (c) determine what knowledge, skills, and values must be learned through different school stages to achieve *Vision 2030*. Specifically, the ETEC built standards for public education curricula in coordination with the Saudi Ministry of Education (MOE) and released them in March 2019. These *Science Learning Standards* are based on the contents of both *Vision 2030* and the *National Framework for Public Education Curricular Standards* (ETEC, 2018, 2019a).

Per the latter, Saudi leaders see human beings (its citizens) as the goal of development with education a prominent anchor in that process (ETEC, 2018). "The National Framework for Public Education Curricula Standards is the first step towards developing curricula that comply with the Kingdom's developmental ambitions" (ETEC, 2018, p. 11). The new framework is thus based on aspirations drawn from the Kingdom's

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vision (i.e., its national development plan) and associated growth strategies. The intent of the national curricular framework is to prepare "learners who are proud of their religion and language, are contributors to their nation's development, possess a constructive and balanced personality, and are creative and productive" (ETEC, 2018, p. 18).

The *Science Learning Standards* include a four-level matrix with adjectives describing each level translated from Arabic to English: *foundation* level for grades 1-3, *reinforcement* level for grades 4-6, *expansion* level for grades 7-9, and *concentration* level (strengthen and intensify) for secondary school (grades 10–12). They also include a set of pivotal ideas, common dimensions, and content standards with respective weights in various science subjects (e.g., chemistry, physics, and biology).

KSA's new science standards are designed to develop learners' ability to (a) reflect on the creation of Allah; (b) appreciate science scholars' efforts; (c) form positive scientific tendencies towards science and related professions; (d) form deep understandings of knowledge and scientific inquiry; (e) find creative solutions to problems; and (f) produce scientific, engineering, and technical applications (ETEC, 2019b).

Given the nature of the 4IR (i.e., technological and scientific innovation and development along with digitization), science standards are one of the most important learning standards (Marr, 2019) especially as they enable Saudi learners to carry out scientific and engineering practices and attune them to their close relation to human, social and the environmental issues. The knowledge-based economy anticipated in *Vision 2030* depends on these connections.

2.3. Education and National Development

"National development is viewed in terms of the absolute structural transformation of the socio-economic, political, cultural, scientific and educational set up of a nation" (Emaikwu, 2011, p. 145). Thus, several dimensions factor into the success of national development plans: education, social, culture, health, and technology (Kaldaru & Parts, 2008; Ozturk, 2001; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2010). This study concerns education and national development.

Education is a key factor in national development plans regardless of how difficult it is to effectively implement good education (Stauffer, 2020; Thomas, 1992). Among other things, when it comes to national development, education serves to (a) develop students' personalities, talents, and character; (b) develop human resources for economic growth; and (c) increase production and productivity (Bawa, n.d.). "In a supporting environment, [education can] make major contributions to the complex processes of technology transfer and economic productivity" (Adams, 2002, p. 1). *Vision 2030*'s architects thought along the same lines, noting that, to be effective contributors to the nation's thriving economy and economic development, educational systems will be reshaped, so children's character includes initiative, persistence, leadership, creativity, resilience, and an independent nature (KSA, 2016).

"No country can achieve sustainable economic development without substantial investment in human capital [through the education system]" (Ozturk, 2001 p. 39). "Human capital is the stock of productive skills, talents, health and expertise of the labor force" (Goldin, 2016, p. 77). "Education raises people's productivity and creativity and promotes entrepreneurship and technological advances [and] it plays a very crucial role in securing economic ... progress" (Ozturk, 2001 p. 39).

Science education in particular is *very* important for national development as evidenced by the success of many developed-world nations who privileged science education and training in their development plans (Kola, 2013). Economically advanced countries have high enrollments in science, information technology, management, and industrial technology education programs (Adams, 2002). Science education (e.g., physics, chemistry, and biology) is the foundation for information and communication, medicine, engineering, architecture, agriculture, and manufacturing (Kola, 2013). These factors are the crux of the third and fourth industrial revolutions (David, 2016; Ezell, 2018; Schwab, 2016).

2.4. Children's Education and Saudi's National Development Plan (Vision 2030)

The single most effective investment a nation can make toward national development is educating its children (Ozturk 2001). Fortunately, the KSA's government is privileging children's education (Rajab, 2019). To illustrate, before launching *Vision 2030* in 2016, Saudi's ministers of education had already signed UNESCO's (2015) *Education 2030 Framework for Action*. Indeed, Saudi representatives received special mention for their involvement with and contributions to this framework whose slogan embodies the

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Kingdom's *Vision 2030* goal of reaching quality learning outcomes (Fujimoto, 2015).

At the local level, to create a vibrant society, a thriving economy, and achieve the country's ambitions, the KSA's national development strategy recognizes its fundamental, first pillar – its children (KSA, 2016). Children's (adolescents and youth) education is society's means of advancement, development, progress, and growth (Al-Sulami & Al-Qahtani, 2019). Children constitute its very future and are the most important educational stage in the nation's education system. Their personalities, intellect, and relational skills are forming and can thus be shaped (Abu Arad & Al-Ghafiri, 2017; Rajab, 2019).

Vision 2030 expressed a concern for children specifically in the dimension of an ambitious nation and homeland. It argued for the provision of quality education opportunities for every Saudi child, adolescent, and youth (KSA, 2016; Rajab, 2019). Prince Muhammad bin Salman exclaimed that children "are our nation's pride and the architects of our future" (KSA, 2016, p. 6). Respecting this, the Kingdom is committed, through its 2030 vision, to becoming a pioneering model of how to use education to invest in human resources to bolster a knowledge-based economy and keep pace with rampant, digitized globalization (KSA, 2016).

The vision's architects gave great care to education and considered it the basic guarantee to achieve its aspirations (KSA, 2016). The vision statement includes many references to learning and education in all three axes (Patalong, 2016; Saudi MOE, 2020). To illustrate, the narrative for a vibrant society refers to improving the educational environment to stimulate creativity and innovation; developing curricula, teaching methods, and evaluation; and enhancing students' basic values and skills. A prosperous economy pillar pertains to increasing private and non-governmental sectors' participation in the education sector. And the ambitious nation axis points to providing educational services to all types of students, diversifying innovative sources of funding, improving the education sector's financial efficiency, and strengthening the education system's capacity to meet national development requirements and labor market needs (KSA, 2016).

The vision statement also deals with many facets of the education system to enable schools to cooperate with families, non-profit, and industry sectors to build children's personalities and character such that they will value contributing to developing the nation in adulthood (Al-Yami, 2018; KSA, 2016). Thompson (2017) reported that Saudi youth believed that achieving seventy-five percent (75%) of the vision's ambitions would be a great success for the Kingdom. This success would change history and bridge the gap between education and moving toward the future, including science education.

3. Theoretical Framework

Of the many national development theories (e.g., neoliberalism, basic needs, dependency, world systems theory, and neo-Marxist) (Anderson, 2018; Halperin, 2018; Roxborough, 2018), this study draws on modernization theory, which is concerned with the processes that take place when a society is modernizing. Modernization theory assumes that societies pass through universal stages of development moving from traditional to a more modern state. Traditions are presumed to be potential obstacles to development. KSA (which became a modern state in 1932), views oil dependency as its established tradition (Philby et al., 2023) and is convinced that it must transition to a knowledge-based economy (KSA, 2016), so it can engage with the 4IR. Saudi Arabia's *Vision 2030* "illustrates a good opportunity to benefit from [the 4IR] as it is considered one of the most significant engine drivers unlocking major economic purpose and enabling the diversification that [the] Saudi economy requires going forward under Vision 2030" (Abdulrahim & Mabrouk, 2020, p. 292).

Modernization theory also assumes that particular institutions and structures are necessary for national development (Anderson, 2018). In Saudi Arabia's case, *Vision 2030* identified three such necessary institutions: a vibrant society, a thriving economy, and an ambitious nation. As discussed, the educational system was identified as key to all three axis of development (KSA, 2016).

In addition to social structures and institutions, modernization theory also concerns the rapidity and linearity of the change process (Roxborough, 2018). In Saudi Arabia's case, the nation moved rapidly to manufacturing (mainly oil production) (Saudi Ministry of Planning, ca. 1990) and is now again rapidly transitioning to a knowledge-based economy because its oil reserves are declining. In their efforts to transition their economies, "countries do not all necessarily converge to a single steady-state" (Goorha, 2017, p. 5). The success of this transition is crucial, as KSA's inability to successfully diversify and transition its economy could "become a significant source of geopolitical instability" (Bradshaw, Van de Graaf, & Connolly, 2019, p. 2).

Modernization theory also accommodates a nation's and its people's capacity for transformation as its

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society and related social processes become more complex. This capacity can be used rationally, irrationally, or remain unused. The extent to which capacity is operationalized affects the degree of transformation (Roxborough, 2018), in KSA's case, its economic transformation. Abdulrahim and Mabrouk (2020) recognized the urgency of economic diversification if Saudi Araia hopes to move forward under *Vision 2030*. KSA must diversify its economy if it wants to ensure sustainable economic growth and national development into the future (National Industrial Development and Logistics Program, 2023). Science education plays a part in this transition (Stauffer, 2020).

Per the tenets of modernization theory, hand in hand is the transformation of Saudi Arabia's education sector (a major social institution) (al-Soudeir, 2020) and the modernization of its science education curricula (ETEC, 2018, 2019a), which is so important for national development (Stauffer, 2020). "Considerable modernizations and transformations to program specifications [are] required to allow [Saudi] students to develop capacity in the rapidly emerging areas of different sciences" (Abdulrahim & Mabrouk, 2020, p. 292).

3.1. Research Problem and Question

One of the most important objectives of education is preparing good citizens. Through education, society ensures a sense of belonging; preserves identity; instills values, skills, and norms; and teaches citizens to effectively engage with decision making and problem solving so they can meet the future (Amer, 2012). The KSA, through its ambitious 2030 vision, has sought to reform its educational system and make education one of its priorities, believing in its active role in creating human capital and achieving national development requirements. The Saudi MOE (2020) defined learner characteristics as they pertain to the directions set out in *Vision 2030*: high values, conscientious, strong character, creativity, belief in moderation, pride in national identity and cultural heritage, and knowledgeable and skilled for future jobs and careers as adults in a transitioning economy. These characteristics apply to science learners.

The research statement guiding this study was thus. *The purpose of this study was to explore KSA's new secondary science standards to judge their potential to prepare secondary science students (adolescents) to become mature adults who can contribute to achieving KSA's national development vision.*" Findings and their interpretation may help to improve future science education standard development according to the requirements of the modern era, the fourth industrial revolution, and a knowledge-based economy.

1.

4. Method

An exploratory, descriptive research design was employed. Exploratory research paves the way for more nuanced and comprehensive scholarship about a phenomenon. In the short term, it generates a better understanding of a current issue (McGregor, 2018). The methods included a content analysis and critical judgement of the 2019 Saudi science standards at the Grade 10–12 *concentrated* level. Content analysis helps determine the presence of certain concepts in a database (Krippendorf, 1980) – in this case, science standard documents.

In more detail, a four-stage research design protocol occurred in spring 2021. First, *Vision 2030* was examined for evidence of how the architects envisioned the role of both education and children in national development. Second, the *National Framework for Public Education Curricula Standards'* document was examined to determine its intent and gain insights into the essence of the curricular framework. Third, the researchers became familiar with the new *Natural Sciences Education Standards*.

4.1. Concept Analysis Protocol

Fourth, with this contextual background in place, the content of the Grade 10–12 Saudi science standards' document was analyzed and compared to *Vision 2030* to discern how the former accommodated and aligned with the latter regarding the role of children's education relative to implementing and attaining national development goals and visions. The Grade 10–12 *concentration* level (strengthen and intensify science learning) was chosen because secondary students are the upcoming generation of workers employed in all sectors to transition the economy from oil to knowledge.

The literature reviewed herein (especially Saudi MOE, 2020) affirmed that successful national development depends on children and adolescents having some combination of the traits affecting national development set out in Table 1. This roster was used to gather data to discern the extent to which the science

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standards intimated the intention for science students to learn these things and hone these traits while studying science and apply them afterwards as adults contributing to the economy and national development.

The standards document was hand coded repeatedly by the same person using Table 1 as a calculated, predetermined *start list*. Also, using a *code-in-use* approach provided the flexibility to add additional traits to the original start list so pertinent data in the document could be satisfactorily captured. Words, phrases, and sentences were coded. As well, a flexible but rigorous level of implication (researcher inference) was employed to capture text that implied the concept (i.e., trait affecting national development). Validity was addressed by consistently following the coding rules. An 85% intra-coder reliability coefficient was achieved, which is deemed acceptable for repeated coding by the same person (Krippendorff, 1980; Miles & Huberman, 1984).

In this analysis, the concern was for whether specific traits were present in the document rather than the frequency or extent of their presence. This approach yielded a profile of the range of traits evident in the standards document rather than their depth (a topic for future research). Findings and their discussion reflect a subjective interpretation of the data. The intent was not to explore the extent of usage so much as to infer meaning from inclusion and exclusion of given traits (Hsieh & Shannon, 2005).

5. Results

The overall research inquiry pertained to judging the potential of the 2019 Saudi science standards (at the Grade 10-12 concentrated level) to prepare adolescents to become mature adults who can contribute to achieving KSA's national development vision. Based on the content analysis findings (see Table 1), we propose that the answer is *moderately well*. Moderately means something exists to a certain extent (i.e., partly but not completely) (Merriam-Webster, 2008; Waite, 2012). Evidence was strong for some traits, weak or inferred for others, and some traits were absent, and their absence was noteworthy. This answer to the research inquiry was substantiated by (a) reporting the findings and discussion in the same section and (b) introducing new sources to develop discussion points around issues that had not fully materialized in the literature reviewed (Labaree, 2016; McGregor, 2018; Wiersma & Jurs, 2009).

Table 1. Evidence of traits affecting national development in Saudi Arabia's 2019 grades 10–12 concentration-level science standards.

Traits affecting national development	**Present in curriculum**	**Evidence accepted for presence**
Balanced personality: physical health and safety, intellectual/cognitive ability, psychological and emotional, social connections and relations, spiritual wellness	✓	- cognitive passion - community cooperation and participation - appreciate idea of community vitality - respect moderation and fairness - devotion to God
Support of a strong family		
Adult models of good behavior		
Initiative		
Leadership	✓	- take responsibility
Decision making for good of the nation	✓	- good communication skills - participate in solving environmental change - master peer criticism skills and accepting criticism from others
Creative abilities	✓	- creative thinking skills
Self-confidence	✓	- self-esteem
Persistence		
Resilience		
Independent and autonomous nature	✓	- independent learner
Respect for scientific and technological innovation	✓	- use technology

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		- build computer models and simulation models
Respect for how science can be used to invest in human capital	✓	- acquire scientific knowledge
Extra traits present in the science curriculum (actual words were coded as evidence)		
Critical thinking and reading	✓	
Analytical ability	✓	
Debate and argumentation	✓	
Problem solving	✓	
Planning and investigation	✓	
Prediction skills	✓	
Questioning skills	✓	
Research skills	✓	

5.1. Clearly Evident Traits

Some traits deemed necessary for students to know, so they can help achieve national development goals, were clearly evident in the Saudi Grade 10–12 science standards: balanced personality, self-confidence, leadership, creative abilities, and independent nature (see Table 1). Balanced personality was thin on physical health and safety, and psychological and emotional stability, but the other elements were represented: cognitive, social, and spiritual.

Taking responsibility was coded to reflect leadership, as leaders are responsible for guiding others in given directions (Knights & O'Leary, 2006). But leadership is more. Leaders must be motivated to lead; exhibit honesty and integrity; exude self-confidence; have emotional stability; cognitive ability (e.g., analyze, interpret, integrate); and have some degree of charisma, creativity, originality, and flexibility (Kirkpatrick & Locke, 1991). Many of these traits are also evident in Table 1, which bodes well for the Grade 10–12 science standards being able to develop citizens who can moderately contribute to national development.

5.2. Inferred Evidence for Traits

In the spirit of a subjective interpretation of data to infer meaning (Hsieh & Shannon, 2005), evidence for some traits in the standards was inferred by the researchers: innovation, human capital, and decision making. This analytical strategy was employed because the only time the word *science* appeared in *Vision 2030* was in reference to privatization: "To create a comprehensive privatization program…we will make use of international best practices, transfer knowledge and achieve our goals in a balanced and *scientific* [emphasis added] manner" (KSA, 2016, p. 83). This word usage implies doing things carefully and thoroughly by using experiments and field tests rather than using science education to prepare citizens who can help achieve national development.

This rhetorical issue around the meaning of science in the vision statement prompted some initial hesitation: How realistic is it to expect the science standards to reflect national development? Quite realistic it seems given that the *Science Learning Standards* were based on *Vision 2030* (ETEC, 2018, 2019a); any content therein was construed as fostering national development. Also, when speaking of education and national development, Njeng'ere (2014) said that the inclusion of anything in a national education curriculum implies that it is worth intentionally transmitting to learners. Another unknown is whether those writing the standards intended their ideas to be interpreted as they were in this analysis risking the presumption of evidence of their presence. Respecting this murky analytical scenario, some findings and their import remain open to speculation and further study: innovation, human capital, and decision making. Their interpretation is presented here for consideration.

5.3. Innovation

One example of evidence possibly being perceived as overzealous is for the factor 'respect for scientific and technological innovation.' Innovation was loosely coded in the science curriculum as (a) using technology and (b) building computer and simulation models, but the science standards did not directly link these to

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innovation. Innovation refers to the introduction of new or improvement of existing methods, ideas, products, or services and their spread. This often requires the use of technology and computers hence the coding protocol. Creating new or improving engineering processes leads to technological and scientific innovation. Innovation spearheads more efficient or efficacious processes, technologies, services, products, business models, and such. The practical implementation of innovations can have a meaningful impact on the market, industry, economy, society, government, medicine, and education (Lijster, 2018; Schumpter, 1939).

Vision 2030 envisioned innovation around (a) educational programs and events; (b) advanced technologies and entrepreneurship; (c) competitive investments and economic opportunities; and (d) bureaucratic, administrative, and funding processes to ensure national transformation (KSA, 2016). But it made no mention of using science to effect innovation, and the science standards did not explicitly refer to teaching science students so they can influence national development. This is shortsighted on both fronts because innovation is at the heart of achieving *Vision 2030*'s goal of growing a knowledge-based economy (Pearson, 2016), and the latter is deeply dependent on educating children (Adams, 2002; KSA, 2016; Thomas, 1992). Science education is a pillar of the 4IR (Ezell, 2018). Using science education to teach a respect for innovation seems a logical recommendation because science and national development both depend on innovation (Vestberg, 2018).

5.4. Human Capital

Another example of insubstantial evidence is that coded to represent a 'respect for how learning science can be an investment in human capital,' which is an invisible inventory of the strength of the labour force (Goldin, 2016; Kenton, 2020). *Vision 2030* directly addresses human capital but only as it pertains to the public sector (KSA, 2016). Granted, the government sector is key to a strong private sector and the education sector, but different human capital is needed to be productive in the civil service than industry or education.

The only content in the Grade 10-12 Saudi science standards that was coded for human capital was reference to students acquiring science knowledge as it pertains to the environment, ecosystems, energy and matter, earth systems, the universe, and outer space. Whether the science standards' architects meant this aspect of science to be interpreted this way is open for deliberation. It was coded thus because a respect for and knowledge of science is a key aspect of human capital for an economy transitioning to a knowledge-based economy. Science education is the foundation of many industrial sectors shaping such an economy (e.g., information and communication technology, engineering, and digitized manufacturing) (Adams, 2002; Kola, 2013).

Any nation embarking on a national development plan must ensure substantial investment in human capital (Ozturk, 2001; Bawa, n.d.), and education plays a key role in developing human capital (Abuzyarova et al., 2019). Science education is no exception because science can influence technology transfer and economic productivity (Adams, 2002). Future efforts to update the science standards should give more consideration to how science education influences human capital, which is necessary to transition the Saudi economy. Science education is the crux of the 4IR (Ezell, 2018; Schwab, 2016), which depends on productive workers in key industry sectors – their human capital is paramount.

5.5. Decision-Making

A third example of potentially weak evidence is the decision-making factor. Making decisions is a cognitive process wherein, after due consideration, people select a belief or course of action from among several viable options (Simon, 1977; Waite, 2012). The architects of *Vision 2030* envisioned parents and the educational system developing "children's characters and talents so that they can contribute fully to society" (KSA, 2016, p. 28; see also Almudara, 2019). Although the words *decision making* do not appear in the vision statement, the KSA wants citizens who are open to engaging for the good of the nation.

Evidence from the Grade 10-12 Saudi science standards coded for this factor pertained to (a) participating in solving environmental issues impacting the nation (and by association the development process), (b) mastering the ability to critique peers (who may hold contrasting opinions) and accept their criticism and (c) exercising good communication skills (to express thought processes and attendant decisions). Whether the science standards' architects actually meant for content coded thus to effect national development is uncertain, but it is tenable given that the standards were based on *Vision 2030* (ETEC, 2018, 2019a). Education helps members of society effectively engage with decision making to meet the future (Amer, 2012), and science

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education is needed to meet the imperatives of the 4IR (Vestberg, 2018).

5.6. Extra Traits (Cognitive/Intellectual)

The content analysis also revealed character traits entrenched in the science curriculum not specifically mentioned in the national development literature, but they would surely augment the latter. All were related to the cognitive/intellect domain (see Table 1): critical and creative thinking, analysis and problem solving, debate and argumentation (reasoning), and research and investigation. Of note is that traits related to cognition and intellect were present in the science standards but not identified as key to national development in *Vision 2030.* So, how can their prevalence be subjectively interpreted (per Hsieh & Shannon, 2005)?

Consider that human capital is a key factor for national development, and cognitive ability and intelligence are key aspects of human capital (Kenton, 2020). Human capital *is* mentioned in *Vision 2030* (KSA, 2016 at pages 69 and 82). "Because human capital is a crucial factor in the success of any substantial [national transformation] project, we aim to launch a thorough program for nurturing our human talent… in our civil service" (KSA, 2016, p. 82). "Human capital is an intangible asset or quality not listed on a [nation's] balance sheet. It can be classified as the economic value of a worker's experience and skills. This includes assets like education, training, *intelligence* [emphasis added], skills, health" (Kenton, 2020, para.1).

Intelligence is the mental capacity to acquire knowledge, apply logic, problem solve, and use powers of reasoning and judgement (Waite, 2012). Given that the Grade 10–12 science standards were developed with achieving *Vision 2030* in mind (ETEC, 2018, 2019a), the architects are to be commended for appreciating and incorporating the powerful role that cognitive ability and intellect play in science *and* in the national development process. Intelligence is a key aspect of human capital (Kenton, 2020), which is the crux of shifting to a knowledge-based economy where knowledge-intensive activities inform production pursuant to rapid technological advancement and scientific innovation (Powell & Snellman, 2004).

5.7. Missing Traits

Several traits deemed significant relative to national development were not coded in the Saudi Grade 10–12 science standards (see Table 1). It is somewhat understandable (albeit disappointing) that a science curriculum would omit the necessity of a strong family base for children, adult models of good behaviour, or even the character traits of persistence and resilience, which are deemed central to effective national development in Saudi Arabia (KSA, 2016).

But no evidence was coded for initiative, which is the ability to assess and then take independent action. Initiative requires seeing and taking advantage of opportunities to act or take charge of a situation before others do. It connotes enterprise, which means it takes physical, emotional, and intellectual effort (Waite, 2012). Initiative could readily be part of a science curriculum, and it is definitely an important element of national development. Respectively, "scientists exhibit strong self-directedness, which includes motivation to explore new ideas. [To that end, they must] take initiative in their jobs" (Sato, 2016, p. 5). The focus of developing Saudi adolescents' character vis-à-vis national development goals "will be on the fundamental values of initiative…" (KSA, 2016, p. 28).

The KSA (2016) government appreciated both that achieving its national development plan would require initiative, and it is imperative that this trait be instilled in children. But the science standards' architects seemed to have missed an opportunity to align science learning with this aspect of *Vision 2030* (at least as interpreted during the coding process). School systems at all levels must absorb many changes to ensure that all citizens are prepared for the 4IR – and that includes science education (Marr, 2019; Vestberg, 2018). One such change is a strong focus on students' inclination to embrace and welcome taking initiative and to teach this trait in science education.

5.8. Suggestions for Future Research

Future studies of this nature should examine the other three levels of science learning: foundation, reinforcement, and expansion. Once completed, a comparative analysis of all four levels could be conducted to further yield an overall profile of the ability of the new Saudi science standards to help students contribute to achieving KSA's national development plans. Researchers are further encouraged to augment these content analyses with in-depth interviews with those who wrote the standards to better discern their intent relative to aligning the standards with *Vision 2030* to ensure citizen contribution to national development.

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6. Conclusion and Recommendations

The KSA's government has begun developing standards-based education to ensure that citizens can contribute to achieving *Vision 2030.* Regarding the use of science education to achieve the vision's three goals, findings suggested that the Grade 10–12 science standards will serve 'moderately well' for ensuring a thriving economy and an ambitious nation. They were especially focused on a balanced personality, self-confidence, independent learners, leadership, and cognitive/intellectual/reasoning abilities. A respect for human capital, decision making, and innovation was inferred. Less so for taking initiative. The science standards were not directly focused on a vibrant society (i.e., community, family, and such).

Transitioning to a knowledge-based economy, so the KSA can embrace the rigors of the fourth industrial revolution, partly depends on science education that prepares citizens for their contributions to national development. KSA educational representatives were lauded for their contributions to UNESCO's (2015) *Education 2030 Framework for Action*. The authors of standards are further commended for updating Saudi's secondary science education standards with Vision 2030 in mind and are encouraged to consider the study findings herein in future revisions.

Per the tenets of modernization theory (Anderson, 2018, Halperin, 2018; Goorha, 2017; Roxborough, 2018), Saudi's national development progress will depend on certain institutions, one of which is the education sector and attendant curricula. If the science standards and associated curricula are designed with insights from our study in mind, KSA will have improved its chances of achieving *Vision 2030*. Modernization of the economy will benefit from modernization of the science curricula, so secondary students can grow into mature adults aware of their role in nation development.

To that end, a sharper focus is recommended on designing Saudi science education so it concerns (a) decision making for nation building, (b) the import of human capital in national development and (c) the significance of preparing citizens who take initiative and innovate, so the KSA can successfully transition to the fourth industrial revolution as a knowledge-based economy grounded in sustainability principles.

References

Abdulrahim, H., & Mabrouk, F. (2020). COVID-19 and the digital transformation of Saudi higher education. Asian Journal of Distance Education, 15(1), 291–306. http://www.asianjde.com/ojs/index.php/AsianJDE/article/view/468

Abu Arad, S., & Al-Ghufairi, A. (2017). Nedam altaaleem fi almmlakah alarabia alswdeia [The Kingdom of Saudi Arabia's education system]. Dammam: Dar Al-Mutanabi Library.

Abuzyarova, D., Belousova, V., Krayushkina, Zh., Lonshcikova, Y., Nikiforova, E., & Chichkanov, N. (2019). The role of human capital in science, technology and innovation. Foresight and STI Governance, 13(2), 107–119. https://doi.org/10.17323/2500-2597.2019.2.107.119

Adams, D. K. (2002). Education and national development. Manila, Philippine: Asian Development Bank.

Alghamdi, A. K. H., & El-Hassan, W. S. (2020). Interdisciplinary inquiry-based teaching and learning of sustainability in Saudi Arabia. Journal of Teacher Education for Sustainability, 22(2), 121–139. https://doi.org/10.2478/jtes-2020-0020

Alghamdi, A. K. H., Alsaadi, R. K., Alwadey, A. A., & Najdi, E. A. (2022). Saudi Arabia's Vision 2030's compatibility with women and children's contributions to national development. Interchange, 53(2), 193–214. https://doi.org/10.1007/s10780-021-09451-3

Al-Harbi, A. (2018). Tatweer manaheg alaloom bi almarhalah almotawasetah fi dawa almafaheem alalmeah almotadaminah fi rwayat almmlakah alarabia alswdeia 2030 [Development of middle school science curricula in the light of scientific concepts in Saudi Arabia's Vision 2030]. Education and Psychology Mission, 61, 109-132.

Alhomairi, A. O. (2018). A proposed perspective for developing science curriculum for the upper primary grades in accordance with Saudi Arabia's Vision for 2030: An analytical and descriptive study according to Delphi method. International Journal of Higher Education, 7(1), 69-86. https://doi.org/10.5430/ijhe.v7n1p69

Al mutarrafi, R. (2020). Madaa aishtimal muqararat aleulum lilmarhalat almutawasitat ealaa almafahim aleilmiat alwaridat fi ruyat almamlakat alearabiat alsaeudiat 2030 wataweiat altulaab baha [The extent to which the science courses for the intermediate stage include the scientific concepts included in the Kingdom of Saudi Arabia 2030 vision and the students' awareness of them]. Alfateh Journal, 84, 110–130.

Almudara, S. B. (2019). An observation study of 2030 vision in primary and secondary schools in Saudi Arabia. Euromentor Journal, 10(1), 51–63.

Al-Soudeir, Z. (2020, February 9). Saudi educational reform progressing but not without resistance. The Arab Weekly. https://thearabweekly.com/saudi-educational-reform-progressing-not-without-resistance

Al-Sulami, S., & Al-Qahtani, Y. (2019). Motatalbat tatbeek kaskasaht madares altaaleem alaam fi dawa rwayat almmlakah 2030: Tasawr moktarah [Requirements for implementing the privatization of public education schools in light of the Kingdom's Vision 2030: A proposed scenario]. Reading and Knowledge Journal, 210, 207-235.

Al-yami, H. (2018). Rwayah ostakbaleah li tatweer altaleem fi almmlakah alarabeah alswadyah fi dawa rwayat almmlakah 2030 [Future vision for developing education in the Kingdom of Saudi Arabia in light of Vision 2030]. Sciences, Psychology and

International Journal of Educational Studies
Vol. 8, No. 2, pp. 35-47
2025
DOI: *10.53935/2641533x.v8i2.320*

Email: amani.k.hamdan@gmail.com

Education Journal, 2(26), 32-49.
Amer, T. (2012). Almwatanah wa altarbeah alwatanyah [Citizenship and national education (international and Arab trends)]. Egypt, Cairo: Good Foundation.
Anderson, C. (2018, May). Theories of national development. Paper presented at the Korean Official Development Assistance Conference, Incheon, Korea. https://doi.org/10.13140/RG.2.2.17628.46723 Link
Bawa, B. (n.d.). Education in the process of national development. In Your Article Library. https://www.yourarticlelibrary.com/education/education-in-the-process-of-national-development/76818
Bradshaw, M., Van de Graaf, T., & Connolly, R. (2019). Preparing for the new oil order? Saudi Arabia and Russia. Energy Strategy Reviews, 26, Article 100374. https://doi.org/10.1016/j.esr.2019.100374
David, N. (2016, January 19). What is the fourth industrial revolution. World Economic Forum Agenda. https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution/
Education and Training Evaluation Commission. (2018, March). National framework for public education curricula standards in Kingdom of Saudi Arabia. Riyadh, Saudi Arabia. https://etec.gov.sa/ar/productsandservices/NCSEE/Cevaluation/Documents/English%20Book.pdf
Education and Training Evaluation Commission. (2019a). Wathigat maaeir magal taalm alalom altabiayah [Natural sciences learning standards document]. Riyadh, Saudi Arabia.
Education and Training Evaluation Commission. (2019b). Aletar altakassi li magal taalm alalom altabiayah [Specialized framework for learning natural sciences]. Riyadh, Saudi Arabia.
Emaikwu, S. O. (2011). Integrating entrepreneurship skills acquisition in the university curriculum for national development. Journal of Research in Education and Society, 2(3), 40-48.
Ezell, S. (2018, April). Why manufacturing digitalization matters and how countries are supporting it. Washington, DC: Information Technology and Innovation Foundation. http://www2.itif.org/2018-manufacturing-digitalization.pdf
Fujimoto, G. (2015, July 27-August 1). Childhood pathways to sustainability. Keynote presented at World Organization for Early Childhood Education conference, Washington, DC. http://iin.oea.org/pdf-iin/RH/EARLY-CHILDHOOD-PATHWAYS-2015-FUJIMOTO.pdf
Glossary of Education Reform. (2017, November 9). Standards-based. https://www.edglossary.org/standards-based/
Goldin, C. (2016). Human capital. In C. Diebolt & M. Haupert (Eds.), Handbook of cliometrics (1st ed.) (pp. 55–86). New York, NY: Springer-Verlag.
Goorha, P. (2017). Modernization theory. In N. Sandal (Ed.), Oxford Research Encyclopedia: International Studies. https://doi.org/10.1093/acrefore/9780190846626.013.266
Halperin, S. (2018, December 17). Development theory. In Encyclopedia Britannica. https://www.britannica.com/money/topic/development-theory
Handayani, R. D., Wilujeng, I., & Prasetyo, Z. K. (2018). Elaborating indigenous knowledge in the science curriculum for cultural sustainability. Journal of Teacher Education for Sustainability, 20(2), 74-88. https://doi.org/10.2478/jtes-2018-0016
Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. Qualitative Health Research, 15(9), 1277–1288. https://doi.org/10.1177/1049732305276687
Kaldaru, H., & Parts, E. (2008). Social and institutional factors of economic development: Evidence from Europe. Baltic Journal of Economics, 8(1), 29–51. https://doi.org/10.1080/1406099X.2008.10840444
Kenton, W. (2020, September 4). Human capital. In C. Silver (Ed.), Investopedia. https://www.investopedia.com/terms/h/humancapital.asp
Kingdom of Saudi Arabia. (2016). رؤية المملكة العربية السعودية 2030 [Vision 2030: Kingdom of Saudi Arabia]. https://vision2030.gov.sa/sites/default/files/report/Saudi_Vision2030_EN_2017.pdf
Kirkpatrick, S. A., & Locke, E. A. (1991). Leadership: Do traits matter? Academy of Management Perspectives, 5(2), 48-60. https://doi.org/10.5465/ame.1991.4274679
Knights, D., & O'Leary, M. (2006). Leadership, ethics, and responsibility to the other. Journal of Business Ethics, 67(2), 125-137. https://doi.org/10.1007/s10551-006-9008-6
Kola, A. J. (2013). Importance of science education to national development and problems militating against its development. American Journal of Educational Research, 1(7), 225-229. https://doi.org/10.12691/education-1-7-2
Krippendorff, K. (1980). Content analysis. Newbury Park, CA: Sage.
Labaree, R. V. (2016). Research guides: Organizing your social sciences research paper. University of Southern California Writing Center website: http://libguides.usc.edu/writingguide
Lijster, R. (2018). The future of the new: Artistic innovation in times of social acceleration. Amsterdam, the Netherlands: Valiz.
Makhlouf, A. (2021). Saudi schools' openness to change in light of the 2030 vision. American Journal of Educational Research, 9(1), 52–60. https://doi.org/10.12691/education-9-1-6
Marr, B. (2019, May 22). 8 things every school must do to prepare for the 4th industrial revolution. Forbes Blog. https://www.forbes.com/sites/bernardmarr/2019/05/22/8-things-every-school-must-do-to-prepare-for-the-4th-industrial-revolution/
McGregor, S. L. T. (2018). Understanding and evaluating research. Thousand Oaks, CA: Sage.
Merriam-Webster. (2008). Merriam-Webster's advanced learner's English dictionary. Springfield, MA: Author.
Miles, M. B., & Huberman, A. M. (1984). Qualitative data analysis. London, England: Sage.
National Industrial Development and Logistics Program. (2023). Vision realization programs. https://www.vision2030.gov.sa/v2030/vrps/nidlp/
Njeng'ere, D. (2014). The role of curriculum in fostering national cohesion and integration: Opportunities and challenges [IBE Working Papers on Curriculum Issues Nº 11]. Geneva, Switzerland: UNESCO International Bureau of Education. http://www.ibe.unesco.org/sites/default/files/nationalcohesion_kenya_ibewpci_11_eng.pdf

International Journal of Educational Studies
Vol. 8, No. 2, pp. 35-47
2025
DOI: *10.53935/2641533x.v8i2.320*
Email: amani.k.hamdan@gmail.com

Ozturk, I. (2001). The role of education in economic development: A theoretical perspective. Journal of Rural Development and Administration, 33(1), 39-47. https://mpra.ub.uni-muenchen.de/id/eprint/9023
Patalong, F. (2016, August). Vision 2030 and the transformation of education in Saudi Arabia. Al Tamimi Company. https://www.tamimi.com/law-update-articles/vision-2030-and-the-transformation-of-education-in-saudi-arabia/
Pearson. (2016, November 9). Building STEM capability in Saudi Arabia. https://middleeast.pearson.com/Blogsocialmedia/blog/2016/11/building-stem-capability-in-saudi-arabia.html
Philby, H. S. B., Ochsenwald, W. L., & Teitelbaum, J. (2023, August 10). Saudi Arabia. In Encyclopedia Britannica. https://www.britannica.com/place/Saudi-Arabia
Powell, W. W., & Snellman, K. (2004). The knowledge economy. Annual Review of Sociology, 30(1), 199–220. https://doi.org/10.1146/annurev.soc.29.010202.100037
Rajab, A. A. (2019). Stakeholder perceptions of child-centered education in Saudi public sector preschools: Using practice architecture to examine progress towards Saudi Vision 2030. Unpublished Doctoral Dissertation of Philosophy, University of Hull.
Rotatori, D., Lee, E. J., & Sleeva, S. (2021). The evolution of the workforce during the fourth industrial revolution. Human Resource Development International, 24(1), 92–103. https://doi.org/10.1080/13678868.2020.1767453
Roxborough, I. (1988). Modernization theory revisited. A review article. Comparative Studies in Society and History, 30(4), 753–761. https://www.jstor.org/stable/178933
Salam, S. A., & Sekim, S. A. (2019). Integrating sustainable development requirements into the secondary stage chemistry curriculum in Egypt. Journal of Teacher Education for Sustainability, 21(2), 139-154. https://doi.org/10.2478/jtes-2019-0022
Saudi Ministry of Education. (2020). Altaalem wa rwayat alswadeah 2030 [Education and Saudi Vision 2030]. https://www.moe.gov.sa/ar/Pages/vision2030.aspx
Saudi Ministry of Planning. (ca. 1990). Fifth development plan (1990-1995) (Chapter 1). Ministry of Planning Press. https://www.mof.gov.sa/en/about/OldStratigy/Fifth%20Development%20Plan%20-%20Chapter%201%20-%20Planning%20And%20Development%20In%20Saudi%20Arabia-%D9%85%D8%AF%D9%85%D8%AC.pdf
Sato, W. (2016). Scientists' personality, values, and well-being. SpringerPlus, 6(5), Article 613. https://doi.org/10.1186/s40064-016-2225-2
Schumpeter, J. A. (1939). Business cycles. New York, NY: McGraw Hill.
Schwab, K. (2016). The fourth industrial revolution: What it means, how to respond. World Economic Forum Global Agenda. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/
Simon, H. A. (1977). The new science of management decision. Hoboken, NJ: Prentice-Hall.
Stauffer, B. (2020). Ultimate guide to teaching 21st century skills in secondary schools. Applied Educational Systems.
Thomas, R. M. (Ed.) (1992). Education's role in national development plans: Ten country cases. Westport, CT: Praeger.
Thompson, M. C. (2017). Saudi Vision 2030: A viable response to youth aspirations and concerns? Asian Affairs, 48(2), 205-221. https://doi.org/10.1080/03068374.2017.1313598
United Nations Department of Economic and Social Affairs. (2018). Towards Saudi Arabia's sustainable tomorrow: First voluntary national review 2018. https://sustainabledevelopment.un.org/content/documents/20230SDGs_English_Report972018_FINAL.pdf
United Nations Educational, Scientific and Cultural Organization. (2010). The power of culture for development [CLT/2010/WS/1]. Paris, France: Author. https://unesdoc.unesco.org/ark:/48223/pf0000189382
United Nations Educational, Scientific and Cultural Organization. (2015, May). Incheon declaration and SDG4 – Education 2030 framework for action. Paris, France: Author. http://uis.unesco.org/sites/default/files/documents/education-2030-incheon-framework-for-action-implementation-of-sdg4-2016-en_2.pdf
Vestberg, H. (2018, September 21). Why we need both science and humanities for a fourth industrial revolution education. https://www.weforum.org/agenda/2018/09/why-we-need-both-science-and-humanities-for-a-fourth-industrial-revolution-education/
Waite, M. (Ed.). (2012). Paperback Oxford English dictionary (7th ed.). Oxford, England: Oxford University Press.
Wiersma, W., & Jurs, S. (2009). Research methods in education (9th ed.). New York, NY: Pearson.

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