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Mathematical Model: Activating Knowledge Triangle Roles in Arabian Universities

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Abstract: The current paper develops proposed procedures to foster the main actors' roles in implementing the knowledge triangle in Arab universities. The descriptive approach is utilized to achieve the research objectives. The research sample consists of (85) experts from the main actors in employing the knowledge triangle in universities "universities, private sector and business sector, government departments, and Ministry of Education/Ministry of Higher Education. The research instruments comprise two questionnaires used to identify the reality of employing the knowledge triangle in Arab universities and the reality of the proposed procedures to activate the main actors' roles in employing the knowledge triangle in Arab universities. The findings indicate that the means of the research sample's agreement with the reality of employing the domains of the knowledge triangle in Arab universities have ranged between (2.38) and (3.01), with a medium degree of application. Given the findings, several procedures are achieved to activate the roles of the main actors in employing the Knowledge Triangle in Arab universities, together with the necessity of Arab universities to joining relevant academic alliances to facilitate the exchange of knowledge on best practices for employing the Knowledge Triangle in universities and establishing Arab alliances so that partners from the main actors cooperate in employing the knowledge triangle in universities.

Keywords: Activating Main, Actors Roles, Applying Knowledge Triangle, Arabian Universities.

1. Introduction

Innovation is one of the most significant factors driving economic growth in the current era, as the knowledge factor is now an essential element for developing the economy and enhancing competitiveness, making innovation a necessary strategy in regional development. Development theory and innovation orientation have played an important role in leading regional, national, and international development. Given the significance of the university's role in building the knowledge economy and achieving economic and social well-being, countries around the world have striven to develop universities. Of late, various approaches have emerged to support their role in national innovation systems and to promote knowledge-based development, and these approaches have developed as a result of the interaction between science and industry.

The knowledge boom witnessed by the world has contributed to tremendous developments at various levels, including in countries around the world, as knowledge has become a major driver of production and economic growth. As a result of this knowledge boom, many terms have emerged such as the information society, the information revolution, the knowledge society, and the knowledge economy. The knowledge economy is the new economic model that relies on three pillars as follows: knowledge, innovation, and technology (Altarawneh & Al-Ghammaz, 2023). It is mainly concerned with knowledge and information as the most important commodity in society, and hence the power and wealth of countries have become measured by the minds and human capital they produce, not by the material resources they possess (Abdel-Jawad, 2019; Tohamy, 2022).

Learning, creating, and using knowledge is one of the most important topics for scientists and entrepreneurs due to its importance to policymakers and society as a whole. As a

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result of the dynamic development of information and communications technology, the importance of the knowledge-based economy is accompanied by a rapid internationalization of research, development, innovation, and business, which prompted universities to gradually move from the academic role to entrepreneurial universities to be a center of innovation (Marczewska & Weresa 2022).

The Global Innovation Index emerged as a measure of the degree of innovation, and one of its sub-indicators is based on higher education, research, and development, which indicates the importance of universities that seek to achieve excellence and develop academic and research roles. It also indicates the interest of universities that seek to use more modern standards to improve their outputs and reach international quality, enhance the ability to advance society, improve the capabilities of their employees in innovation, research, and development, and increase the potential of scientific and technical research to meet the requirements of the development process (Issa and Al-Mahjoubi, 2020).

Universities are interested in innovation because they play an intermediary role between capital and labor in economic growth and carry out a large share of basic and applied general research, which increases the efficiency of research activities. They contribute to economic development through so-called "community engagement" or "third mission" activities such as informal engagement with industry, advisory activities, support for entrepreneurial skills, contribution to community interaction, and exploitation of the results of research activity, contributing to local economic activities, and therefore becoming a central actor in innovation systems (Cervantes, 2017).

Smart digital universities are an outcome of the natural and logical development of e-learning and the accompanying broad launch in the field of open-source cloud computing and educational platforms, which today are considered one of the most important pillars of modern education in international and Arab universities, going hand in hand with traditional education. This rapid development in e-learning techniques is reflected in the teaching side, changing the faculty member from a mere conveyer of information to a more advanced member through the role of a guide, trainer, and corrector. Digital technologies have also affected the change of the role of the student from a mere recipient of science to a researcher and discoverer in the academic specialization. One of the most important reasons for relying on smart-university systems is the problem of accepting and accommodating students wishing to enroll in higher education institutions in Arab countries, which generated great pressure on public universities, not to mention the obvious weakness in the infrastructure of the scientific research sector in the educational institutions of Arab countries, which is almost modest (Daradkah et al,2023)

As significant agents in innovation systems for producing and disseminating knowledge and educating and training the workforce, universities are always in the spotlight on national policy agendas. One of their most important roles is that it represents knowledge generators that meet the needs of the knowledge society, and acts as a source of national economic and social well-being. This imposes high expectations on the performance and strength of universities as institutions and their employees, especially scientists and researchers, in understanding inexhaustible renewable resources through the innovative scientific research and distinguished education they provide that achieves leadership for their universities at the local and international levels and brings about the desired economic development for their societies (Meissner & Shmatko, 2017).

The role of universities has shifted from an academic focus to entrepreneurship and innovation, and this requires creativity and interaction, in terms of innovation and the research and educational activities of universities. Among these recent approaches is the knowledge triangle which emphasizes the need for an integrated approach to research, innovation, and education policy with an emphasis on higher education institutions as knowledge-producing institutions. The knowledge triangle emerged recently in 2000 as part of the European Union's Lisbon Strategy to overcome the weak diffusion of a culture of innovation in research and higher education, weak investment in research and development, and the difficulty of transferring R&D results to commercial teams (Cadil & Kostic, 2018; Cervantes, 2017). The knowledge triangle refers to the innovation, research, and educational activities of universities (Soriano & Mulatero, 2010; Turcinovic, 2013).

The knowledge triangle assumes that knowledge production in higher education institutions results from education, research, and innovation, emphasizing the equal importance of each of these elements in the knowledge production process, as each of these elements influences the others. The bilateral and trilateral flows between these elements form the basis of the knowledge construction process, as the knowledge triangle mediates the coordination tools necessary to mobilize resources and achieve a balance between the different components of knowledge construction (Sjoer et al., 2011).

The concept of the knowledge triangle links research, education, and innovation and replaces the traditional one-way flow of knowledge from research to education with a circular movement between all corners of the triangle in both directions (Sjoer et al., 2016). There are also positive externalities that extend to each dimension and the triangle's connections can be strengthened through processes and platforms that build bridges between education, research, and innovation to facilitate the circulation of knowledge (Sjoer et al., 2011; Soriano & Mulatero, 2010).

The concept of the Knowledge Triangle, which describes the new role of universities and focuses on creativity and innovation, is an extension of Florida's thesis, consisting of three heads that describe contemporary university activities;

education, research, and innovation. The connections between these three heads encourage multidirectional knowledge flows, enabling them to enhance economic growth dynamics (Unger & Polt, 2017; Marczewska & Weresa, 2022).

Organization for Economic Co-Operation and Development (2015) asserts that the Knowledge Triangle is a useful framework for exploring the context in which actors involved in research, innovation, and education interact as the nature, type, and quality of interactions within the Knowledge Triangle determine the overall performance of local, national and global innovation systems. This approach also relies on a methodology for coordinating the processes of building knowledge and innovation by linking the three areas; research, education, and innovation. It also includes social networks that act as important channels that connect actors in the knowledge triangle in some way (Unger et al., 2020).

Vonortas (2017) adds that the knowledge triangle is a new image of traditional university tasks. However, the assimilation of knowledge has formalized the interaction between these tasks, as universities rely on mutual bilateral interactions between their teaching and research activities to produce knowledge on the one hand, and interaction with society, on the other hand, to apply this new knowledge in the form of new products, processes, and services. The Knowledge Triangle is distinguished from other approaches, such as the third mission of the university, the transfer of knowledge and technology, the entrepreneurship university, and the triple helix, by the nature of its work by starting from the broad concept of innovation systems.

With that, starting from the broad concept of innovation systems includes not only limiting it to actors but rather emphasizing the dynamic interactions between them to produce, disseminate, and apply knowledge among all institutions that affect competitiveness, productivity, and the economy. Accordingly, some decide to place the knowledge triangle within the category of systemic innovation concepts (Groumpos & Meissner, 2021; Unger et al., 2020). It also takes a more systematic approach to coordinating knowledge creation and innovation processes by linking the three areas of academic research, knowledge creation, education, training, and business innovation (Unger & Polt, 2017). Likewise, it mainly examines the different missions of universities focuses on the interactions between education, research, and innovation, and uses an activity-based approach to express the fields of education, research, and innovation (Unger et al., 2020; Groumpos & Meissner, 2021).

Thanks to the significance of the concept of the Knowledge Triangle in emphasizing the contribution of education to research and the creation of innovation, recent decades have witnessed a surge in political interest in the innovation function in universities, which has resulted in the Knowledge Triangle formalizing the interaction between the “core” functions of higher education institutions of teaching, research, and public service.

The Knowledge Triangle emphasizes the generation of knowledge through the activities of universities in education and research, and their interactions with society, which helps in employing new knowledge in the form of new products, processes, and services, and the interaction of each of these three elements of the Knowledge Triangle with the other elements and influences them. The resulting bidirectional or circular knowledge flows between the three basic elements of the knowledge construction process form the knowledge triangle, as these flows rely on tools to mobilize resources to create value for members of the knowledge network “stakeholders”, including actors from the public, private and academic sectors (Vonortas, 2017).

During the past decade, the Knowledge Triangle has received great attention from science, innovation, and technology policymakers, which has resulted in a wide range of policy initiatives around the world to guide universities towards achieving the Knowledge Triangle’s missions of education, research, and innovation within a broader framework of the national innovation system (Cervantes, 2017; Kuzminov et al., 2021). It emphasizes the links between education, research, and innovation, places higher education institutions at the heart of innovation ecosystems and interprets their performance as crucial in raising the level of national innovation performance (Raunio et al., 2018).

Therefore, political institutions such as the Organization for Economic Co-operation and Development (OECD) (2016) and the European Commission (EC) (2005) have stressed the need to strengthen bilateral and trilateral links between education, research, and innovation, known as the knowledge triangle, given the broader societal responsibilities that universities currently face. The Knowledge Triangle concept has been developed as a framework for conceptualizing the relationships between higher education institutions, business, and society as a whole as part of the European Commission's policy strategies, addressing the objectives formulated in the 2020 EU Strategy for Smart Sustainable Growth.

The 2020 EU Strategy for Smart Sustainable Growth considered the availability of effective links between research, education, and innovation to be a prerequisite for meeting societal challenges (European Council, 2010), as a result of the Council of the European Union (2009) declaring the need to improve the impact of investments in the three forms of activities through systematic and continuous interaction. On the other hand, the successful implementation of the Knowledge Triangle requires an integrated understanding of the relationship and dependencies between education, research, and innovation as areas of equal importance in the Knowledge Triangle, and thus their crucial nature for policy planning. This is due to the emergence of a set of global trends, including the globalization of academic research and knowledge flows, independence, decentralization and differentiation between the specializations of higher education institutions, and

increased competition to attract and retain talent.

Other global trends include expanding the main types of university activities beyond teaching and research, turning to innovation strategies, financing plans, and related policies, realizing the third mission of the entrepreneurial university, increasing international cooperation that facilitates the exchange of experience and knowledge in best practices and research activities, and achieving transformations in financing plans that focus strictly on performance and competition (Unger et al., 2020; Unger & Polt, 2017).

According to Unger et al. (2020) and Unger & Polt (2017), the knowledge triangle represents a set of actors and policy areas of education, research, and innovation that underpin collaborative activities. Regarding the actors, they are government authorities, public research institutions, private companies, and higher education institutions (Markkula, 2013; Unger & Polt, 2017; Unger et al., 2020). However, Unger et al. (2020) argue that universities bridge two areas of the knowledge triangle: higher education and research institutions, integrating research and teaching in line with an emphasis on research-oriented education, as full-fledged universities in the sense of Humboldt's ideal.

Additional important channels linking these actors also appear in the Knowledge Triangle, focusing on interaction through education, research, and innovation, distinguishing it from some other related concepts. For example, the triple helix is an entrepreneurial university that emphasizes the relationship between individual actors (Erdil et al., 2018; Hayter, 2016; Meissner, 2018). Due to the nature of Arab universities, the actors are the state, the Ministries of Education and Higher Education Roles and Scientific Research, the university, private companies, and institutions. Furthermore, the concept of the Knowledge Triangle takes a more systematic approach to coordinating the processes of knowledge creation and innovation by linking the three areas of research, education, and innovation with the equal importance of each element, the mutual influences between these elements, and the presence of bilateral and trilateral flows between them in knowledge production.

Sjoer et al. (2011) confirm that this can be achieved through the coordination tools that mediate the triangle to mobilize resources and achieve a balance between its various components as well as external and internal factors that facilitate the circulation of knowledge, with a particular focus on the following channels:

Interaction between research and education: The channels are diverse through the role of education in providing human capital capable of conducting successful research, development, and innovation activities (Cervantes, 2017).

These channels include improving the alignment of graduates' skills with the needs of institutions, engaging and applied research as a basis for research-based teaching or problem-based learning to develop basic research skills and soft skills, funding basic and applied research in which students participate, and advanced human capital programs (Marczewska & Weresa, 2022; Unger & Polt, 2017; Unger et al., 2020).

Interaction between research and innovation: This focuses on supporting and intensifying knowledge through the commercialization of publicly funded research "intellectual property rights", spin-offs and academic start-ups, public-private partnerships such as science parks, science parks, consultancy activities and conferences, technology transfer offices, business incubators, open science/open innovation platforms, and contract R&D services from universities to businesses (Cervantes, 2017; Marczewska & Weresa, 2022; Unger & Polt, 2017; Unger et al., 2020).

Interaction between education and innovation: The channels are various including supporting the culture of entrepreneurship "entrepreneurship mindset" within the framework of training programs "academic", forming appropriate competencies "business plan development and management", providing educational programs that meet the needs of the productive sector, relying on modern teaching methods such as team competitions and case studies (Cervantes, 2017; Groumpos & Meissner, 2021; Unger & Polt, 2017; Unger et al., 2020), relying on living laboratories (Hirvikoski, 2013) and community innovation camps (Pirttivaara et al., 2013), ecosystem networks (Stam et al., 2016), and lifelong learning programs (Van Petegen, 2013).

Accordingly, the Knowledge Triangle was transformed from just an idea called for by some scholars and researchers to a term referred to by the initials "KT" in official documents. There have become national and national strategies based on it to develop institutions and societies, as academic circles are full of research on the knowledge triangle to confirm its importance and develop its application (Ahmed & Youssef, 2023). The remainder of the paper is structured as follows: Section two provides an overview of the literature review. Section three presents the research problem, while section four shows the research significance. Section five presents the research terms and definitions, while section six shows research limitations. the methodology adopted is given in, and a review of the methodology adopted is given in section seven. Section eight provides results and discussion, while section nine presents the proposed procedures. Subsequently, section ten makes concluding remarks, while section eleven provides recommendations.

2. Literature Review

Research has documented the role of procedures in fostering the main actors' roles in implementing the knowledge triangle in Arab universities. Ahmed and Youssef (2023) propose a vision for employing the Knowledge Triangle at Beni-Suef University to support the

Egyptian national innovation system in light of the experiences of some foreign universities. The method of comparative causal studies is adopted as one of the methods of the descriptive approach to determine the possible reasons for the success of employing the knowledge triangle at the University of Huddersfield in the United Kingdom, Erasmus University in the Netherlands, and the University of Zaragoza in Spain, and the possibility of benefiting from it at Beni-Suef University to support the Egyptian national innovation system. The research study proposes a vision for employing the Knowledge Triangle by identifying the foundations of the vision, its objectives, dimensions, implementation procedures, implementation requirements, obstacles, and ways to overcome them. The vision has included the actors in the knowledge triangle, the bilateral interactions between the components of the triangle, as well as the interaction channels responsible for coordination between the university and other parties.

From a different lens, Marczewska and Weresa (2022) reveal the situation of Polish universities in terms of innovation in comparison with other EU countries from Central and Eastern Europe. The analysis is performed using the knowledge triangle concept based on data available in the Eurostat and OECD databases for the period 2010-2016. The results show that Poland leads in the CEE region in terms of the relatively high share of the higher education sector in conducting scientific research and the availability of scientific staff resources. However, it reflects the position of Polish universities in innovation measured by citations or the number of patents. These advantages appear only in industrial design, and therefore, the effects of interactions within the "knowledge triangle" in Poland are not sufficient.

Moreover, Tohamy (2022) sets a vision for employing the knowledge triangle in universities through interaction and integration between education, research, and innovation to achieve a high score on the global competitiveness index. The descriptive approach is used to analyze the literature related to the knowledge triangle. The research recommends that universities should seek legislative reforms that contribute to developing policies that increase the contributions of research to innovation, encourage interdisciplinary research, cooperate with industrial institutions and companies, establish offices for the transfer of technology and knowledge, centers for innovation, and business incubators, helping it improve its ranking in the Global Competitiveness Index.

Likewise, Daimer et al. (2021) discuss the approaches used by higher education institutions in Germany as they develop their regional integration patterns and address the functions defined by the Knowledge Triangle. The case study is used through two examples: Heidelberg University and University of Applied Sciences Bremen. The Knowledge Triangle is not widely used in Germany, except for the KIT Institute, which has used it explicitly since 2009, helping it better integrate the components of the Knowledge Triangle. The results show that the activities of the third mission are very diverse and do not serve the sole purpose of generating economic impact directed toward social and environmental goals. The findings also indicate that there are many developments related to traditional knowledge taking place either in higher education institutions or public research institutions at the 15-year level. There are also some activities implicitly related to the knowledge triangle, but their main activities and strategies are located in different corners of the knowledge triangle, where standard and non-standard national or institutional policies and strategies played an important role in shaping the regional integration of higher education institutions in Germany.

Similarly, Scipioni and Marco (2020) present a model of the actors in the knowledge triangle, represented by three main actors: higher education institutions, research institutions, and companies. Through analysis of the literature, it is found that higher education institutions play the most important role in forming theoretical and professional competencies required by the labor market, as research institutions represent the main actors in directing change in society. Companies also play an important role as a result of their possession of experienced professionals at all executive and operational levels, as well as their role in identifying market needs.

Besides, Unger et al. (2020) examine the role of higher education institutions within the framework of the knowledge triangle between academic education, scientific research, and innovation. The descriptive approach is used to achieve the research objectives. The findings show that The Knowledge Triangle model poses many challenges to actors related to research, education, and companies alike, as current and former employees and graduates of universities are valuable links to act as key actors in exploiting new knowledge and technologies. It is also found that understanding these basic factors and challenges is essential for developing a promising sustainable strategic vision for the future university direction of entrepreneurship and understanding the indirect influences between public sector research and the business sector according to the Knowledge Triangle. The results also indicate that the awareness activities carried out by universities and the expanded role model for understanding the concept of the knowledge triangle are extremely important for understanding the new requirements for university management.

In the same context, Abdel Jawad (2019) develops a future vision for Egyptian universities in light of the knowledge triangle. The descriptive approach is used to discuss the concept of the knowledge triangle, which has recently gained great importance because it emphasizes an integrated methodology for the interconnection between research, education, and innovation. The research has analyzed the reality of Egyptian universities and their problems and developed a future vision for Egyptian

universities in light of the knowledge triangle model adopted by many universities around the world, especially European universities, through processes of interaction and integration between education, research, and development, while establishing a set of elements for the success of this model.

3. Research Problem

Considering that decisive transformations are necessary to focus on cooperation instead of competition, the UNESCO World Conference on Higher Education, held in Barcelona and attended by about 1,500 participants in 2000, announced the global "Roadmap 2030" for higher education to ensure the quality of higher education in a method that adapts to contemporary challenges. The roadmap was characterized by the principles of maintaining cooperation for the sake of excellence rather than competition, balanced academic freedom, integrity, and ethics, establishing a dynamic relationship with society, and unleashing the potential of every type of scientific knowledge (Saadallah, 2022).

At large, universities face many local and global challenges that affect their performance and functions, requiring them to predict the future to renew their roles and improve their ability to compete with their human resources in global markets through the interaction between the components of the knowledge triangle represented by education, scientific research, and innovation. These components have become indispensable for any university seeking global leadership, innovation, and improving its creative performance (Tohamy, 2022). Six early areas of interest have been raised before defining the Knowledge Triangle, namely translating R&D results into commercial opportunities, reaching critical mass in certain areas, fragmenting the EU research and higher education system, lack of critical mass in SMEs, and a culture of innovation and entrepreneurship in research and higher education, and limited interaction between academic and research institutions with large and small industries (Groumpos & Meissner, 2021).

Regarding Arab universities and the components of the Knowledge Triangle, in the latest global classifications carried out by QS for the Arab world region published in 2022, 75 Arab universities were distinguished by an increase of 5 universities in last year's classification, 19 universities improved their classification, and 13 universities declined, where 12 Arab universities were ranked by Webmetrics among the top 1000 universities in the world. There was no mention of Arab presence in the Chinese ranking for the year 2021, which necessitated the need to build bridges of cooperation between Arab universities, focusing on the quality of teaching, the depth of scientific research, improving innovation, and integration between these components (Saadallah, 2020).

The previous ideas are supported by Al-Sharif (2020) demonstrating that the lag of Arab universities in global rankings is a result of weak spending on scientific research, the absence of the role of the private sector in supporting scientific research, the lack of national policies, strategies and plans for scientific research, which resulted in the weak contribution of higher education and scientific research systems in accelerating the wheel of development, investment problems, the convictions of donors and the private sector, the decrease in the number of qualified researchers, and the shortage of faculty members' research published globally. Other reasons for the lag of Arab universities in global rankings include the decline in the level of curricula and study programs and their obsolescence, problems with intellectual property rights, weak interest in scientific and technological studies, the absence of a spirit of competition and creativity (Fares, 2020), in addition to financial and administrative problems and a weak relationship between scientific research and application, weak international publishing (Ammar, 2020), lack of universities' budget, which in turn led to a decrease in their productivity (Younis, 2021), and the lack of academic freedom for faculty members in creating knowledge and clarifying the truth as a result of the weak independence of universities (Al-Harathi, 2022).

Therefore, Hilal (2020) recommends the need to improve the position of Arab universities in global rankings through regional and international cooperation, spreading a culture of competitiveness among universities, developing standards for evaluating Arab universities, supporting scientific research and innovation, developing teaching and learning processes, information technology, university management systems, and restructuring. Al-Dahdouh (2021) also recommends the necessity of making appropriate changes to the scientific research system to achieve excellence, competition, and quality, modernizing the structure of scientific research in an integrated manner, localizing electronic technology, establishing and equipping laboratories, and focusing on the intellectual, creative, and skill aspects of educational curricula.

Concerning the 2019 Global Innovation Index, Issa and Mahjoubi (2020) point out a clear deficiency and decline in the level of innovation in Arab countries compared to countries in developed countries and a clear decline in the index of corporate spending on research and development. Therefore, a combination of national innovation systems must be encouraged to form an integrated Arab system for innovation, and scientific research on innovation must be encouraged and supported.

To face various challenges, Arab universities must keep pace with global changes and requirements, and interact with these changes with all flexibility and dynamism, not only to survive but also to improve the quality of their educational, research, and community services, and keep pace with the evolving and endless aspirations of students, researchers and society as a whole to respond to new job opportunities, thus achieving global competitiveness.

As gleaned from the above, it is clear that in implementing these ambitions Arab universities seek to address deficiencies in education, research, and innovation, and achieving the integration between these components lies in the application of the knowledge triangle. Cadil & Kostic (2021) recommend the Knowledge Triangle for countries with low innovative performance, as it helps universities become an important source of knowledge production, increase their ability to technologically advance traditional industries, and develop new specializations to effectively exploit the local places available for innovation.

In contrast, although the value of linking research, education, and innovation is well known, it has often proven that strengthening linkages is challenging and that the task of aligning tasks and creating meaningful and rewarding links between them is fraught with tensions (Sjoer et al., 2016). Given the significant political interest in the knowledge triangle, a comprehensive understanding of the real-world manifestations of this concept is urgently needed. Without this adequate understanding, resources may be misspent, and misleading pressures may arise on both academics and universities (Vico et al., 2021).

Although the concept of the Knowledge Triangle to strengthen links between research, education, and innovation has emerged as a result of expectations by policymakers in universities to assume broader societal responsibility, little is still known about how these tasks are coordinated and interact in universities (Vico et al., 2021). As pointed out by Vico et al. (2017), little is known about how Knowledge Triangle tasks and their interactions are coordinated in universities, and more research is needed on the interconnectedness of Knowledge Triangle tasks, the actors in the triangle, and the effects of Knowledge Triangle tasks on university policies and management.

On the other hand, despite the results made by (Cervantes, 2017; Furman et al., 2002; Marczewska & Weresa, 2022), there is no single model for universities and the knowledge triangle due to the specificity of educational systems, the diversity of functions performed by educational institutions of higher education, and the goals they serve in terms of education, knowledge creation, innovation development, and the distinctive features of regional ecosystems, must ensure a balance and complementarity between their tasks for universities to contribute to the development of regional and local innovation.

For universities to contribute to the development of regional and local innovation, they must ensure a balance and complementarity between their tasks. Although the Arab countries are similar in terms of the extent of the independence of these universities, the state's intervention in them, their systems, policies, and work procedures, and the problems, issues, and fate they face in education, research, and innovation, they may differ in some of the distinctive features of regional environmental systems. Accordingly, the research problem is reflected in answering the following two research questions:

What is the degree of employing the knowledge triangle in Arab universities from the perspective of experts?

What are the proposed measures to activate the main actors' roles in employing the knowledge triangle in Arab universities from the perspective of experts?

4. Research Significance

The research significance is reflected in the fact that the research study subject is one of the important issues that have imposed themselves strongly on universities to ensure their survival keep pace with increasing changes and developments and achieve the requirements of economic development in light of the knowledge economy on the other hand. It is also important as it coincides with the trends of Arab countries, their sustainable development visions, and their plans to shift towards a knowledge-based economy, thus keeping pace with global trends towards enhancing global competition based on innovation as a driver of economic development.

This piece of research also contributes to directing decision makers to the main actors in employing the Knowledge Triangle in the universities of Arab countries in finding realistic solutions to the problems facing Arab countries through the Knowledge Triangle. The current research paper may also address many problems that the economy of Arab countries suffers from by adopting the idea of the knowledge triangle as an effective means of activating and integrating the main actors in employing such knowledge.

Besides, this research study is significant as it seeks to identify the degree of application of the Knowledge Triangle in Arab universities to determine the level of application and deficiencies in requirements and address them. It also opens new horizons for researchers to study other fields useful in employing the knowledge triangle. The results of the current study can be an introduction to conducting more in-depth and specific studies in the future.

5. Research Terms and Definitions

In this study, various terms are mentioned, and their procedural definitions are as follows:

Knowledge Triangle: It is defined as an integrated approach to achieving integration between research, education, and innovation, working to improve mutual bilateral and trilateral interactions between the elements of the triangle, the interaction between the various parties related to innovation, with a focus on universities as producers of knowledge. This can be achieved by relying on the various tools necessary to coordinate these efforts to improve the role of universities in the national innovation system and their role in community development (Ahmed & Youssef, 2023). It is a policy framework based on the integration of research, innovation, and education policy, as well as a conceptual instrument for analyzing the interactions between research, innovation, and education (OCED, 2015, p. 29).

The framework of this research study is procedurally defined as an integrated political approach and framework to achieve coherence and integration in bilateral and trilateral interactions between the dimensions of the triangle represented by research, innovation, and education in universities, by improving the interaction between the main actors "universities, private sector and business sector, government departments, Ministry of Education/Ministry of Higher Education" in the knowledge triangle and those interested in research, innovation and education. This can be achieved by using appropriate procedures to enhance and coordinate the efforts of these parties to improve the role of universities in achieving systematic and continuous interaction between research, innovation, and education according to an integrated and interconnected network system.

Knowledge Triangle is measured by the degree that Arab universities obtain through the study's sample of experts' answers to the questionnaire items related to the reality of employing the knowledge triangle in Arab universities consisting of 3 domains "interaction between education and scientific research, interaction between education and innovation, interaction between scientific research and innovation". The procedures for activating the roles of the main actors are measured to the desired degree from the experts' point of view, by identifying the procedures for activating the roles of the main actors in the knowledge triangle in Arab universities consisting of 4 domains as follows: "universities, the private sector and the business sector, government departments, and the Ministry of Education/Ministry of Higher Education".

6. Research Limitations

The findings of this research can be generalized in light of the following limitations:

1. Human Limitations: This research is limited to a sample of experts from the main actors in employing the knowledge triangle in Arab universities.
2. Spatial Limitations: This research is conducted in Arab countries
3. Temporal Limitations: This research is conducted in the first semester of the academic year 2023/2024.
4. Objective Limitations: This research is limited to identifying the reality of employing the Knowledge Triangle model in Arab universities and attaining a set of procedures to activate the roles of the main actors in employing the Knowledge Triangle in Arab universities.

7. Method

Research Approach

The descriptive approach is adopted to describe the reality of employing the Knowledge Triangle in Arab universities and attaining a set of proposed procedures to activate the roles of the main actors in employing the Knowledge Triangle in Arab universities.

8. Research Population & Sample

The research sample consists of a sample of (85) experts from the main actors in employing the knowledge triangle in Arab universities, as follows: 31 experts from faculty members in Arab universities, 18 experts from the private sector and business sector, 18 experts from government departments, and18 experts from the Ministry of Education/Ministry of Higher Education". All experts were selected to cover the majority of actors and have experience with university practices and national innovation institutions.

9. Research Instrument

A closed 18-item questionnaire covering 3 domains is developed to identify the reality of employing the Knowledge Triangle model in Arab universities. Another 99-item questionnaire covering 4 domains is developed to identify the reality of employing the Knowledge Triangle model in Arab universities is developed to identify the proposed procedures to activate the roles of the main actors in employing the knowledge triangle in Arab universities.

Furthermore, a five-point Likert scale is adopted, as five levels are specified for two questionnaires to clarify the degree of agreement. The scale of the first questionnaire is as follows: (5) always, (4) often, (3) sometimes, (2) rarely, (1) never, so the score (5) represents always and the score (1) represents never. The scale of the second questionnaire is as follows: (5) Very highly agree, (4) Highly agree, (3) Moderately agree, (2) Lowly agree, (1) Not agree at all. The sections are regular, and all the questions in the two questionnaires fall within a five-point Likert scale.

10. Research Instrument Validity

(1) Questionnaire of the reality of employing the Knowledge Triangle in Arab universities

Face Validity

Face validity is used to check the research instrument validity by reviewing the questionnaire in its initial forms from (11) experienced and specialized faculty members in universities, the private sector, ministries of higher education, and government departments in Arab countries. The comments, modifications, and recommendations proposed by the validators are taken into account, as the items have obtained an approval rating of (80%) or more. The necessary action is taken with the items suggested to be deleted, modified, or reformulated, and thus the questionnaire in its final form consists of (18). This method is suitable for checking the face validity of the questionnaire, that is, its items can measure what they are set to measure.

Internal Consistency Validity

By applying the questionnaire to a survey sample of (25) specialists and experienced faculty members in universities, the private sector, ministries of higher education, and government departments in Arab countries, the correlation coefficient is calculated between the degree of each item with the total degree of the related domain as shown in Table (1).

Table 1: Correlation Coefficients between the Degree of the Item and the Overall Score of the Related Domain

Interaction between Scientific Research and Innovation		Interaction between Education and Innovation		Interaction between Education and Scientific Research	
No.	**Correlation**	**No.**	**Correlation**	**No.**	**Correlation**
1	0.77	1	0.73	1	0.71
2	0.69	2	0.68	2	0.75
3	0.75	3	0.69	3	0.71
4	0.74	4	0.75	4	0.74
5	0.72	5	0.78	5	0.68
6	0.67	6	0.75	6	0.77

The values of the correlation coefficients have ranged from (0.77) to (0.67), where they are all positive and statistically significant at the level (0.05), indicating the internal consistency between the degree of each item with the total degree of the related domain.

Internal Consistency Reliability

The research instrument reliability is checked by calculating the reliability coefficient by applying Cronbach's Alpha formula on all domains. The Cronbach's Alpha formula measures the extent of consistency in the respondents' responses to all the items in the questionnaire as shown in Table (2).

Table 2: The Reliability Coefficients of the Questionnaire The Reality of Employing the Knowledge Triangle in Arab Universities

Domain	Internal Consistency
Interaction between Scientific Research and Innovation	**0.86**
Interaction between Education and Innovation	**0.81**
Interaction between Education and Scientific Research	**0.83**

As shown in Table (2), the reliability coefficients of the questionnaire on the reality of employing the knowledge triangle in Arab universities have ranged between (0.81) and (0.86), where the highest reliability coefficient is the "Interaction between Scientific Research and Innovation", while the lowest is "Interaction between Education and Innovation".

(2) The Reality of the Proposed Procedures to Activate the Main Actors' Roles in Employing the Knowledge Triangle in Arab Universities

Face Validity

Face validity is used to check the research instrument validity by reviewing the questionnaire in its initial forms from (11) experienced and specialized faculty members in universities, the private sector, ministries of higher education, and government departments in Arab countries. The comments, modifications, and recommendations proposed by the validators are taken into account, as the items have obtained an approval rating of (80%) or more. The necessary action is taken with the items suggested to be deleted, modified, or reformulated, and thus the questionnaire in its final form consists of (99). This method is suitable for checking the face validity of the questionnaire, that is, its items can measure what they are set to measure.

Internal Consistency Validity

By applying the questionnaire to a survey sample of (19) specialists and experienced faculty members in universities, the private sector, ministries of higher education, and government departments in Arab countries,, the correlation coefficient is calculated between the degree of each item with the total degree of the related domain as shown in Table (3).

Table 3: Correlation Coefficients between the Degree of the Item and the Overall Score of the Related Domain

University Roles						Ministries of Education and Higher Education Roles Education		Private Sector and Business Sector Roles		Government Roles			
Coefficient	**No**	**Coefficient**	**No**	**Coefficient**	**No**	**Coefficient**	**No**	**Coefficient**	**No**	**Coefficient**	**No**	**Coefficient**	**No**
0.68	33	0.68	17	0.69	1	0.71	1	0.73	1	0.65	12	0.77	1
0.67	34	0.71	18	0.71	2	0.75	2	0.68	2	0.67	13	0.69	2
0.69	35	0.66	19	0.68	3	0.71	3	0.69	3	0.63	14	0.75	3

University Roles						Ministries of Education and Higher Education Roles Education		Private Sector and Business Sector Roles		Government Roles			
0.65	36	0.69	20	0.67	4	0.74	4	0.75	4	0.61	15	0.74	4
0.68	37	0.65	21	0.71	5	0.68	5	0.78	5	0.65	16	0.72	5
0.65	38	0.67	22	0.65	6	0.77	6	0.75	6	0.73	17	0.67	6
0.71	39	0.63	23	0.66	7	0.69	7	0.71	7	0.72	18	0.68	7
0.68	40	0.61	24	0.73	8	0.71	8	0.69	8	0.68	19	0.71	8
0.69	41	0.65	25	0.66	9	0.66	9	0.65	9	0.67	20	0.73	9
0.65	42	0.73	26	0.71	10	0.68	10	0.68	10	0.66	21	0.69	10
0.71	43	0.72	27	0.69	11	0.71	11	0.67	11	0.69	22	0.65	11
0.66	44	0.68	28	0.73	12	0.73	12	0.71	12				
0.65	45	0.67	29	0.65	13	0.65	13	0.73	13				
0.68	46	0.66	30	0.71	14	0.66	14	0.70	14				
0.70	47	0.69	31	0.75	15	0.71	15						
		0.65	32	0.70	16	0.69	16						

The values of the correlation coefficients have ranged from (0.65) to (0.77), where they are all positive and statistically significant at the level (0.05), indicating the internal consistency between the degree of each item with the total degree of the related domain.

Internal Consistency Reliability

The research instrument reliability is checked by calculating the reliability coefficient by applying Cronbach's Alpha formula on all domains. The Cronbach's Alpha formula measures the extent of consistency in the respondents' responses to all the items in the questionnaire as shown in Table (4).

Table 4: The Reliability Coefficients of the Questionnaire The Reality of Activating the Main Actors' Roles in Employing the Knowledge Triangle in Arab Universities

Domain	Internal Consistency
Government Roles	**0.86**
Private Sector and Business Sector Roles	**0.83**
Ministries of Education and Higher Education Roles Education	**0.81**
University Roles	**0.85**

As shown in Table (4), the reliability coefficients of the questionnaire on the reality of activating the main actors' roles in employing the knowledge triangle in Arab universities have ranged between (0.81) and (0.86), where the highest reliability coefficient is the "Ministries of Education and Higher Education Roles Education" with (0.86), while the lowest is "Interaction between Education and Innovation" with (0.81).

Statistical Processing

The following statistical methods are used to answer the research questions and process the data statistically.

1. Means, standard deviations, ranks, and degrees are used to answer the first research questions.
2. Cronbach's Alpha coefficient is used to find the internal consistency coefficient of the research instrument.

The degree of the reality of employing the knowledge triangle in Arab universities is also determined by applying the following equation:

Length of One Category = (the Highest Value of the Alternative - the Minimum Value of the Alternative) ÷ Number of Levels = (5-1) ÷ 3 = 1.33

And by adding (1.2.33) to the Minimum Value of the alternative (the minimum); the criterion for expressing those levels is: the Mean ranging between (1-2.33) indicates a Low Degree, the Mean ranging between (2.34-3.67) indicates a Medium Degree, and the Mean ranging between (3.68-5) indicates a High Degree.

11. Results & Discussion

First: Results related to the First Research Question

What is the degree of employing the knowledge triangle in Arab universities from the perspective of experts?

To answer this question, the means and standard deviations of responses of to the questionnaire for employing the knowledge triangle in universities in Arab countries are calculated. Table (5) illustrates those results.

Table 5: Means, Standard Deviations, degrees, and Rank of the Experts' Responses to the Questionnaire for the Reality of Employing the Knowledge Triangle in Universities in Arab Countries

No.	Domain	AM	SD	Degree of Employing	Rank
1	**Interaction between Education and Scientific**	**3.01**	**0.80**	**Medium**	**1**

	Research				
2	**Interaction between Education and Innovation**	**2.38**	**0.83**	**Medium**	**3**
3	**Interaction between Scientific Research and Innovation**	**2.56**	**0.84**	**Medium**	**2**
The Overall Reality of Employing the Knowledge Triangle		**2.65**	**0.81**	**Medium**	

As shown in Table (5), the means of the experts' approval on the reality of employing the knowledge triangle in universities in the Arab countries have ranged between (2.83) and (3.01) with a medium degree. In terms of means, the domains are ranked as follows: The interaction between education and scientific research, the interaction between scientific research and innovation, and the interaction between education and innovation, where the overall mean for the degree of employing the Knowledge Triangle in Arab universities is (3.65) with a medium degree.

This result is explained by the lack of interconnection and integration between the components of the Knowledge Triangle, as it is a recent term for Arab universities, as well as the lack of integration between the main actors in applying the Knowledge Triangle, and the gap between theory and application. This result is also attributed to the weakness of partnerships with the private sector and industry in general, the tendency of Arab universities to the ivory tower model, the lack of orientation towards knowledge capitalization, and the lack of infrastructure and awareness of the procedures for applying the knowledge triangle and its importance in developing universities and achieving global competitiveness.

Second: Results related to the Second Research Question

What are the proposed measures to activate the main actors' roles in employing the knowledge triangle in Arab universities from the perspective of experts?

To answer this question, the means and standard deviations of responses of to the questionnaire for the reality of activating the main actors' roles in employing the knowledge triangle in Arab universities are calculated. Table (6) illustrates those results.

a. Government Roles Domain

Table 6: Means, Standard Deviations, Degrees, and Rank of the Required Government Roles in Employing the Knowledge Triangle in Arab Universities

Text of Item	**AM**	**SD**	**Degree of Approval**	**Rank**
Establishing a national innovation system based on open innovation centered on universities.	4.97	0.81	High	1
Developing a national vision and future plans to implement the Knowledge Triangle in universities.	4.96	0.79	High	2
Providing a national policy environment in the areas of research, education and innovation.	4.96	0.83	High	2
Providing the legislative framework regulating the integration of the roles of all actors in applying the knowledge triangle in universities.	4.95	0.85	High	4
Achieving integration between ministries related to applying the knowledge triangle in universities.	4.94	0.81	High	5
Providing the necessary funding for universities to support the development of strategies for the integration and interaction of education, research and innovation.	4.93	0.77	High	6
Providing incentives to support integration among the main actors in implementing the Knowledge Triangle in universities.	4.93	0.82	High	6
Determining national educational, research and technological priorities at the medium and long-term levels to achieve the knowledge economy.	4.91	0.79	High	8
Providing legislation guaranteeing the governance and independence of universities to ensure the success of the Knowledge Triangle Model.	4.91	0.81	High	8
Providing the necessary legislation and laws to protect intellectual property.	4.90	0.80	High	10
Adopting a long-term vision for institutional change among actors in implementing the Knowledge Triangle in universities ensures its success.	4.89	0.83	High	11
Expanding the establishment of national innovation centers and	4.88	0.78	High	12

networks near or within universities.				
Providing the political and legislative framework regulating the work of universities with the production and services sector to ensure the success of implementing the Knowledge Triangle.	4.87	0.77	High	13
Supporting research capabilities, such as research infrastructure, human capital, ICT, and others in scientific fields that promote development and new businesses.	4.86	0.77	High	14
Activating cooperation between key actors by forming regional and internal groups for excellence and creating a competitive environment for entrepreneurship.	4.86	0.82	High	14
Supporting regional, transnational or interregional collaborations with universities aiming to establish partnerships in high-priority research areas.	4.86	0.85	High	14
Providing legislation for a system of shared governance by integrating businesses and other institutions into university governance to link the university with industry.	4.84	0.79	High	17
Launching national awards to encourage all major actors to implement the Knowledge Triangle in universities.	4.83	0.82	High	18
Providing the necessary legislation and support to establish university companies in cooperation with the private sector and business sectors.	4.82	0.77	High	19
Establishing interface systems to support education, research and innovation between universities and the production and service sectors.	4.81	0.85	High	20
Providing the necessary legislation and support to activate the roles of professional unions in implementing the Knowledge Triangle in universities.	4.80	0.77	High	21
Using highly skilled university human resources and research and innovation outputs.	4.79	0.81	High	22
Overall Government Roles	4.88	0.79	High	

As shown in Table (6), the means of the experts' approval of the government roles in employing the knowledge triangle in Arab universities have ranged between (4.97) and (4.79) with a high degree. Item (1) stipulating "Establishing a national innovation system based on open innovation centered on universities" is ranked first for it is the ideal model for activating all the roles of actors in applying the knowledge triangle and integrating between them, contributing to integrating university ideas, experiences and skills with the parties concerned, transforming innovations into products, producing new patterns and images for universities such as entrepreneurship universities, and building mutual institutional links that allow production and sharing of knowledge and its transformation into innovative products. University also represents the core of the innovation process and the focus of the national innovation system for any country seeking growth and prosperity.

However, item (22) stipulating "Using highly skilled university human resources and research and innovation outputs" is ranked last with the lowest mean and a high degree because it is the way to invest and benefit from the university's innovative resources and outputs to transform them into products that enhance the national economy and solve its problems, especially in light of the centralization that characterizes Arab countries.

b. The Private Sector and Business Sector Roles Domain

Table 7: Means, Standard Deviations, Degrees, and Rank of the Private Sector and Business Sector Roles in Employing the Knowledge Triangle in Arab Universities

Text of Item	**AM**	**SD**	**Degree of Approval**	**Rank**
Participating in financing universities through donations, the endowment system, or investment in infrastructure.	**4.95**	**0.81**	**High**	**1**
Contributing to providing scholarships, incentives, and competitive awards for students and faculty members in accordance with the requirements of the Knowledge Triangle.	**4.94**	**0.84**	**High**	**3**
Participating in developing educational and research programs in accordance with labor market requirements.	**4.93**	**0.82**	**High**	**2**

Text of Item	AM	SD	Degree of Approval	Rank
Encouraging Universities' participation in short- and long-term research projects.	**4.92**	**0.78**	**High**	**4**
Providing the necessary support to universities to transform academic research into applied research.	**4.92**	**0.85**	**High**	**4**
Supporting the establishment of specialized laboratories in universities.	**4.90**	**0.85**	**High**	**6**
Establishing joint projects and programs with universities that support the Knowledge Triangle model.	**4.88**	**0.82**	**High**	**7**
Corpora ting support and sponsorship of innovative students and faculty.	**4.87**	**0.81**	**High**	**8**
Providing training and specialized skills to students and faculty at work sites.	**4.86**	**0.85**	**High**	**9**
Providing the necessary funding to establish applied or specialized universities according to the needs of companies.	**4.85**	**0.82**	**High**	**10**
Creating an entrepreneurship ecosystem around universities in which a dynamic diversity of companies is located.	**4.84**	**0.86**	**High**	**11**
Organizing events that support the knowledge triangle in universities such as lectures, presentations to companies and seminars.	**4.84**	**0.89**	**High**	**11**
Employing qualified university students in specific projects in companies.	**4.83**	**0.78**	**High**	**13**
Providing full- or part-time jobs for researchers to apply the results of their research or study problems on the ground.	**4.82**	**0.83**	**High**	**14**
Overall Private Sector and Business Sector Roles	**4.88**	**0.81**	**High**	

As shown in Table (7), the means of the experts' approval on the private sector and business sector roles in employing the knowledge triangle in Arab universities have ranged between (4.95) and (4.82) with a high degree in all items and overall mean of (4.88) with a high degree. Item (1) stipulating "Participating in financing universities through donations, the endowment system, or investment in infrastructure" is ranked first as it is an extremely important element for the multiple tasks and ambitions of universities as they are the innovation factory, and therefore they need all funding to carry out these tasks in light of the lack of government funding in some Arab countries.

However, item (14) stipulating "Providing full- or part-time jobs for researchers to apply the results of their research or study problems on the ground" is ranked last with the lowest mean and a high degree. This result may also confirm the importance of this element because it contributes to linking theory and practice and benefits both the university, the private sector, and the business sector, linking experiences, skills, and capabilities, especially because there are deficiencies in university laboratories and laboratories compared to the capabilities of the private sector.

c. Ministries of Education and Higher Education Roles

Table 8: Means, Standard Deviations, Degrees, and Rank of the Ministries of Education and Higher Education Roles in Employing the Knowledge Triangle in Arab Universities

Text of Item	AM	SD	Degree of Approval	Rank
Motivating universities to develop university quality assurance standards practices that support the application of the Knowledge Triangle.	**4.96**	**0.84**	**High**	**1**
Establishing regulations that support the integration and interaction of education, research and innovation activities in universities.	**4.95**	**0.81**	**High**	**2**
Reconsidering the policies that regulate the work of universities with the production and services sector to ensure the success of the model.	**4.95**	**0.85**	**High**	**3**
Developing policies that encourage competition between universities in applying the knowledge triangle model.	**4.94**	**0.82**	**High**	**4**
Expanding the establishment of universities and specialized departments that support employing knowledge economy.	**4.93**	**0.82**	**High**	**5**
Establishing regulations and policies that ensure integration between universities and other research institutions in implementing the Knowledge Triangle.	**4.92**	**0.86**	**High**	**6**
Coordinating with all relevant ministries to provide logistical support for implementing the Knowledge Triangle in universities.	**4.91**	**0.78**	**High**	**7**
Linking universities' budget to their performance in employing the knowledge triangle model.	**4.91**	**0.79**	**High**	**7**

Text of Item	AM	SD	Degree of Approval	Rank
Establishing technological networks and platforms that link universities and various relevant parties locally, nationally and internationally.	**4.90**	**0.82**	**High**	**9**
Providing the necessary technological infrastructure for universities to implement the knowledge triangle model.	**4.89**	**0.85**	**High**	**10**
Encouraging universities to cooperate internationally in exchanging information, knowledge, experience and best global practices.	**4.87**	**0.81**	**High**	**11**
Developing an effective university governance system to support Knowledge Triangle activities.	**4.86**	**0.85**	**High**	**12**
Providing all necessary guarantees for the independence of universities, as this contributes to the success of implementing the Knowledge Triangle.	**4.84**	**0.78**	**High**	**13**
Providing all the necessary requirements to transform universities into entrepreneurship universities.	**4.83**	**0.83**	**High**	**14**
Directing universities towards benefiting from research programs funded by international bodies and organizations.	**4.81**	**0.79**	**High**	**15**
Educating university leaders about the importance of the knowledge triangle, and the country's trends in improving its position in the Global Innovation Index.	**4.80**	**0.85**	**High**	**16**
The Overall Ministries of Education and Higher Education Roles	**4.89**	**0.81**	**High**	

As shown in Table (8), the means of the experts' approval of the ministries of education and higher education roles in employing the knowledge triangle in Arab universities have ranged between (4.80) and (4.96) with a high degree in all items and overall mean of (4.89) with a high degree. This emphasizes the importance of these roles from the experts' point of view. Item (1) stipulating "Motivating universities to develop university quality assurance standards practices that support the application of the Knowledge Triangle" is ranked first with the highest mean as it is an extremely important element in light of the centralization of universities and their subordination to the Ministry of Education or Higher Education, as the Ministry has mechanisms and supporting policies to stimulate these universities by linking funding to the performance of these universities. However, item (16) stipulating "Educating university leaders about the importance of the knowledge triangle, and the country's trends in improving its position in the Global Innovation Index" is ranked last with the lowest mean and a high degree. It may also confirm the importance of this element, given the novelty of the concept, and its importance in developing universities and the trend to be the core of the innovation process, as the Ministry is also the link between the state's trends and universities.

d. University Roles

Table 9: Means, Standard Deviations, Degrees, and Rank of the University Roles in Employing the Knowledge Triangle in Arab Universities

Text of Item	AM	SD	Degree of Approval	Rank
Incorporating the knowledge triangle into the university's vision, mission, goals and strategic plans.	**4.97**	**0.78**	**High**	**1**
Providing advanced infrastructure that supports the application of the Knowledge Triangle.	**4.96**	**0.80**	**High**	**2**
Organizing research projects in cooperation with various production and service sectors.	**4.96**	**0.82**	**High**	**2**
Establishing innovation centers in universities as an environment for transferring and applying knowledge.	**4.96**	**0.85**	**High**	**2**
Establishing technology transfer centers in universities.	**4.96**	**0.86**	**High**	**2**
Spreading the culture and programs of entrepreneurship and innovation at the university.	**4.96**	**0.88**	**High**	**2**
Directing all university employees to benefit from the programs of national and international innovation centers.	**4.95**	**0.79**	**High**	**7**
Strengthening partnerships between the university and manufacturers and concluding joint cooperative and research contracts.	**4.95**	**0.80**	**High**	**7**
Professional development for faculty members includes all competencies related to applying the knowledge triangle (research competencies, use of teaching methods based on problem solving and research...).	**4.95**	**0.82**	**High**	**7**

Text of Item	AM	SD	Degree of Approval	Rank
Ensuring the protection of the intellectual rights of university faculty members.	**4.95**	**0.84**	**High**	**7**
Designing educational programs similar to those of leading universities.	**4.94**	**0.81**	**High**	**11**
Providing dual degrees with international higher education institutions with a global reputation.	**4.94**	**0.93**	**High**	**11**
Providing international student exchange programs with reputable international educational institutions.	**4.93**	**0.77**	**High**	**13**
Providing training programs and field visits for students with public and private sector institutions.	**4.93**	**0.79**	**High**	**13**
Implementing modern applied educational methods and strategies in university education such as case studies, and educational games.	**4.93**	**0.81**	**High**	**13**
Providing study programs that combine study and practical experience.	**4.92**	**0.80**	**High**	**16**
Establishing research centers that work directly with organizations and industry to address the challenges of business enterprises.	**4.92**	**0.81**	**High**	**16**
Including creative and innovative students in all research projects and university events.	**4.91**	**0.85**	**High**	**18**
Providing part-time or online masters and doctoral programs targeting workers in business institutions.	**4.90**	**0.79**	**High**	**19**
Making research cooperation with prestigious national and international higher education institutions.	**4.90**	**0.81**	**High**	**19**
Striving to find external funding that motivates universities to implement socially oriented programs and develop research and marketing.	**4.90**	**0.83**	**High**	**19**
Focusing on creating new knowledge and distinguished research.	**4.89**	**0.78**	**High**	**22**
Forming strong links with relevant industries, both at the institutional and employee level, as direct providers of knowledge.	**4.88**	**0.80**	**High**	**23**
Making flexible structures adapted to market characteristics.	**4.87**	**0.79**	**High**	**24**
Developing incentive plans that focus on innovation and entrepreneurship	**4.87**	**0.80**	**High**	**24**
Focusing on knowledge transfer and innovation activities and commercialization, including business services and consulting.	**4.87**	**0.83**	**High**	**24**
Giving importance to financing market-oriented research projects.	**4.86**	**0.81**	**High**	**27**
Making effort by universities to create spin-offs and academic start-ups.	**4.86**	**0.83**	**High**	**27**
Reconsidering educational programs and curricula to keep pace with the knowledge economy.	**4.86**	**0.84**	**High**	**27**
Encouraging interdisciplinary educational and research programs.	**4.854**	**0.79**	**High**	**30**
Capitalizing knowledge in universities, and giving commercialization and marketing to research results.	**4.84**	**0.81**	**High**	**31**
Focusing on the activities of the third mission of universities “Entrepreneurship University”.	**4.82**	**0.76**	**High**	**32**
Including expert representatives of knowledge triangle actors in university governing boards, colleges, departments and relevant units.	**4.82**	**0.79**	**High**	**32**
Organizing events for discussion between companies and researchers about research results and requirements for their application.	**4.81**	**0.85**	**High**	**34**
Developing a number of university indicators that contribute to evaluating and monitoring the impact of knowledge transfer.	**4.80**	**0.79**	**High**	**35**
Showcasing successful models of universities that were able to implement the Knowledge Triangle Model.	**4.80**	**0.84**	**High**	**35**
Educating university employees about bodies interested in and funding research projects and creative ideas.	**4.79**	**0.81**	**High**	**37**
Funding basic and applied research in which students participate.	**4.78**	**0.77**	**High**	**38**
Improving graduates’ skills to suit the needs of companies and the national and international labor market.	**4.78**	**0.81**	**High**	**38**
Encouraging cooperation between university employees and partner entities instead of competition.	**4.77**	**0.83**	**High**	**40**
Internationalizing some curricula by teaching them in living international	**4.76**	**0.79**	**High**	**41**

Text of Item	AM	SD	Degree of Approval	Rank
languages.				
Supporting the participation of students and researchers in national and international discussions, competitions, exhibitions and workshops.	**4.76**	**0.83**	**High**	**41**
Organizing exhibition forums for student research projects for communication and participation between companies and students.	**4.75**	**0.84**	**High**	**43**
Training students in partner companies and providing specialized courses for business institutions.	**4.74**	**0.81**	**High**	**44**
Organizing employment fairs with the participation of business representatives, such as the "Employment Forum".	**4.74**	**0.82**	**High**	**44**
Launching an online platform that facilitates communication between students and graduates on the one hand, and the university and companies on the other hand.	**4.72**	**0.77**	**High**	**46**
Encouraging the scientific advancement of doctoral students through policies of participation in universities, national and international projects and events.	**4.71**	**0.80**	**High**	**47**
Overall University Roles	**4.86**	**0.82**	**High**	

As shown in Table (9), the means of the experts' approval of the university roles in employing the knowledge triangle in Arab universities have ranged between (4.74) and (4.97) with a high degree in all items and overall mean of (4.86) with a high degree. This emphasizes the significance of these roles from the experts' perspective. Item (1) stipulating "Incorporating the knowledge triangle into the university's vision, mission, goals and strategic plans" is ranked first with the highest mean as it is an extremely important element, considering the vision guiding the university is translated into goals, a strategic plan, activities, and practices that lead to applying the knowledge triangle, and achieving interconnection and integration between education, research, and innovation, especially in light of the novelty of the concept to Arab universities.

However, item (47) stipulating "Encouraging the scientific advancement of doctoral students through policies of participation in universities, national and international projects, and events" is ranked last with the lowest mean and a high degree. This is due to the role of these fields in refining researchers' experiences, increasing their knowledge and skills, internationalizing these practices, and achieving coherence between theory and practice.

12. Proposed Procedures (PP)

Given the research study results and the experts' perspective, a set of procedures is attained to activate the roles of the main actors "the government, the private sector and the business sector, the ministries of education and higher education roles, and the university" in implementing the knowledge triangle in Arab universities. The said roles can be detailed as follows:

1. Government

The government roles are reflected in establishing a national innovation system based on open innovation centered on universities, developing a national future vision and plan to implement the Knowledge Triangle in universities, providing a national policy environment in the areas of research, education, and innovation, providing the legislative framework regulating the integration of the roles of all actors in applying the Knowledge Triangle in universities, achieving integration between the ministries related to the application of the Knowledge Triangle in universities, providing the necessary funding to universities to support the development of strategies for the integration and interaction of education, research, and innovation, and providing incentives to support integration among the main actors in the application of the Knowledge Triangle in universities.

Other key government roles lie in determining national educational, research and technological priorities at the medium and long-term levels to achieve the knowledge economy, providing legislation guaranteeing the governance and independence of universities to ensure the success of the Knowledge Triangle model, providing the necessary legislation and laws to protect intellectual property, adopting a long-term vision for institutional change for the actors in applying the Knowledge Triangle in universities to ensure its success, expanding the establishment of national innovation centers and networks near or within universities, providing the political and legislative framework regulating the work of universities with the production and services sector to ensure the success of applying the knowledge triangle, supporting research capabilities, such as research infrastructure, human capital, information and communications technology, and others in scientific fields that promote development and new businesses, activating cooperation between key actors by forming regional and internal groups for excellence and creating a competitive environment for entrepreneurship.

Importantly, the government roles are also read in supporting regional, transnational or inter-regional collaborations with universities that aim to establish partnerships in high-priority research areas, providing

legislation for a system of shared governance by integrating businesses and other institutions into university governance to link the university with industry, launching national awards to encourage all major actors to implement the Knowledge Triangle in universities, providing the necessary legislation and support to establish university companies in cooperation with the private sector and business sectors, creating interface systems to support education, research and innovation between universities and the production and service sectors, providing the necessary legislation and support to activate the roles of professional unions in applying the Knowledge Triangle in universities, using highly skilled university human resources and research and innovation outputs.

2. The Private Sector and the Business Sector (PSBS)

The private sector and the business sector roles lie in participating in financing universities through donations, the endowment system, or investing in infrastructure, contributing to providing scholarships, incentives, and competitive prizes for students and faculty members by the requirements of the Knowledge Triangle, participating in developing educational and research programs per the requirements of the labor market, participating in short- and long-term research projects, providing the necessary support to universities to transform academic research into applied research, supporting the establishment of specialized laboratories in universities, establishing joint projects and programs with universities that support the knowledge triangle model, supporting companies for innovative students and faculty members and sponsoring them.

Other key private sector and business sector roles are also reflected in providing training and specialized skills for students and faculty members in the workplace, providing the necessary funding to establish applied or specialized universities according to the needs of companies, creating an entrepreneurship ecosystem around universities in which there is a dynamic variety of companies, organizing events supporting the knowledge triangle in universities such as lectures, corporate presentations, seminars, employing qualified university students in specific projects in companies, providing full-time or part-time jobs for researchers to apply the results of their research or study problems on the ground.

3. The ministries of education and higher education roles

The ministries of education and higher education roles are crystalized in motivating universities to develop university quality assurance standards practices that support the application of the knowledge triangle, developing regulations that support the integration and interaction of education, research and innovation activities in universities, reconsidering the policies that regulate the work of universities with the production and services sector to ensure the success of the model, developing policies that encourage competition between universities in applying the Knowledge Triangle model, expanding the establishment of universities and specialized departments that support the application of the knowledge economy, developing regulations and policies that ensure integration between universities and other research institutions in applying the Knowledge Triangle, coordinating with all relevant ministries to provide logistical support for implementing the Knowledge Triangle in universities, and linking the universities' budget to their performance in applying the knowledge triangle model.

Notably, other key roles related to ministries of education and higher education are reflected in establishing technological networks and platforms that connect universities with various relevant parties locally, nationally and internationally, providing the necessary technological infrastructure for universities to implement the Knowledge Triangle model, encouraging universities to cooperate internationally in exchanging information, knowledge, experience and best global practices, developing an effective university governance system to support Knowledge Triangle activities, providing All necessary guarantees for the independence of universities in a way that contributes to the success of implementing the Knowledge Triangle, providing all necessary requirements to transform universities into entrepreneurial universities, directing universities towards benefiting from research programs funded by international bodies and organizations, and educating university leaders about the importance of the Knowledge Triangle, and the state's trends in improving its position in Global Innovation Index.

4. University Roles

The university roles cab be read in incorporating the Knowledge Triangle into the university's strategic vision, mission, goals and plans, providing advanced infrastructure that supports the implementation of the Knowledge Triangle, organizing research projects in cooperation with various production and service sectors, establishing innovation centers in universities as an environment for transferring and applying knowledge, establishing technology transfer centers in universities, spreading the culture and programs of entrepreneurship and innovation at the university, directing all university employees to benefit from the programs of national and international innovation centers, strengthening partnerships between the university and industries and concluding joint cooperative and research contracts, professional development of faculty members with all competencies related to applying the knowledge triangle such as research competencies, using problem-based teaching methods and research, ensuring the protection of the intellectual rights of university faculty members, designing educational programs similar to those of leading universities, and providing dual academic degrees with international higher education institutions with a global reputation.

Other key roles related to university roles include providing

international student exchange programs with reputable international educational institutions, providing training programs and field visits for students with public and private sector institutions, applying modern applied educational methods and strategies in university education such as case studies and educational games, providing study programs that combine study and practical experience, establishing research centers that work directly with organizations and industry to confront the challenges of business institutions, including creative and innovative students in all research projects and university events, offering part-time or online masters and doctoral programs targeting those working in business institutions, research cooperation with national higher education institutions and prestigious international institutions, seeking to find external funding that motivates universities to implement socially oriented programs and develop research and marketing, and focusing on creating new knowledge and distinguished research.

More important roles relating university are seen in forming strong links with relevant industries, both at the institutional level and at the level of individual employees, as direct providers of knowledge, having flexible structures adapted to market characteristics, developing incentive plans that focus on innovation and entrepreneurship, focusing on activities of transferring and commercializing knowledge and innovations, including commercial services and consulting, giving importance to financing market-oriented research projects, seeking to establish spin-off companies and emerging academic companies, reconsidering educational programs and curricula to keep pace with the knowledge economy, encouraging interdisciplinary educational and research programs, capitalizing knowledge in universities, giving commercial and marketing character to research results, focusing on the activities of the third mission of universities "Entrepreneurship University", including representatives of experts of actors in the knowledge triangle in the university's governing boards and relevant faculties, departments and units, organizing events for discussion between companies and researchers on research results and requirements for their application, developing a number of university indicators, contributing to evaluating and monitoring the impact of knowledge transfer, presenting successful models from universities that can apply the knowledge triangle model.

Also, among the key roles are reflected in educating university employees about bodies interested in and funding research projects and creative ideas, financing basic and applied research in which students participate, improving graduates' skills in a way that suits the needs of companies and the national and international labor market, encouraging cooperation between university employees and partner agencies instead of competition, internationalizing some curricula through teaching them in international languages, supporting the participation of students and researchers in national and international discussions, competitions, exhibitions and workshops, organizing exhibition forums for student research projects for communication and participation between companies and students, training students in partner companies, providing specialized courses for business institutions, organizing employment fairs with the participation of business representatives such as the "Employment Fair", launching an online platform that facilitates communication between students and graduates on the one hand, and the university and companies on the other hand, and encouraging the scientific advancement of doctoral students through policies of participation in universities, national and international projects and events.

13. Conclusion

In a nutshell, this paper develops a set of procedures to foster the main actors' roles in implementing the knowledge triangle in Arab universities. The findings indicate that the means of the research sample's agreement with the reality of employing the domains of the knowledge triangle in Arab universities have ranged between (2.38) and (3.01), with a medium degree of application. Given the findings, several procedures are achieved to activate the roles of the main actors in employing the Knowledge Triangle in Arab universities, together with the necessity of Arab universities to joining relevant academic alliances to facilitate the exchange of knowledge on best practices for employing the Knowledge Triangle in universities and establishing Arab alliances so that partners from the main actors cooperate in employing the knowledge triangle in universities. The following figure shows the roles of the knowledge triangle.

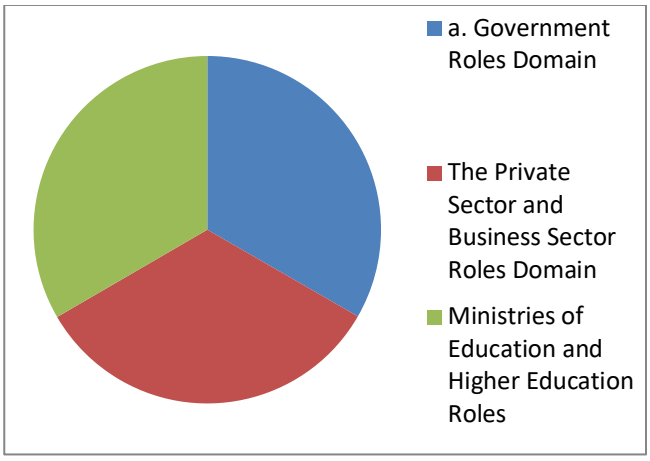

Fig. 1: Roles of the knowledge triangle

From the previous figure, it is noted that the importance of knowledge roles is close to each other in the arithmetic averages due to their importance in Arab universities. They need to be Ministries of Education and Higher Education Roles. The Private Sector and Business Sector Roles Domain, and Government Roles Domain

14. Recommendations

Given the aforementioned results and analysis, the research recommends making partnerships between Arab universities with international ones and joining relevant academic alliances to facilitate the exchange of knowledge on best practices for applying the Knowledge Triangle in universities, establishing Arab alliances in which partners from the main actors cooperate in applying the knowledge triangle in universities, and each alliance has a brand that distinguishes innovative products resulting from the integration between education, research and innovation, and working to activate communication channels between actors to integrate them, and to focus on the principle of cooperation instead of competition.

Importantly, this research study recommends establishing an Arab innovation system whose primary mission is to develop universities and transform them into entrepreneurship universities, and develop plans and strategies per the Knowledge Triangle to transform the Arab world into a center for innovation, expanding the establishment of national and Arab innovation centers in which all actors participate, each in their respective fields, to achieve Arab innovation, and which are based on universities as an essential component, and developing an Arab strategic plan as an umbrella for national plans to develop education, scientific research and innovation in universities per the pillars and requirements of the Knowledge Triangle.

More importantly, other key recommendations consist of developing the knowledge transfer environment in Arab countries by modernizing the infrastructure of universities and innovation centers to facilitate relations between actors, launching Arab and national initiatives to implement the Knowledge Triangle, including cultural and professional awareness, amending legislation and organizational structures that support the application of the Knowledge Triangle, and related Arab competitions, and creating Arab platforms for open innovation.

References

[1] Abdel-Jawad, J. (2019). International models and experiences in applying the knowledge triangle in higher education and the possibility of its application in Egyptian universities. *Educational Journal of the Faculty of Education in Sohag, 68(*68), 1703-1723.

[2] Ahmed, A & Youssef, S. (2023). Applying the Knowledge Triangle at Beni Suef University to support the national innovation system in light of the experiences of some foreign universities: A proposed scenario. *Journal of the Faculty of Education - Beni Suef University, 1*(1), 1-134.

[3] Al-Dahdouh, F. (2021). Window for developing scientific research in Arab universities. *International Islamic Economics Journal, 1*(108), 84-85.

[4] Al-Harathi, M. (2022). The reality of academic freedoms in Arab universities: A procedural study. *Middle East Affairs, 1*(168), 83-99.

[5] Al-Sharif, F. (2020). The suitability of international university classification standards to the reality of Arab universities: An evaluation study. *Educational Journal - Kuwait University, 34*(134), 221-264.

[6] Altarawneh, M & Al-Ghammaz, S. (2023). The journey of e-learning technology from application to challenges: Evidence from Jordan. 11th International Conference on Information Technology: Cybersecurity Challenges for Sustainable Cities, ICIT-Proceeding, 531-536.

[7] Ammar, B. (2020). Developing scientific research in Arab universities in light of international university classification standards. *Journal of University Performance Development,* 12(1), 409-427.

[8] Cadil, V. & Kostic, M. (2021). The Role of Knowledge Triangle Policies in Development of Science-Industry Links in the New EU Member States: The Case of Czech Universities. In D. Meissner, L. Gokhberg, Y. Kuzminov, M. Cervantes & S. Serger, *The knowledge triangle: Changing higher education and research management paradigms* (pp. 249- 271), Science, Technology and Innovation Studies, Berlin: Springer.

[9] Cadil, V.& Kostic, M. (2018). Universities and the knowledge triangle policy in new EU member states: the case of the Czech Republic. *International Journal of Knowledge-Based Development*, 9(2), 106- 128.

[10] Cervantes M. (2017). Higher education institutions in the knowledge triangle. *Foresight and STI Governance*, 11(2), 27–42.

[11] Council of the European Union. (2009). *Conclusion of the council and of the representatives of the governments of the member states*. Meeting within the Council on Developing the Role of Education in a Fully-functioning Knowledge

[12] Daimer, S., Rothagang, M. & Dehio, J. (2021). Different approaches to regional embeddedness and the knowledge triangle in Germany. In D. Meissner, L. Gokhberg, Y. Kuzminov, M. Cervantes & S. Serger, *The knowledge triangle: Changing higher education and research management paradigms* (pp. 63- 83), Science, Technology and Innovation Studies, Berlin: Springer.

[13] Daradkah,A , Alotaibi ,T , Badarneh, H , Momani, K , Hamadin, K , Alqudah, Rabha , AL-Momani, M, Al-Ibrahim, A , A. Ashour, M , Almawadeh ,N 8 , Al-nemrat, A, Mahmoud, A(2023). A Proposed Vision of the Transformation of the Arab Universities into Smart Digital Universities, *Information Sciences Letters,* 12(9), 2355-2374

[14] EC. (2005). *Mobilising the brainpower of Europe: enabling universities to make their full contribution to the Lisbon strategy*. European Comission, Brussels: COM(2005) 152 final.

[15] Erdil, E., Meissner, D., & Chataway, J. (2018). Innovation ecosystems and universities. In D. Meissner, E. Erdil, & J. Chataway (Eds.), *Innovation and the entrepreneurial university* (pp. 3–14). Cham: Springer.

[16] European Council. (2010). *Cover note from general secretariat of the council to the delegations.* EUCO 13/10, 17.06.2010, Brussels: European Council.

[17] Fares, T. (2020). A proposed model for developing the performance of Arab universities in international classifications. *Journal of Islamic Management and Leadership, 5*(1), 53-75.

[18] Furman, J., Porter, M. & Stern, S. (2002). The determinants of national innovative capacity. *Res. Policy,* 31, 899–933.

[19] Groumpos, P. & Meissner, D. (2021). Knowledge Triangle: The Right Concept to Align Universities Missions?. In D. Meissner, L., Gokhberg, Y., Kuzminov, M., Cervantes& S., Serger (Eds.), *The knowledge triangle: changing higher education and research management paradigms* (pp. 19-32). Springer Nature.

[20] Hayter, C. (2016). A trajectory of early-stage spin off success: The role of knowledge intermediaries within an entrepreneurial university ecosystem. *Small Business Economics,* 47, 633–656.

[21] Hilal, N. (2020). A future vision to raise the competitiveness of Arab universities in light of the international university classification. *Journal of the Faculty of Education19*(4), 43- 144.

[22] Hirvikoski, T. (2013). The knowledge triangle promoting innovation and multidimensional learning. In P. Lappalainen & Markkula, M. (Eds.), *The knowledge triangle: re-inventing the future* (pp. 43-52), Aalto University, Aalto, pp 43–52.

[23] Issa, M. & Al-Mahjoubi, K. (2020). The role of universities in enhancing the position of Arab countries within the Global Innovation Index. Economic Horizons Journal, 1(11), 32-53.

[24] Kuzminov, Y., Gokhberg, L., Fursov, K., Zaichenko, S. & Meissner, D. (2021). Incorporating Knowledge Triangle in University Management System: The Case of the Higher School of Economics, Russia. In D. Meissner, L. Gokhberg, Y. Kuzminov, M. Cevantes, S. Serger (Eds.), *The knowledge triangle: changing higher education and research management paradigms* (pp. 145- 161), Science, Technology and Innovation Studies, Berlin: Springer.

[25] Marczewska, M. & Weresa, M. (2022, July, 11- 14). Creativity and innovation in Polish universities: The knowledge triangle approach. In L. Unden, I. Ting & B. Feldmann (Eds.), *Knowledge management in organization* (pp. 145- 159), 16th International Conference, KMO, Hagen, Germany: Springer.

[26] Markkula, M. (2013). The knowledge triangle renewing the university culture. In P. Lappalainen & M. Markkula (Eds.), *The knowledge triangle: Re-inventing the future* (pp. 11- 32), European Society for Engineering Education SEFI, Aalto University & Universitat Politècnica de València.

[27] Meissner, D. & Shmatko , N. (2017). Keep open‖: the potential of gatekeepers for the aligning universities to the new knowledge triangle. *Technological Forecasting & Social Change* ,(123) ,191–198.

[28] Meissner, D. (2018). Entrepreneurial universities: Towards a revised paradigm. In D. Meissner, E. Erdil, & J. Chataway (Eds.), I*nnovation and the entrepreneurial university* (pp. 37- 55). Berlin: Springer.

[29] Organisation For Economic Co-Operation And Development [OECD]. (2015). *Scoping Paper For Cstp/Tip Project On Higher Education Institutions In The Knowledge Triangle,* DSTI/STP(2015)6, Paris, France

[30] Organisation For Economic Co-Operation And Development [OECD]. (2016). *Emerging policy issues in the knowledge triangle*. 02-Mar-2016, DSTI/STP(2016) 4, Paris, France.

[31] Pirttivaara, M., Laitala, P., Miikki, L. & Kalman, A. (2013). Experiences in implementing knowledge triangle: cases. In: Lappalainen P, Markkula M (Eds.) *The knowledge triangle: re-inventing the future (pp. 173- 187),* Aalto University, Aalto.

[32] Raunio, M., Nordling, N., Kautonen, M. (2018). Open innovation platforms as a knowledge triangle policy tool – evidence from Finland. *Foresight-Russia*, 12(2), 62–76.

[33] Saadallah, A. (2022). Arab universities and international rankings. *Arab Affairs, 1*(191), 156-171.

[34] Scipioni, S., Niccolini, F. & Giannini, M. (2020). *Enhancing collaboration in logistics knowledge triangle: A European analysis*. Pisa: Pisa University Press,

[35] Sjoer, E., Norgaard, B. & Goosens, M. (2011, Sep. 27- 30). *Implementing Tailor-made CEE in theory and in practice*. the SEFI annual conference, The knowledge triangle as a conceptual tool, Lisbon.

[36] Sjoera, E., Nørgaard, B. & Goossen, M. (2016). From concept to reality in implementing the Knowledge

Triangle. *European Journal of Engineering Education*, 14(3), 353–368.

[37] Soriano, F. & Mulatero, F. (2010). Knowledge policy in the EU: from the Lisbon strategy to Europe 2020. *J. Knowl. Econ*. 1, 289–302.

[38] Stam, E., Romme, A., Roso,. M, van den Toren, J. & van der Starr, B. (2016). *The knowledge triangle in the Netherlands: an ecosystem approach* (draft case study for the OECD working party on innovation and technology policy). Paris: OECD, (unpublished).

[39] Tohamy, G. (2022). The application of the knowledge triangle in universities as an approach to achieve global competitiveness. *BSU Journal of Pedagogy and Curriculum*, 1(2),1- 9.

[40] Turcinovic, P. (2013). EU knowledge triangle: renaissance or ocean of papers? Donald Sch. *J. Ultra-sound Obstet. Gynecol*., 7(3), 272–277.

[41] Unger M. & Polt, W. (2017). The knowledge triangle between research, education and innovation – A conceptual discussion. *Foresight and STI Governance*, 1(2), 10–26.

[42] Unger, M., Marsan, G., Meissner, D., Polt, W. & Cervantes, M. (2020) New challenges for universities in the knowledge triangle. *The Journal of Technology Transfer*, 45, 806–819.

[43] Van Petegen , W. (2013). Lifelong learning strategy development. In: P. Lappalainen & M. Markkula (Eds), *The knowledge triangle: re-inventing the future* (pp. 73- 84), Aalto University, Aalto.

[44] Vico, P., Serger, S., Wise, E. & Benner, M. (2021). Knowledge Triangle Configurations at Three Swedish Universities. In In D. Meissner, L., Gokhberg, Y., Kuzminov, M., Cervantes& S., Serger (Eds.), *The knowledge triangle: Changing higher education and research management paradigms* (pp. 187- 211), Springer Nature.

[45] Vonortas N. (2017) The role of universities in the knowledge triangle. *Foresight and STI Governance,* 11(2), 6–8.

[46] Younis, I. (2021). Balancing higher education and the productivity of Arab universities. *Scientific Journal of Business Research, 8*(2), 9-31.