



Review Article

The application of the knowledge triangle in universities as an approach to achieve global competitiveness

Tohamy, Gomaa Saeed

Dept. of Foundations of Education, Faculty of Education, Beni Suf University (Beni Suf- Egypt)

Email address:

gstohamy2006@hotmail.com

gomaa.tohamy@edu.bsu.edu.eg

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Abstract: Universities face many local and global challenges that affect their performance and functions, and require 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 in education, scientific research and innovation, those components have become indispensable for any university that seeks global leadership, innovation and upgrading its creative performance. This article discusses the components of the knowledge triangle (KT), which has gained great importance in recent years as a framework for innovation policies, and because it emphasizes an integrated methodology for the interrelationship between research, education and innovation. It aims to set a vision for the application of the knowledge triangle in universities through interaction and integration between the components of the knowledge triangle (education, research and development) to achieve a higher ranking in the Global Competitiveness Index.

Keywords: universities; knowledge triangle; knowledge economy; global competitiveness index

1. Introduction

The knowledge boom contributed to bringing about tremendous developments at various levels, becoming a major driver of production and economic growth, and giving rise to such terms as 'information society,' 'information revolution,' 'knowledge society,' and 'knowledge economy'. Information, in tandem with its application, dissemination and marketing, has become one of the most important basic elements in the knowledge economy, and hence the power and wealth of countries are measured by what they produce of minds and human capital, not by what they possess of material resources.

The term 'knowledge economy' appeared for the first time in the sixties of the last century by F. Drucker Peter and others. It was used to indicate the importance of knowledge capital represented in competencies, information organization, and research& development activities (Nazih, 2016, 98).

The knowledge economy is based on four main pillars: a strong economic system based on the conviction of the importance of knowledge, an educational system based on student information and skills, an

information infrastructure that exploits knowledge and information, and a research environment that facilitates creativity and innovation. (Gabbour, 2017, 117)

Higher education institutions are among the most important institutions supporting the knowledge economy, with their knowledge structure represented in human and technical elements. It has become one of the most important roles of universities as they represent generators of knowledge that meet the needs of the knowledge society and achieve economic and social development. This imposes high expectations on both the performance of universities and their employees, especially scientists and researchers who belong to them through their innovative scientific research and distinguished education that achieves leadership for their universities, locally and internationally, and brings about economic development for their societies (Meissner& Shmatko, 2017, p.191).

2. Objectives, Questions & Hypotheses

This article aims to set a vision for the application of the knowledge triangle in universities through interaction and integration between the components of the knowledge triangle (education, research and development) to achieve a higher ranking in the Global Competitiveness Index.

3. Research Method, Design&Participants

The descriptive method was used to analyze the literature related to the knowledge triangle. This analysis was to define the concept of knowledge triangle, and determine the elements of KT, and the interactions among these elements as well. Nevertheless, the actors of TK were determined.

4. Literature Review

Studies and literature of the knowledge triangle:

1. The concept of the knowledge triangle:

The KNOWLEDGE TRIANGLE (KT) is defined by the OECD (2015, p. 29) as a policy framework based on the integration of research, innovation and education policy, as well as a conceptual tool for analyzing the interactions between research, innovation and education. It emphasizes an integrated approach to the policy of research, innovation, and education in higher education institutions, as institutions specialized in the production of knowledge. (Cervantes, 2017, 30)

The knowledge triangle model, therefore, differs from other models that are more direct for the transfer of knowledge and the commercialization of scientific research, as it takes a more integrated approach to coordinating the processes of knowledge production and innovation by linking both the three areas of scientific research, education, and innovation, and the different actors and models of application of a triangle Entrepreneurial university knowledge. (Polt, 2017, 11)

The importance of applying the knowledge triangle in the development of universities:

The application of the knowledge triangle (KT) model is useful in analyzing the role of universities in innovation processes and their multiple interactions with other actors (between research, education, innovation and the channels used).

A- Interaction between education and scientific research:

Research and educational interactions are manifested, for example, in the geographical and sectoral mobility of graduates, graduate student training programs, and basic and applied research, which serve as a basis for research-based teaching or problem-based education in order to provide graduate skills development matching the needs of companies (Leydesdorff L., 2012, 28-32).

B- Interaction between scientific research and innovation:

The interactions between research and innovation focus on supporting and intensifying knowledge transfer through public-private partnership models, work teams, scientific complexes, commercial marketing of publicly funded research, contractual research and development services between universities and the industrial sector, and contracts between the university and academic companies startups, knowledge and technology transfer offices, incubators, and open innovation platforms (Erdil et al. 2018, 9-11).

C- The interaction between education and innovation:

The interaction between education and innovation is done by looking at supporting the development of an entrepreneurial culture within the framework of academic training programs such as industry-focused PhD programmes, case study education, team competitions, etc. (Erdil et al. 2018, 9-11).

D- Interaction between the components of the triangle of knowledge:

The need for an integrated understanding of the relationship and dependency between the three areas of education, research, and innovation is of equal importance in the knowledge triangle, which imposes changes to the planning of higher education policies that affect developed countries as well as emerging economies.

How to mix between education, research and innovation:

There are a number of ideas and lessons for universities and policy makers on how to better integrate the knowledge triangle with educational activities, summarized as follows (Markkula, 2013, 18-19):

- Integrating the culture of entrepreneurship in higher education institutions.
- Involving students as creators of knowledge and as part of the innovation system
- Providing rich learning environments for the development of academic talents
- Quality assurance and attention to the development of new skills
- Taking an interdisciplinary approach
- Paying attention to internationalization as a means to improve institutional practices
- Implementing flexible management models
- Transition to work environments.
- Including assessment and monitoring of the impact of activities related to the knowledge triangle in the university's strategy
- Intelligent specialization as a center of knowledge triangle activities
- Take a long-term vision for change at the institutional level

The pillars of the knowledge triangle:

Knowledge society: in which all individuals possess knowledge of knowledge and skills in different fields and levels of their work.

1. **Education:** It is one of the necessities of the success of the knowledge triangle, and there are many examples of countries that rose when they directed their investments towards education and became high-income and economies, such as Singapore and Malaysia when educational and research institutions were employed to prepare individuals who think creatively and possess lifelong learning skills.
2. **Attention** to scientific research, development and creativity: It is one of the most important features of knowledge societies that establish a culture that respects mental abilities. All over the world in a short
3. **The information and communication technology revolution:** where technology has become an indispensable way of life in an open year that depends on competition, and technology

has become a major source of knowledge dissemination and marketing in order to benefit from it in education and the economy.

4. Changing the structure of exports: After the exports of developed and developing countries - alike - consisted of material goods, the exports of developed countries depend on the production, marketing and distribution of knowledge, while developing countries still suffer from a severe weakness in the production and marketing of knowledge globally, which has increased Challenges and economic problems in it, as it is still a source of raw materials and material goods that are threatened with extinction. (Al-Hashimi, 2007, 28)

5. Global scientific partnerships: These partnerships allow countries to attract highly qualified, trained and experienced people, which increases their ability to produce knowledge and market it globally.

The actors of the knowledge triangle model:

A- Higher Education Institutions:

Higher education institutions are the backbone of the knowledge triangle model because they provide key inputs for each of its dimensions, and they integrate those dimensions in an institutional way in their vision and internal mission. Higher education institutions include: universities that conduct education-oriented research, and universities of applied sciences that provide Education focused on a particular profession or a narrow specialization and its applied research academies of science that give doctoral degrees and institutions of higher education that serve specific professions, such as nursing schools, colleges of education or business schools, which may often focus on specific levels of education such as a degree Bachelor's or Master's degree. (Scott, 2014).

B- Public research institutions such as research centers:

Public research institutions in a number of countries are important actors in public sector research, and over the past few decades their share of domestic R&D spending has been declining in many OECD countries, especially in light of the presence of educational institutions Higher education, although it remains active institutions in some innovation systems, as it conducts specialized and unique research for commercial application, and it plays a role in the knowledge triangle model also through its interaction with institutions of higher education and the private sector.

C- Private companies:

The business sector or the private sector is a major player in implementing the knowledge triangle model, but it differs significantly from public institutions and decision-makers, as it focuses on the commercial aspect in the field of innovation through its cooperation with higher education institutions and research centers to benefit from the commercial aspect of what these institutions offer across the three functions of the knowledge triangle. (Gulbrandsen, 2011)

D- State authorities:

The state authorities represented by ministries and regional and local administrations should play the following roles in the knowledge triangle model: provide a legal and regulatory framework for research, education and public innovation activities on the basis of delegating tasks to relevant universities and research centers to formulate their own rules, standards and regulations, and provide funding for higher education institutions to carry out Innovate activities and provide competitive incentives for them in pioneering projects, with the use of highly skilled human resources, and setting priorities at the medium and long-term levels.

Literature related to the knowledge triangle:

Hayter, et al. (2018) shows that the knowledge triangle helps in the transfer of knowledge and related

technology, through the introduction of a deep analysis of the process of research and knowledge generation, and the skills required for the applications of knowledge and technology by researchers, in addition to the availability of institutional culture that Support the activities of the knowledge triangle.

Raunio, et al. (2018) explores the role of open innovation platforms in coordinating joint innovation projects within the framework of the "smart city" model. The tasks of the platforms in coordinating innovation are reflected in the practices of three universities that apply the "knowledge triangle" strategy. The researchers were guided by the participatory action research (PAR) approach aimed directly at developing the strategy, and reached several results for the development of the concept of open innovation platforms programs in order to improve the process of interaction between the university, industry and society, and innovation policy in recent years aimed to integrate Research, education and innovation within the framework of the knowledge triangle, and innovation policy is also evolving towards more flexible and applied innovative processes, where ecosystems, innovation models and open systems are essential elements by higher education institutions (Heaton et al, 2019; Rosli & Cacciolatti, 2022; Taxt et al., 2022).

Vico, et al. (2017) attempts to explore how the knowledge triangle emerged in the organization and strategy of three different Swedish universities, and how these manifestations are shaped by the political landscape. That national policies are not available, as the responsibility for integrating into the knowledge triangle lies with the universities themselves through management strategies, planning and dealing with the three tasks interactively.

Polt (2017) examines the main features of the concept of the knowledge triangle and its relationship to some other concepts that are intertwined and integrated. The study also provides an analysis of the roles and challenges facing the various actors that participate in activities related to each of the three areas of the triangle. These actors are higher education institutions, public authorities, and research and technology institutes and private sector companies.

Cervantes (2017) discusses the best practices that aim to enhance the performance of higher education institutions and improve their impact on society and economy through the knowledge triangle, by integrating the functions of research, education and innovation. The study also addresses the performance of higher education through the lens of the knowledge triangle model, and the policies aimed at enhancing it. Cervantes concludes that there is a need for integration and balance between the three roles and tasks.

Lassnigg, et al. (2017) critically reviews the feasibility of the knowledge triangle model, highlighting a void between political discourse and academic research. The study, further, examines the bilateral relations between the three dimensions of the model.

Unger, et al. (2018) discusses the role of higher education institutions within the framework of the knowledge triangle model, as this model has gained great importance in recent years as a framework for innovation policies, especially in the Organization for Economic Cooperation and Development and Europe, and this reflects the third role of the university linked to innovation through models Pioneering universities and "smart specialization" to conform to the concept of the knowledge triangle, which imposes new requirements on universities and their leaders and reconsider their relationship and interactions with the public sector and the business sector in accordance with the knowledge triangle.

Participation of universities in the knowledge triangle:

In order to participate in the knowledge triangle, it has become necessary for universities to play new roles represented in (Markkula, 2013)

1.Knowledge production: It includes the institution's ability to provide information and ideas, whether from the internal or external environment, and this requires the skills of investigation, critical thinking,

creative thinking and discovery, and this function is linked to the function of scientific research and development entrusted to universities and research centers, and this requires increasing funding allocated to research and development in universities.

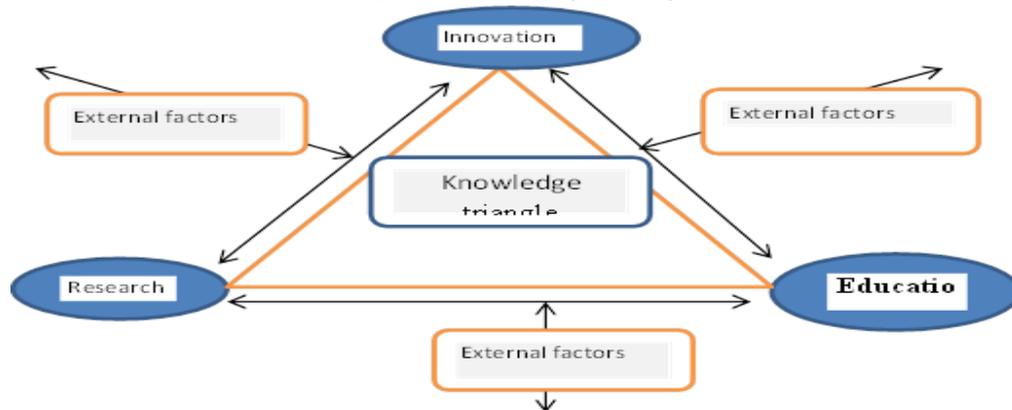
2.The stage of storing and preserving knowledge: It is related to preserving knowledge, protecting it, coding it and making it available, while preserving intellectual property and the possibility of retrieval.

3. Dissemination of knowledge: It is related to the transfer, sharing, dissemination and exchange of knowledge and transforming it into an economy beneficial to humanity, through its students and faculty members and through the process of learning and training, with attention to the means and tools of knowledge dissemination through Internet networks and various media, whether at the local or global level.

4.Knowledge investment: If the matter stops at the previous stages, there is no benefit from knowledge unless it achieves the benefit and is harnessed for the benefit of societies through its application and experimentation, by building links and partnership relations between knowledge production bodies and institutions related to that knowledge and which need it, where knowledge is transferred From research and development institutions to companies and societal institutions to be converted into economic value.

5. Distribution and dissemination of knowledge: It is related to the transfer, sharing, dissemination and exchange of knowledge and its transformation into an economy beneficial to humanity.

Figure1: Knowledge Triangle



5. Results

A future vision for the renewable roles of universities in the light of the knowledge triangle in Figure 1 above are summed up as follows:

- Developing policies that increase research contributions to innovation through legislative reforms.
- Establishing technology transfer offices based on interaction between universities and companies in research and innovation.
- Continuously developing minds by providing knowledgeable content and appropriate activities for students, staff and faculty members.
- Finding new areas and platforms for cooperation between different disciplines or the so-called interdisciplinary research.
- Viewing interest in integrated cooperation with relevant institutions such as factories and laboratories in large research projects that benefit the community and the university.

- Giving a commercial and marketing formula to research results for companies to benefit from.
- Creating more links between policies in the areas of education, research and innovation.
- Developing the necessary measures to develop a culture of innovation in universities.
- Investing in modern infrastructure to help companies grow, innovate and create jobs.
- Establishing a strong innovation system with strong regional and global centers and universities.
- The trend towards internationalization, attracting foreign students, and maximizing the university's benefit from research results.
- Establishing parks and innovation centers and maximizing the role of universities and higher education institutions in encouraging scientific and research innovations.
- Developing policies that ensure the contribution of education to the success of the labor market or train highly qualified graduates for research activities.
- Developing students' attitudes towards entrepreneurship and self-employment through a range of entrepreneurship education programs.
- The establishment of technology transfer offices or other interactions between research and innovation in companies.
- Establishing business centers and incubators in universities to transfer knowledge.
- Providing long-term funding for cooperation between higher education institutions and public actors to strategically help strengthen the interaction between education, innovation, and research.

6. Discussion:

Knowledge Triangle emphasizes the interaction among education, research and innovation, it considers the university as a major actor in the innovation system, and emphasizes the interaction of universities with other actors within KT. Therefore, it is important to develop policies that increase research contributions to innovation through legislative reforms. universities should seek to encourage interdisciplinary research, cooperation with industrial institutions and companies, establishing centers for innovation, technology and knowledge transfer offices, and business incubators, which may help them improve their ranking in the global competitiveness index.

7. Conclusion:

Local and global have imposed new roles on the university. Universities should use new approaches to face those challenges. The knowledge triangle (KT) is one of the new approaches that has attracted the attention and interest of policy makers as well as academics. KT emphasizes a new role for the university in addition to education and research, this new role is innovation. Universities should adopt KT approach, and implement activities to activate the interaction among KT vertices. Adopting KT within the university environment will improve the universities ranking in the global competitiveness index.

8. Implications:

This article can help Government develop the innovation policy in the light of KT approach. Using KT approach can activate the whole innovation system as it focuses on the interactions among the different actors responsible for innovation. KT approach can contribute in the societal development because it is based on the open innovation instead of closed innovation.

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