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Article

Knowledge economy, innovation and the universities' education role in Saudi Arabia : a study of academicians' perspectives at the University of Hail

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KNOWLEDGE ECONOMY, INNOVATION AND THE UNIVERSITIES' EDUCATION ROLE IN SAUDI ARABIA: A STUDY OF ACADEMICIANS' PERSPECTIVES AT THE UNIVERSITY OF HAIL

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Abstract: *The labour market is witnessing a significant increase in the levels of demand to learn new skills in areas such as data science, artificial intelligence and machine learning, which are among the most prominent features of the new industrial revolution. Universities have a vital function in the knowledge economy and innovation, as they generate and share knowledge through research, education, and creativity. The knowledge economy (KE) and innovation are key drivers of economic growth, as they promote innovation, productivity, and competitiveness. It creates new industries and jobs that require highly skilled workers. Weakness and inadequacy of the educational and research system have been considered as one of the main issues in Saudi Arabia. The aim of this study is to identify the role of universities in the knowledge economy and innovation in Saudi Arabia from the perspective of academics at the University of Hail. To achieve the objective of this research, a cross-sectional explanatory and descriptive research design with a quantitative approach was adopted by the researchers. A sample size of 83 academicians was chosen using a simple random sampling procedure. The analysis method employed was structural equation modelling (SEM) with partial least squares (PLS). The adopted instrument for collecting the data were a survey. The questionnaire measures were based on a 5-point Likert scale. To measure the reliability and validity of the instruments, Cronbach's alpha, composite reliability, and Fornell-Lacker criterion tests were conducted. The findings of the study revealed that educational curriculum, educational policy, infrastructure, and scientific research have a significant role in (KE) and innovation, whereas the results of teaching methods showed no significant role in (KE) and innovation. To remain competitive in the ever-changing economic landscape, policymakers in Saudi Arabian universities must prioritize curriculum design, infrastructure, teaching methods, policies, and skilled manpower while paying more attention to science, technology, and innovation. In addition, universities should focus on developing the skills of their graduates to meet the demands of the job market. This can be achieved by offering internships and apprenticeships, as well as providing training in soft skills such as communication, teamwork, and problem-solving.*
Keywords: education; knowledge economy; innovation; policies; infrastructure; Saudi Arabia.

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1. Introduction. Knowledge is considered a critical factor in the development of nations, as it is seen as a central capacity builder by international development, research, and governance bodies. This includes the knowledge economy (KE) and innovation, which encompasses information and communication technology, education, and innovation. Therefore, it is important for nations to take these factors seriously in their national planning strategies to ensure that their strengths and weaknesses are assessed and addressed. In the present economic crisis and uncertain environment, having knowledge is seen as the key determinant of having a competitive edge (Heng et al., 2012). The term "KE" refers to an economic system where the primary drivers of competitiveness for businesses, industries, and cities or regions are the acquisition, generation, and utilization of knowledge (Winther, 2019).

The explosion of knowledge resulting from scientific activity in various fields and the rapid movement and change that the world is witnessing have led to an enormous amount of inventions and innovations, which leads to social, cultural, and economic prosperity. This led to the emergence of a new term that links the educational system to knowledge production, which enables those who invest in it to obtain benefits. The concept has been called "KE and innovation". This investment can be expressed by working to develop and prepare human capital scientifically, culturally, skilfully, and socially so that this development and preparation will be reflected later in the societal environment in which the individual lives and can lead to economic prosperity. In his book, the effective executive, Peter Drucker developed the concept of the KE and innovation in 1966, distinguishing between manual workers and knowledge workers. Manual employees utilize their hands to generate items or services, whereas knowledge workers rely on their minds. A knowledge worker, on the other hand, "puts to work what he has between his ears rather than the brawn of his muscles or the skill of his hands" and generates ideas, knowledge, and information. The concept of a KE and innovation is debated among thinkers, with some believing it to be the next stage of global economic development after agriculture and industry, while others view it as buzzwords attempting to relate on-going trends. Various studies have been conducted on the factors affecting the growth of the KE, and it has been recognized as the foundation for the development of the economy (Yigitcanlar, 2014; Muzeyin et al., 2022). Investing in high-quality education and training creates significant external advantages that are crucial for the advancement of the economy and society driven by knowledge (Ramady, 2010). The most important aspect of the KE and innovation and university education is their ability to promote innovation, creativity, and critical thinking skills that are essential for solving complex problems in today's world. KE and innovation and university education provide individuals with the tools and skills necessary to think critically, analyse data, and innovate new solutions to complex problems. These skills are essential for success in today's rapidly changing world, where technology and globalization are transforming the nature of work and society.

Higher education (HE) plays a critical role in KE and innovation by training and equipping individuals with the skills, knowledge, and expertise needed to drive innovation and economic growth. According to Moiseev et al. (2019), HE is an integral part of KE and innovation, and it serves as a crucial factor in the growth of knowledge, economy, and human resources in organizations. The Arab Knowledge Index (2015) suggests that individuals cannot succeed or compete in the knowledge and economic sectors without HE. HE is a critical driver of innovation and competitiveness in the KE. The success of the KE and innovation is based on the quality of HE institutions and their capacity to create graduates with the necessary skills to prosper in today's rapidly changing environment. According to Salem (2014), universities have a crucial role in the advancement of information and KE. This type of economy values innovation and prioritizes ideas over human labour and raw materials. To encourage more entrepreneurial thinking, many have advocated for deregulation of the HE sector and greater autonomy for universities, as emphasized by Park (2013). In recent years, the Kingdom of Saudi Arabia (KSA) has made significant progress in its HE system, investing heavily in infrastructure, research, and development. The country's Vision 2030 plan prioritizes the development of a KE and innovation, with HE institutions playing a crucial role. However, accountability and transparency are essential for these institutions to effectively contribute to the country's development. This requires strong governance structures, data-driven decision making, and responsiveness to stakeholder needs. Moving forward, it is important for universities in the KSA to continue prioritizing these factors to build a sustainable and impactful HE system. The transition to a KE and innovation has increased the importance of skills development in companies and institutions. Employees are now expected to continuously develop their skills at a faster pace in line with rapid knowledge advancements. It is not only about producing knowledge but also making it accessible through various means, especially mobile devices. Therefore, this study is significant because it focuses on the role of universities in KSA's KE and innovation efforts. According to the preceding reasoning, the effectiveness of HE is a critical variable in realizing KE

and innovation. As per the conducted previous studies on this topic, no study has been carried out on the factors of educational curriculum, educational policy, scientific research, infrastructure, and teaching methods and their role in KE and innovation. Most of the conducted studies were on the concepts of KE and innovation and other factors, such as demographics, skills, and innovation factors. Therefore, this study aims to fill that research gap and to identify the relationship between the educational system and KE and innovation. Strengthening HE in this specific area has the potential to generate significant positive impacts on both the KE and innovation and sustainable development. By providing students with the necessary skills and knowledge through HE, they will be better equipped to contribute to the economy and society in a meaningful way, thereby creating a positive feedback loop that leads to further growth and development. In addition, Hail is one of the fastest-growing regions in the KSA, with significant economic potential. Investigating the role of university education at the University of Hail can shed light on how it contributes to economic growth, job creation, and innovation within this specific context. Therefore, the University of Hail is a relevant focus for studying the role of university education in the KE in the KSA due to several factors and characteristics that make it an important case study: economic importance, academic programmes, researchers' workplaces and sponsors, and research and innovation. The aim of this study is to identify the role of universities in KE and innovation in the KSA by investigating educational curriculum, educational policy, scientific research, infrastructure, and teaching methods variables and their contribution to KE and innovation.

The paper begins with an introduction that provides background information and states the objectives and the research gap. This is followed by a literature review, which summarizes previous studies and theories related to the topic. The methodology and research methods section explains how the study was conducted. The outcomes of the study are presented in the results section, which is frequently in the form of tables and statistical analysis. The discussion section discusses the findings and compares them to past research, emphasizing any notable findings or study limitations. Finally, the conclusion summarizes the main findings and their implications for future research or practical applications.

2. Literature Review. The KE and innovation is considered a central tool in measuring the ability of countries to progress and possess the necessary ingredients for the success of their comprehensive development plans and programs (Arab Knowledge Report, 2009). It is characterized by the growing relative importance of knowledge-intensive activities in the production of goods and services, which helps to accelerate innovation and technical development, which has become characteristic of the twenty-first century economy. The rapid expansion of knowledge and the increasing reliance on computing, big data analysis, and automation are transforming the global economy to become more dependent on intellectual capital and skills and less dependent on traditional factors of production. The country's transition to KE and innovation required new education and skills institutions (Fleckenstein et al., 2023). Many studies have tried to research the relationship between the variables of the KE and innovation and the components of the educational system, in addition to trying to build perceptions of the future of the educational system in light of the KE and innovation and its most prominent obstacles. This is the most important previous study related to the subject of the current study.

A study conducted by Ramadan (2015) aimed to reveal the KE and innovation skills of university students among a sample of (77) teachers and (299) students in the KSA. The results revealed that there is a medium degree of KE and innovation skills among university students, according to the teachers' estimation, while the students assessed themselves as having a high degree. The findings also revealed statistically significant variations in the application of KE and innovation abilities related to the academic rank variable, with higher rank prevailing. All of the elements, if well researched, will aid in making the appropriate judgements at the right time. Al-Sayegh (2013) also discussed the role of the KE and innovation in the development of Saudi universities and the obstacles to its activation from the point of view of the heads of departments among a sample of 99 heads of the department. The results showed a low level of KE and innovation skills among the study sample members. The results also emphasized the role of KE and innovation in improving students' academic achievement. Barro (2005) in his study aimed to identify the relationship between the level of economic growth, the quality of education and the average years of schooling across the stages of the school ladder. The results also revealed that there is a positive correlation between economic growth and the quality of education in the disciplines (mathematics - science - reading and writing). Al Belooshi & Al Ma'amari (2020) conducted a study to identify the necessary skills for KE and innovation in Oman and how these skills could be incorporated into educational settings. The Delphi method was used to gather expert opinions, wherein a list of potential skills was sent to a sample of elite decision makers. According to the findings, basic knowledge skills are the most crucial, followed by life and

professional skills, digital skills, interpersonal skills, and communication skills. To date, most MENA countries have made insufficient or incorrect expenditures in education, information infrastructure, research and development (R&D), and innovation (Aubert, 2003).

2.1. Educational curriculum. The educational curriculum must be designed to equip students with the skills and knowledge necessary to succeed in a KE. This means that the curriculum must focus on developing critical thinking skills, problem-solving abilities, creativity, and innovation. It should also emphasize the importance of lifelong learning and adaptability. It is worth emphasizing that KE and innovation necessitate skills that must be supported by competencies and curricula to meet individual, industrial, and cognitive demands (Al Belooshi & Al Ma'amari, 2020). In addition to traditional academic subjects such as math, science, and language arts, the curriculum should also include courses in technology, entrepreneurship, and communication skills. These courses will help students develop the skills necessary to thrive in a rapidly changing technological landscape. Furthermore, the educational system must be flexible enough to adapt to changes in the job market. As new technologies emerge and industries evolve, it is essential that educational institutions keep pace with these changes by offering relevant courses and training programs. Overall, a strong educational curriculum is essential for building a successful KE and innovation. By providing students with the skills and knowledge necessary to succeed in this type of economy, we can ensure that our workforce remains competitive in an increasingly globalized world.

Hypothesis 1: The educational curriculum has a significant role in the knowledge economy and innovation.

2.2. Educational Policy. In a KE and innovation, education is no longer just about acquiring basic skills such as reading, writing, and arithmetic. It is about developing critical thinking skills, problem-solving abilities, creativity, and innovation. Educational policy must therefore focus on providing students with the necessary skills to thrive in a KE. Despite rising tensions in the information economy and innovation, Carstensen & Emmenegger (2023) suggest that combining efficiency and inclusiveness in education policy is still possible, but it would require political intervention. Although the push for university education may be argued to promote the KE and innovation through higher demands for high skills, Germany and Korea continue to rely heavily on manufacturing goods exports as their 'engines of growth' (Hassel et al., 2020), implying that specific skills produced by the vocational education and training system, in addition to the high general skills produced by HE, are still needed. Weber (2011) observed this phenomenon in the Gulf States. The competitive landscape is linked to a growing emphasis on the role of education in encouraging economic success. One-way educational policy can support the development of a KE, and innovation occurs by promoting STEM (science, technology, engineering, and mathematics) education. STEM education provides students with the skills they need to succeed in fields such as computer science, engineering, and biotechnology. These fields are critical to the development of new technologies and innovations that drive economic growth. Another way educational policy can support the development of a KE and innovation is by promoting lifelong learning. In a rapidly changing world where new technologies are constantly emerging, individuals must be able to adapt to new challenges and opportunities. Educational policy must therefore provide opportunities for individuals to continue learning throughout their lives. Finally, educational policy must also focus on developing soft skills such as communication, teamwork, and leadership. These skills are critical in a KE where collaboration and innovation are essential for success.

Hypothesis 2: Educational policy has a significant role in the knowledge economy and innovation.

2.3. Scientific Research. Academic research helps to produce scientific knowledge, and current research initiatives can foretell the future of any society (Ioana et al., 2015). University funding for research activities improves the innovative environment and adds to the country's economic growth (Hicks, 2012). Some scholars argue that the sheer presence of prominent research universities in the region does not guarantee economic growth in the region, despite being significant assets for such regional or urban economies (Wolfe, 2005). However, certain policymakers argue that universities have the potential to drive the new economy (Abel & Deitz, 2010), with untapped reservoirs of commercialized knowledge ready to be 'taken up' and deployed by enterprises (Bramwell & Wolfe, 2008).

Scientific research plays a crucial role in KE and innovation, as it generates new knowledge that can be applied to solve problems and create new products and services. This relationship between the KE and innovation and scientific research is mutually reinforcing, with each driving the other forward.

Hypothesis 3: Scientific research has a significant role in the knowledge economy and innovation.

2.4. Infrastructure. In contrast, infrastructure refers to the physical and organizational structures that underpin economic activity. The link between the KE, innovation, and infrastructure is intricate and varied. Universities have an important role in the growth of information and knowledge-based economies (Salem,

2014). The findings show that the infrastructure of a knowledge incentive programme affects information sharing and learning activities in an organization (Mathew & Rodrigues, 2015). Technological progress necessitates changes to the current educational system. Technologically advanced people are crucial for societal economic progress (Kefela, 2010). The government must fund educational institutions so that students may perform well in creativity and innovation for societal economic development (Levy & Hopkins, 2010).

One way in which infrastructure supports the KE and innovation is by providing the necessary physical infrastructure for communication and transportation. For example, high-speed internet connections are essential for businesses to access information and communicate with customers and suppliers. Similarly, efficient transportation networks are necessary for the movement of goods and people. Without these physical infrastructures, it would be difficult for businesses to operate in a KE. The relationship between infrastructure and the KE and innovation is not one-sided; rather, it is mutually reinforcing. As businesses invest in new technologies or processes, they create demand for new types of infrastructure, such as data centres or specialized manufacturing facilities. This demand creates opportunities for further investment in infrastructure, which can help drive economic growth.

Hypothesis 4: Infrastructure has a significant role in the knowledge economy and innovation.

2.5Teaching Methods. The period of KE and innovation demands specific qualities that teachers must have (Al-Hashimi & Al-Azawi, 2009). Awajneh et al. (2017) discovered that knowledge information economy norms encountered by instructors are centred on instructional methods, faculty roles, and students' roles in producing knowledge to strengthen the learning economy. The KE and innovation are characterized by the production and distribution of knowledge as a primary economic activity. It is driven by the increasing demand for highly skilled workers who possess specialized knowledge and expertise (Drucker, 1966). In this context, teaching methods play a crucial role in preparing students for KE and innovation. One of the key features of the KE and innovation is the rapid pace of change and innovation. This requires individuals to be adaptable and continuously learning throughout their careers (OECD, 2007). As such, teaching methods need to focus on developing skills such as critical thinking, problem-solving, and creativity that enable individuals to learn independently and adapt to new situations (Binkley et al., 2012). Furthermore, KE and innovation place a premium on collaboration and teamwork. This is because complex problems often require diverse perspectives and expertise to solve (Wenger-Trayner & Wenger-Trayner, 2015). Therefore, teaching methods need to incorporate opportunities for students to work collaboratively on projects that simulate real-world scenarios. Technology plays a significant role in KE and innovation. It has transformed how we access information, communicate with others, and work (Castells & Cardoso, 2005). As such, teaching methods need to incorporate technology into their pedagogy to prepare students for the digital age.

Hypothesis 5: The teaching method has a significant role in the knowledge economy and innovation.

3. Methodology and research methods. Kothari (2004) defines research design as the conceptual framework within which research is carried out. It is the main procedure and fundamental for gathering, measuring and analysing the data. Descriptive research design seeks to address who, what, when, where and how questions (Yin, 2006; Muzeyin et al., 2022). According to Creswell (2006), descriptive design helps in understanding a phenomenon, which aids in the fact-finding process of the results.

An explanatory research design was employed to investigate the factors affecting KE and innovation. It captures the effect relationship between variables (Saunders et al., 2007). In an explanatory study, a situation or problem leads to the explanation of the relationship between variables, i.e., it seeks answers to why and how types of questions by identifying affect factors and outcomes of the target phenomenon (Bhattacherjee, 2012). This design was chosen because it is one of the correlational research designs that are used in social science research (Creswell, 2012; Saunders et al., 2009). More specifically, it enabled the researcher to describe what type of relationship existed among different variables related to the topic under investigation. As a result, for this study, the researcher employed a cross-sectional descriptive and explanatory research design with a quantitative method, which allows the researcher to explain the cause and effect relationship between the variables.

SEM with PLS was chosen as the statistical modelling technique for this study due to its suitability in addressing the research questions and objectives. SEM is a statistical modelling technique that allows for the examination of complex relationships between multiple variables, while PLS is a type of SEM that is particularly useful for studies with small sample sizes and when the focus is on prediction rather than explanation (Hair et al., 2019). The method is particularly suitable for this study, given that it enables the modelling of latent variables, which are not directly observable but rather inferred from the relationships

between observed variables. SEM with PLS was chosen because of its ability to handle complex relationships, small sample sizes, nonnormal data distributions, predictive modelling, exploratory analysis, and measurement model assessment. These characteristics align with the research questions and objectives of the study, making SEM with PLS a suitable statistical modelling technique. It helps in predicting the suitable relationship between the variables. PLS-SEM is employed as the measurement model and the structural model. The measurement model is evaluated for convergent and discriminant validity, whereas the structural model is evaluated mostly for hypotheses and predictive relevance.

The data were obtained from 83 academicians who are working at the University of Hail. To ensure a comprehensive understanding of the representativeness and reliability of the data collected from the 83 academicians at the University of Hail, it is crucial for the authors to provide a more detailed explanation of how the data were collected. The authors employed convenience sampling techniques by using a preexisting list of all full-time academicians. The university online research platform and email were used for data collection. The researchers followed the procedures of data collection by sending out a reminder email. The questionnaires were completed by the respondents, and the data were stored for the analysis.

Two professors of bilingual translators were selected to translate the original questionnaire from English to Arabic. After the initial translation was completed, a back-translation was conducted by the Languets director, who independently translated the Arabic version back into English. The researchers followed these steps to identify any discrepancies or errors in translation. Afterwards, a comparison is made between the original questionnaire and the back-translated version to identify any discrepancies or inconsistencies. The differences found were discussed and resolved by both translation teams, ensuring that the final Arabic version accurately reflected the intended meaning of the original questionnaire.

The survey method allowed us to obtain data from a diversified sample, allowing us to generalize our findings to a larger population. Hair et al. (2019) advised a ratio of 15 observations for each variable, which the authors followed. Given that all of the items utilized in this study were created in English, the authors translated them into Arabic utilizing the translation-back translation process proposed by Brislin (1980). Two professors of bilingual translators were selected to translate the original questionnaire from English to Arabic. After the initial translation was completed, a back-translation was conducted by the Languets director, who independently translated the Arabic version back into English. The researchers followed these steps to identify any discrepancies or errors in translation. Afterwards, a comparison is made between the original questionnaire and the back-translated version to identify any discrepancies or inconsistencies. The differences found were discussed and resolved by both translation teams, ensuring that the final Arabic version accurately reflected the intended meaning of the original questionnaire. Additionally, pilot testing is conducted to refine and validate the translated questionnaire. This involves administering the translated questionnaire to a small sample of individuals who are similar to the target population. The purpose of this pilot testing is to assess whether participants understand and interpret each item as intended and to identify any potential issues with clarity or cultural relevance. Based on feedback from pilot testing, modifications were made to improve item wording and the concerns raised by participants. This iterative process helps ensure that the final translated questionnaire is valid and reliable for use in measuring constructs within the target population.

4. Results.

4.1. Demographic Characteristics. The demographic characteristics refer to the various attributes and traits that describe the individuals who participated in a survey or study (Table 1).

4.2

Table 1. Demographic characteristics of the respondents

	Gender	Freq.	Percent	Valid Percent	Cum. Percent
Valid	Male	71	85.5	85.5	85.5
	Female	12	14.5	14.5	100.0
	Total	83	100.0	100.0	
Educational qualification					
Valid	Master	8	9.6	9.6	9.6
	Ph. D	75	90.4	90.4	100.0
	Total	83	100.0	100.0	
Age					
Valid	31-40	32	38.6	38.6	38.6
	41-50	42	50.6	50.6	89.2
	51 years and above	9	10.8	10.8	100.0
	Total	83	100.0	100.0	

Continued Table 1

Work Experience					
Valid	1-5 years	17	20.5	20.5	20.5
	6-10 years	23	27.7	27.7	48.2
	11-15 years	23	27.7	27.7	75.9
	Above 15 years	20	24.1	24.1	100.0
	Total	83	100.0	100.0	
Academic Rank					
Valid	Lecturer	9	10.8	10.8	10.8
	Assistant Prof.	43	51.8	51.8	62.7
	Associate Prof.	29	34.9	34.9	97.6
	Professor	2	2.4	2.4	100.0
	Total	83	100.0	100.0	

Sources: developed by the authors based on (Survey, 2023).

These characteristics provide insights into the composition of the sample population and help researchers understand how different groups may have responded to the survey questions or research objectives. Based on the results of Table 1, 85.5% of the respondents are male, while 14.5% are female. Of the respondents, 9.6% had a master's degree, while 90.4% had a PhD degree. In terms of age, 38.6% of the respondents were between 31-40 years old, 50.6% were between 41-50 years old, and 10.8% were 51 years and above. In regard to work experience, 20.5% had 1-5 years of experience, 27.7% had 6-10 years of experience, another 27.7% had 11-15 years of experience, and 24.1% had more than 15 years of experience. In terms of academic rank, the distribution is as follows: Lecturer (10.8%), Assistant Professor (51.8%), Associate Professor (34.9%), and Professor (2.4%).

4.2. Measurement Model Analysis. The reliability test was carried out to ensure the consistency and stability of the study measures. Table 1 shows the outcomes of the study variables. All of the variables have an adequate level of internal consistency for the study (Hair et al., 2019); this means that the value is more than 0.70. The authors utilized the Fronell-Larcker criterion, which is one of the most widely used methodologies, to test the discriminant validity of measurement models. The square root of the average variance derived from all constructs exceeds the correlation between any two constructs (Hair et al., 2019).

There are several indicators to measure reliability and validity. Cronbach's alpha and composite reliability were used to assess the reliability of the instrument. The average variance extracted (AVE) and the Fornell and Larcker test were used to confirm the validity of the instrument. To analyse the internal consistency of the items, the value of composite reliability (CR) and Cronbach's alpha are calculated. However, the CR range is 0 to 1, and the threshold level is 0.60, which means that the CR value should not be less than 0.60, although a CR value of 0.70 to 0.90 shows perfect internal consistency (Hair et al., 2019). In this study, the Cronbach's alpha (which should be more than 0.70) and CR values of all constructs were investigated. Similarly, Hair et al. (2019) claim that to confirm the constructs' convergent validity, the minimum value of AVE should be 0.50 or more, showing that the data are convergent valid. Cronbach alpha scores and composite reliability (CR) were utilized to assess the instrument's reliability for the purposes of this study. Table 2 displays the reliability test results for the various variables used in the study.

Table 2. Reliability and Convergent Validity of Instruments

Variables	Cronbach's Alpha	Composite Reliability (rho_a)	AVE
Educational Curriculum	0.920	0.921	0.757
Educational policy	0.900	0.906	0.714
Infrastructure	0.911	0.916	0.736
KE and innovation	0.930	0.930	0.741
Scientific Research	0.927	0.927	0.733
Teaching Methods	0.933	0.934	0.750

Sources: developed by the authors based on a survey (2023).

As a result, all of the study instruments' Cronbach's alpha and CRs were greater than the suggested threshold of 0.7, indicating that they are dependable. Construct validity is used for validity analysis since it is more relevant in the social sciences (Kombo & Tromp, 2006). Convergent validity is achieved by combining two measures that are claimed to measure the same construct (Pallant, 2011). AVE was

employed to quantify convergent validity in this investigation, and the results are reported in Table 2. As a result, AVE exceeded 0.50, confirming convergent validity.

Discriminant validity, which shows the degree to which measures of different concepts are distinct, is measured using Fornell and Larcker, cross loadings, and HTMT criteria in PLS-SEM (Hair et al, 2019). The authors analysed interconstruct correlations and compared them to the square roots of AVE values for each component to determine discriminant validity. As a result, the criterion proposed by Fornell and Larcker was used to test discriminant validity. The square root of each AVE is compared to the correlation of all constructs and their items using the Fornell-Lacker criterion, and it is confirmed that all AVE square roots (values) are greater than the correlation values (Park, 2013). Table 3 shows the detailed measurement using the Fornell-Lacker criterion; all diagonal average variance extracted values are larger than the correlations, indicating that the data have discriminant validity.

Table 3. Discriminant validity using the criterion by Fornell & Larcker

Fornell-Larcker Criterion	EC	EP	IN	KE	SR	TM
Educational Curriculum	0.870					
Educational policy	0.602	0.845				
Infrastructure	0.452	0.709	0.858			
KE and innovation	0.730	0.827	0.697	0.861		
Scientific Research	0.695	0.776	0.651	0.918	0.856	
Teaching Methods	0.369	0.598	0.624	0.588	0.548	0.866

Sources: developed by the authors based on a survey (2023).

Similarly, discriminant validity was also tested by using the heterotrait–monotrait (HTMT) values, which were not greater than 90%, indicating no problems with discriminant validity (Hair et al., 2019), as shown in Table 4.

Table 4. Heterotrait-monotrait ratio (HTMT)

Heterotrait-Monotrait ratio (HTMT) - Matrix	EC	EP	IN	KE	SR	TM
Educational Curriculum						
Educational policy	0.647					
Infrastructure	0.485	0.767				
KE and innovation	0.785	0.891	0.748			
Scientific Research	0.749	0.836	0.700	0.888		
Teaching Methods	0.395	0.649	0.672	0.630	0.589	

Sources: developed by the authors based on a survey (2023).

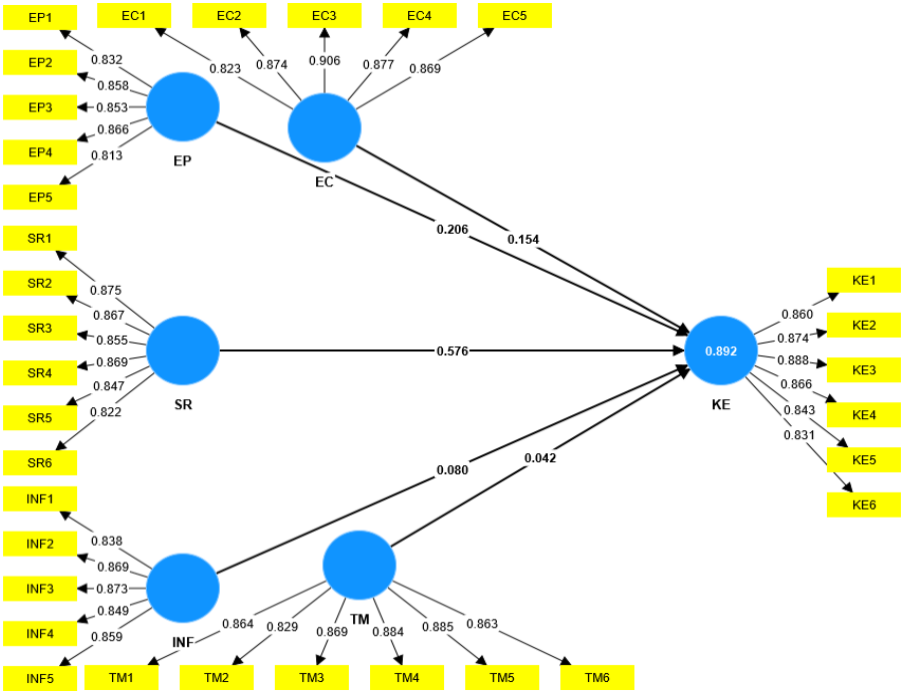

Figure 1. Measurement and structural model estimation
Sources: developed by the authors.

The authors tested the research hypotheses by examining path coefficients. The path coefficient indicates the role of the educational system in KE and innovation in the KSA from the perspective of academics at the University of Hail. In this model, five latent variables were tested for path coefficients.

Table 5. Path coefficients

Variables	Path coefficients	Standard deviation	T statistics	P values
EC -> KE	0.154	0.032	4.772	0.000
EP -> KE	0.206	0.049	4.228	0.000
INF -> KE	0.080	0.033	2.417	0.016
SR -> KE	0.576	0.056	10.200	0.000
TM -> KE	0.042	0.028	1.512	0.131

Sources: developed by the authors based on a survey (2023).

The results for the path coefficient for each hypothesis are shown in Table 5. The results showed that the educational curriculum has a significant role in KE and innovation. The results of the educational curriculum are (EC) (β =0.154; p< 0.000); thus, the alternative hypothesis was accepted. Furthermore, the results of educational policy (EP) showed a significant role in the KE and innovation (β =0.206; p= 0.000); therefore, the proposed hypothesis was accepted. Concerning infrastructure (INF), the results showed a significant connection between the KE and innovation (β =0.080; p< 0.016); accordingly, the alternative hypothesis was accepted. The results of scientific research (SR) showed that scientific research has a significant role in KE and innovation, as the results show (β =0.576; p< 0.000), which leads to the acceptance of the alternative hypothesis. However, the teaching methods (TM) result is β =0.042; p< 0.131), which is greater than the adopted p value; therefore, the alternative hypothesis was rejected. Thus, it is confirmed that the study's hypotheses, such as educational curriculum (EC), educational policy (EP), infrastructure (INF), and scientific research (SR), were all supported, except for teaching methods (TM), which was not supported.

5. Discussion. KE and innovation building are key strategic tasks for firms' success today. HE plays a crucial role in KE and innovation by providing individuals with the necessary skills and knowledge to contribute to economic growth and development. The KE and innovation are characterized by the increasing importance of intellectual capital, innovation, and technology in driving economic growth. In this context, HE institutions are essential in producing highly skilled workers who can create and apply new knowledge to solve complex problems.

The aim of this study is to identify the role of HE in KE and innovation and to determine the challenges and obstacles to KE and innovation. The results of the study in Table 4 display the path coefficient results for each hypothesis. The findings indicate that educational curriculum plays a significant role in KE and innovation, as evidenced by the results for EC (β =0.154; p= 0.000), which is in line with the study of (Carstensen & Emmenegger, 2023). Similarly, educational policy (EP) was found to have a significant impact on the KE and innovation (β =0.206; p= 0.000); to ensure that firms located in key sectors of national knowledge economies have access to crucial skills, universities become involved in HE policy. This result is supported by the findings of Hassel et al. (2020). This article enhances our comprehension of skill formation systems in KE and innovation and demonstrates that policy levers remain available to governments to manage the economy and support domestic firms (Durazzi, 2021). The results of this study are also supported by Durazzi et al. (2023) and Ahmed & Ahmed (2021), who found that education policy appeared throughout the three reforms in Italy. Increasingly, they can shape the priorities of education and skill formation policies (Hall, 2020).

The results also revealed a significant association between infrastructure (INF) and the KE and innovation (β =0.080; p= 0.016), which is supported by the findings of (Carstensen & Emmenegger. 2023; Green-Pedersen & Jensen, 2019). As per Asongu (2014), education has historically been a crucial component of social policy for enhancing labor market integration and improving social mobility. With the rise of the KE and innovation, education policy has become even more crucial for creating the necessary conditions that allow economic efficiency and social inclusion to coexist. This is made possible with the aid of technology and resources. These results are in line with the findings that revealed a significant association between infrastructure (INF) and the KE and innovation (β =0.080; p= 0.016).

Furthermore, scientific research (SR) was found to have a substantial influence on KE and innovation, with β =0.576 and p= 0.000. Thus, we can conclude that the following results are proven: The relationship between education, innovation, and the number of scientific and technical publications is generally

negatively correlated with financial development (Asongu, 2014). However, teaching methods (TM) did not show a significant impact on the KE and innovation (β =0.042; p= 0.131). Education and skills policies are very important for economic growth. Furthermore, the universities found it challenging to provide the workforce with the necessary abilities that were considered essential for the modern economy based on knowledge. The ability to move towards a successful KE is reliant upon the existence of pertinent skills. This has made the process of upskilling the labor force a critical part of the agenda for governments in advanced economies. While education plays a vital role in enhancing efficiency, it is also essential to address the challenge of balancing the changing skill requirements of employers in KE and innovation with the aim of extending or maintaining inclusion. Gulf countries are making an effort to move directly from a pearling, fishing, and trading-based economy to a knowledge-based economy. This transition can lead to economic growth and encourage governments to support the KE and innovation. (Carstensen & Emmenegger, 2023; Green-Pedersen & Jensen, 2019; Hvidt, 2015).

According to the findings, universities and their decision makers should pay special attention to the factors affecting the KE and innovation to improve economic growth. Universities should also design effective programs and initiatives to assist employees in earning skills and in dealing with difficult work situations. As KE and innovation continue to evolve, universities must adapt to new challenges and opportunities to remain relevant and impactful. By embracing interdisciplinary approaches, promoting diversity and inclusion, and engaging with local communities, universities can continue to play a vital role in shaping the future of KE and innovation (Seman et al., 2022).

6. Conclusions. Universities act as centers for intellectual communication and teamwork among academics, learners, and business associates. Moreover, the university aids in economic development by supplying a competent workforce and encouraging entrepreneurial activities. The aim of this study is to identify the role of HE in KE and innovation and to determine the challenges and obstacles to KE and innovation. The results of reliability, convergent validity, and discriminant validity showed that the instrument is reliable and valid. In addition, the results of the coefficient and hypothesis testing show that the educational curriculum, educational policy, infrastructure, and scientific research proposed hypotheses were supported except for teaching methods, which were not supported by the findings.

To stay competitive in the ever-changing economic landscape, KSA universities need to allocate more resources towards science, technology, and innovation. Universities should not only establish guidelines mandating that they integrate innovation into their academic programs but also oversee the execution of these policies. Additionally, the university should provide more research grants and subsidies, particularly to new topics, to encourage their involvement in advancing knowledge. It is also crucial for the university to regulate and safeguard the process of commercializing and transferring knowledge through appropriate policies and regulations. These measures will facilitate a smooth transition towards a KE in the KSA, leading to economic growth and development. Moreover, universities should collaborate with industries and businesses to develop practical solutions to real-world problems. This will not only provide students with hands-on experience but also create a culture of innovation and entrepreneurship. Finally, KSAn universities should prioritize diversity and inclusivity in their recruitment and admission policies. This will ensure that the best talent from all backgrounds has access to HE and can contribute to the country's economic growth.

While this study provides significant findings, it also has some limitations. The study employed a cross-sectional design, which may restrict the conclusions on the relationship between the variables. Future research should implement time-lagged designs to determine the pattern of relationships between variables. In addition, the present study had a relatively small sample size (n=83), which may limit the generalizability of the findings. A larger sample size would have allowed for more robust statistical analyses and increased confidence in the results. To improve the external validity of the findings, future research should try to recruit a more varied and representative sample. Our findings may be limited to different demographics or situations because the study was performed at the University of Hail. The cultural context, educational background, and demographic characteristics of our participants might differ from those in other regions or institutions. Therefore, caution should be exercised when extrapolating these results beyond our specific sample. Replication studies involving diverse populations from various geographical locations would help establish the external validity of our findings.

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Економіка знань, інновації та роль університетів в освіті в Саудівській Аравії: кейс Університету Граду

На ринку праці спостерігається значне збільшення попиту на здобуття нових навичок в таких галузях, як наука про дані, штучний інтелект та машинне навчання, які є однією з найбільш визначальних рис нової промислової революції. Університети відіграють важливу роль в економіці знань та інноваціях, оскільки вони генерують і поширюють знання через дослідження, освіту та творчість. Економіка знань (ЕЗ) та інновації є ключовими каталізаторами економічного зростання, сприяють інноваціям, продуктивності та конкурентоздатності, створюють нові галузі та робочі місця, що потребують висококваліфікованих працівників. Слабкість та неадекватність освітньо-дослідницької системи вважаються однією з головних проблем в Саудівській Аравії. Метою цього дослідження є визначення ролі університетів у ЕЗ та інноваціях в Саудівській Аравії з точки зору викладачів Університету Граду. Метод аналізу, використаний у дослідженні, - структурне рівняння моделювання (SEM) з частково найменшими квадратами (PLS). Для збору даних використовувалось опитування з використанням п'ятибальної шкали Лайкерта. Обсяг вибіркової вибірки дослідження становив 83 викладачі, які були обрані за допомогою простого випадкового відбору. Для перевірки надійності та валідності результатів використано тести Альфа-Кронбаха, композитної надійності та критерій Форнелла-Лакера. Результати дослідження засвідчили, що навчальна програма, освітня політика, інфраструктура та наукові дослідження мають статистично значущий вплив на розвиток ЕЗ та інновацій, в той час, як результати методів навчання не мали значущого впливу на ЕЗ та інновації. Для збереження конкурентоспроможності в постійно змінному економічному оточенні менеджменту університетів Саудівської Аравії потрібно приділяти більше уваги розробці навчальних програм, інфраструктурі, методам навчання, зосереджуючись на науці, технологіях та інноваціях. Крім того, університети повинні акцентувати увагу на розвитку навичок своїх випускників для відповідності вимогам ринку праці. Цього можна досягти за допомогою стажувань та навчання на практиці, а також наданням тренінгів для розвитку софт скілс, таких як комунікація, робота в команді та розв'язання проблем.

Ключові слова: освіта; економіка знань; інновації; політика; інфраструктура; Саудівська Аравія.