

Scientific research in the university: Its roles and some explanatory theories

Hoang Van Tuyen

National Institute for Science and Technology Policy
and Strategy Studies (NISTPASS)
38 Ngo Quyen, Hoan Kiem, Hanoi, Vietnam
E-mail: tuyenhoangvankul@gmail.com

ABSTRACT: *The development of scientific research in the university as well as the development of research university models is increasingly attracting the attention of many scholars as well as scientific and educational policy makers of many countries around the world, including developing countries. Developing scientific research in the university as well as building the research university model is quite expensive and requires a developed national institutional environment to a certain extent. However, the development of scientific research in universities in general and research universities in particular has a particularly important mission in national sustainable development and requires countries, including developing countries and every university needs to have appropriate solutions and steps. This paper contributes to the clarification of the role and the application of theories to explain the role of university's scientific research.*

KEYWORDS: Scientific research; university; a research university.

→ Received 11/4/2020 → Revised manuscript received 10/5/2020 → Published 25/6/2020.

1. Introduction

Today, more and more countries in the world are pursuing a modern economic development model, which is knowledge-based economic development, which focuses mainly on creating, disseminating and using knowledge. In this knowledge transformation chain, the role of scientific research in universities as well as research universities has been recognized as particularly important. A university with strong scientific research activities is considered to play an important role in creating knowledge, promoting the effective and rapid dissemination of knowledge that has been created and contributing to socio-economic growth and development. Universities are not only responsible for teaching but also creating new knowledge, turning knowledge into useful results for society. Many countries around the world, with different efforts, are investing more and more in scientific research in general and university's scientific research in particular as well as in building research university models. Thus, scientific research activities in universities are of special importance in contemporary society or in other words, scientific research in universities plays a key role, especially in the context of a developing country like Vietnam. This paper contributes to the clarification of the role and the application of theories to explain the role of university's scientific research.

2. Research content

2.1. The mission of the university

First, teaching/ education

This mission is perhaps the most important of the university. Universities must provide students with a wide range of skills to prepare them for job positions, requiring a systematic, multi-disciplinary approach to problem solving. The teaching and learning of the university must meet the requirements of the labor market and the community to avoid a waste of education and resources. Universities should be the supply sources of quality educated students who will become the backbone of the country's development. Universities are places where knowledge is synthesized and served as national intellectual pools.

Second, scientific research

Universities must conduct research with great impacts in different fields and levels of development. The university must be the starting source for the creation of new ideas, new principles, new discoveries, new theories and new inventions (presented in the form of scientific publications, patents, etc.). The university also collaborates with external research institutes and centers, enhancing research links with the industrial sector through collaborative, joint research projects in many fields. With the change to the knowledge based economy, today universities are an important part of the value chain of the economy, bridging with industry and society, manifesting as the engine of innovation and

entrepreneurship. Today there is an increasing demand for science/ technology parks near universities (Reddy, 2011). In particular, universities with a contingent of students, researchers, and teachers with strong scientific and technological knowledge form an important resource for the development of future technology entrepreneurship or “technopreneurs” as well as scientific and technological ideas and research. One indicator of a university’s success is its ability to create high-tech startups, science and technology based firms, and nurture graduates who can create jobs for themselves, and not only have jobs but also attract foreign investment. This is the premise that forms the third mission of the university.

Third, service to society (outreach)

Under competitive pressure to bring to market new products, processes and services at high speed, many firms have had to restructure their scientific research activities to better serve the firm’s product, process and service development. Firm’s research programs require a strong knowledge base or role of university and government policy (Wolfe, 2003). Under this increasing pressure, the university must expand its traditional dominant role in scientific research (not just focusing on pure basic research), which must be combined with applied research activities, implementing experimental developments, technology developments, regularly based on university-industry relations. The changes that impact the university system are characterized by three trends: i) government funding and economic policies for university’s scientific research are more emphasized; ii) different channels of relationship between firms and researchers in the university are more developed; and iii) direct participation of universities in research commercialization, regional economic development and the formation of innovation clusters, particularly in knowledge-intensive industries are increased. This means that the university is now looking to create more applied knowledge, more relevant to societal needs and market demands, to disseminate knowledge and provide technical support to the industry. This is the third mission of the university.

2.2. The role of scientific research in universities and some explanatory theories

Scientific research in university and the research university

Currently in the world there are many different terms to refer to an institution with connotations as Research University, Research-Oriented University, Research Intensive/ Active University or High/ Very high Research

University, etc. The name itself has such implications; it is an institution that is very active in scientific research activities.

The concept of Research University first appeared in Germany when Humboldt founded the Berlin University, now known as Humboldt University (opening on October 10, 1810). For the Berlin University, for the first time, science has been freed, out of the excuse of religion, or from influencing social interests or state power and is clearly institutionalized. And only under such framework conditions, science does play the role as driving force for the development of research activities and discovery of truth and only then science can play the role for the effective development of society. This is entirely in the interests of the state (Nguyen Xuan Xanh, 2014). Humboldt University model is a symbol of modern universities around the world (higher education program with the spirit of education by science and scholarship) such as the United States, Europe, Japan, Australia, Singapore and many other countries. Currently, although at different levels, but in countries where science developed strongly, scientific research activities are emphasized in universities, forming and developing many research university models. The concept of a research university is particularly meaningful to developing countries, countries following the Soviet model, with a great distinction between research and teaching/ education activities.

According to Carnegie’s classification of educational institutions for US universities (since version 1987), research universities are institutions: offering a wide range of baccalaureate programs; commitment to higher education through human resources with doctoral degrees; **High priority in scientific research**; Doctorate granting for over 50 doctorates per year (since 1973); and Received over 40 million USD annually from the federation (since 1994). According to the classification of Carnegie (version 2010), US research universities are classified into 3 categories: (i) research universities with **very high research activity** (RU/ VH), including 108 universities; (ii) research universities with **high research activity** (RU/ H), including 99 universities; (iii) Doctoral/ research universities (DRU), with research activities but not at high or very high level, including 90 universities.

From the above analysis, the “research university” can be understood as an academic institution that creates and disseminates knowledge in many disciplines and fields, resources needed to best perform the role of teaching and especially scientific research. Thus, an important

common feature of the research university, that is: high priority for scientific research, learning associated with scientific research and excellence in research is one of the essential goals of the university.

Why scientific research in universities is emphasized?

It can be said that the development of research university model is an irreversible trend of the contemporary world. The research university emphasizes the importance of scientific research and linking teaching with scientific research. In university a good lecturers/teachers must be a good researcher and vice versa. The association of teaching with scientific research benefits for many sides (Hoang Van Tuyen & Nguyen Thi Minh Nga, 2015): Due to the rapid development of science and technology, it requires lecturers/teachers to do research to update knowledge and improve their capabilities; lectures are regularly updated, with plenty of vivid evidence based on research findings; Social development needs require lecturers to do research to meet the training needs of society; research results-based curricula and lectures; practical needs-based teaching issues; many new ideas, many new suggestions from the practice of teaching students, is the premise for the next research projects; research projects have a large team of “assistants” from students and thus are capable of implementing large scaled projects; research projects with student participation, helping students get exposed to research works, increasing their knowledge base; motivating a number of students who loves the research “career”, a number of student with a high entrepreneurship; students are allowed to participate in practical activities based on research topics (learning by doing, learning by studying); increasing the efficiency of using and sharing instruments, equipment and information; increasing the quantity and quality of publications, patents; scientific research requires a large amount of funding, training according to social needs, business needs is to contribute for creating additional funding for university’s research activities (many cases, the grant for university’s research activities of firms is greater than that of the government); through teaching and training according to social needs, researchers/scientists have the “room” to be able to develop and test their ideas.

Some scholars believe that being a university must have scientific research. However, the reality in many universities in many countries is not entirely true. Many universities around the world, which are mostly in developing countries, focus primarily on teaching activities, with very few (or even no) scientific research activities. There are many reasons to explain this

problem: universities need to quickly respond to the demand of human resources for regional and national developments; investing in a research university for a long time is very expensive; there are too many public universities and therefore the state budget is not enough to invest in research activities in universities; In some countries, scientific research is carried out in institutions outside of the university; etc. Although investment in university’s scientific research and development of research university models is very expensive, but today in the world, many countries are increasingly aware of the importance of university’s scientific research in general and develop research university models in particular. In the knowledge based society, research university is a key institution in socio-economic development (Mohrman *et al.*, 2008). Scientific research activities in universities can be developed to meet the challenges of the knowledge era. This knowledge is used for teaching and innovation (university’s role for socio-economic development). Some countries (China, India, etc.) chose a number of universities to focus on investing and developing into universities with an intensive research content. For example, China through the financial aid program from the government (programs 985 and 211) has supported about 150 universities; India through the University Grants Committee has supported 20 universities.

Explanation on the role of scientific research in universities

A number of different theoretical frameworks are applied here to explain the role of scientific research in universities, including: linear model (Mode 1); social commitment model; contrasting model; Mode 2 model; Triple Helix; innovation system model; and “Spiral of university knowledge development” model to explain the role of scientific research in universities.

• Linear model (Mode 1)

This model refers to new knowledge produced first in single academic fields, mainly in universities. The main motivation is to search for new knowledge with the aim of “enriching the treasure of human knowledge”. The commercialization of research results is hardly focused, but instead is publishing publications, discoveries. These results are very important to the reputation of the university scientists (Kazakova, 2011).

• Social commitment Model

A theoretical framework that analyzes the role of academic research (where university’s research is focused) is the “linear model” of innovation (almost like “Mode 1”). This model was used by Vannevar Bush in his “blueprint” on the American scientific research system

after 1945, “Science – The Endless Frontier” reported to the President of the United States (Harry S. Truman on July 5th, 1945) on science and technology policy after World War II. Bush argued that expanded public funding for basic research within U.S. universities is a critical contributor to economic growth, and universities are the most appropriate institutional locus for basic research. This “linear model” of the innovation process asserted that funding of basic research is both necessary and sufficient to promote innovation (Mongkhonvanit, 2008).

- “Contrasting” model

Another view on the role of university’s scientific research focuses on the “contrasting” model between university research and industrial research. There are abundant examples of university’s researchers who make important contributions to technology development in firms and vice versa, much basic research is conducted in firms. Some scholars have argued that the rules of university research differ greatly from research conducted by the industrial sector. For industrial research, industrial innovation relies more heavily on secrecy and limitations to the disclosure of research results. In contrast, for university researchers, the professional recognition, reputation and high status depend upon the research problem that is first to disclose and publish their research results. Prompt disclosure of results and the methodology used to achieve them is central to university research (Mongkhonvanit, 2008). This difference demonstrates the role of scientific research in universities.

- Mode 2 model

The theoretical model has been recently applied in describing the role of academic research in industrial societies mentioned by Gibbons M. *et al.* in 1994, called “Mode 2”. The “Mode 2” model is characterized by *multi-disciplinarity / trans-disciplinarity* (Gibbons & *et al.*, 1994). “Mode 2” involves the interaction of multiple research communities and other actors within any given research area (Mowery & Sampat, 2004). The “Mode 2” model is consistent with the features of a modern innovation system, focusing on the cooperation among institutions. This theoretical framework assumes that the knowledge sources in the modern innovation systems become more diverse and accept the increasing role of university’s scientific research as the basic research center.

- Triple Helix model

The “*Triple Helix*” model, first introduced by Etzkowitz & Leytesdorff in 1997, is another theoretical

framework for analyzing the changing position of the university in national innovation systems, emphasizing into the increasing interaction among the university, industrial and government sectors (Etzkowitz & Leytesdorff, 1997). “Triple Helix” is a model that shows multidimensional interactions at different points in the process of knowledge capitalization. The first dimension of the Triple Helix model is internal transformation in each of the helices, such as the development of lateral ties among companies through strategic alliances or an assumption of economic development mission by universities. The second is the influence of one helix upon another. The third dimension is the creation of a new overlay of trilateral networks and organizations from the interaction among the three helices for the purpose of coordination and generation of new ideas and formats for high-tech development (Etzkowitz, 2002 cited in Mongkhonvanit, 2008). The “Triple Helix” explains the university-industry-government relationship as one of relative equal, interdependent, institutional sphere which overlap and take the role of one another. Bilateral relations between government and university, academia and industry and government and industry have expanded in to triadic relationships among the spheres. The relationship among the spheres is demonstrated by the evidence of knowledge based economic development in many countries around the world (Etzkowitz, 2002). The main idea of this theory is that universities play an important role for innovation and the relationship among the sectors, especially the development of the industrial sector depends heavily on the results of university research.

- National innovation system model

Another model explaining the role of knowledge, especially knowledge from the university sector in the innovation process of a knowledge-based economy is the concept of the innovation system, which has been proposed by many scholars such as Freeman (1988), Lundvall (1988), Nelson (1988), Edquist, 1997; Dosi *et al.* (1988); etc. Although it is difficult to correctly define an innovation system, the first works on the innovation systems above mentioned identified the innovation system as a network of public and private components in the economy, carry out scientific research activities, convert scientific research results into innovations. Universities are often cited as an important knowledge component in the analysis of innovation systems. Mowery & Sampat (2004) examined the important contributions made by US universities to promote innovation, with a specific empirical focus on the role of

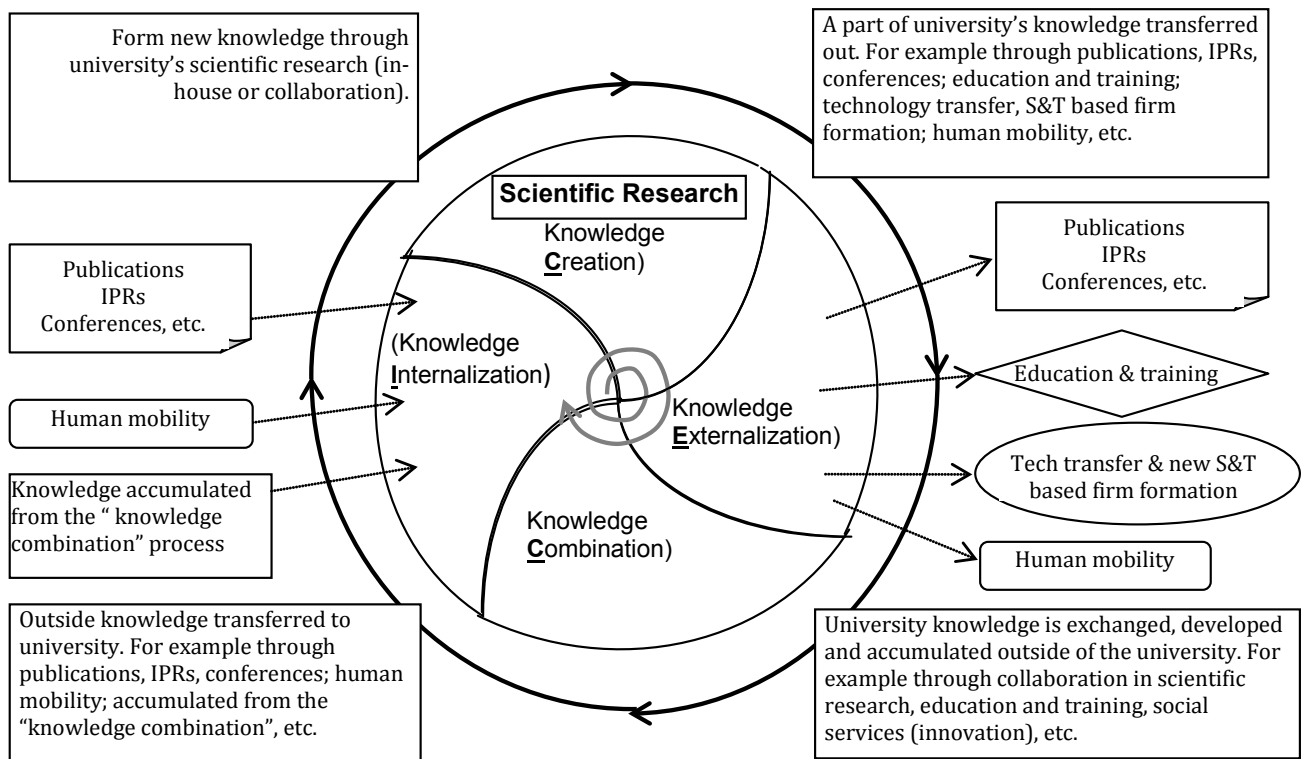


Figure 1: "Spiral of university knowledge development" Model

university patents and licensees in supporting technology transfer between universities and industry. This should mention an important law: Bayh-Dole Act (1980), examines intellectual property as a result of research funded by the US government. The law allowing the person conducting this research (and his/ her university) to file a patent application for his or her research and to retain ownership of their invention is the main driver of the economic boom in that following years.

• The "Spiral" model

Based on the concept of dynamic knowledge creation model given by Nonaka *et al.* in 2000, applied to the university context, Figure 1 simulates the process of university knowledge development at four nodes of knowledge transfer through scientific research activities of the university. The four processes (through the four nodes of knowledge transfer) are interrelated. Accordingly, knowledge flowed in the organization, transformed and developed in a spiral pattern, including: (i) **Knowledge Creation**, new knowledge created through university's scientific research (in the form of in-house or collaboration in scientific research activities); (ii) **Knowledge Externalization**, a part of the internal university knowledge transferred out through channels such as publications, intellectual property rights (IPRs), seminars/conferences; education and training; technology transfer, science and technology based firm formation; human mobility,

etc. (iii) **Knowledge Combination**, knowledge of the university is exchanged, developed and accumulated outside the university through cooperation in scientific research, training, and social service (innovation, ...); and (iv) **Knowledge Internalization**, outside knowledge transferred to university through publications, IPRs, seminars/conferences; human mobility; accumulated from the "knowledge combination" process, etc. The above mentioned knowledge transfer processes do not appear independently, but together appear in different combinations in the different operation models of the university. Through scientific research activities, internal and external collaboration of the university, the scientific research capacity developed to a new higher level in the so-called "spiral of university knowledge development".

Although the above mentioned theoretical models differ in interpretation, it can be said that most of the models emphasize the key role of scientific research which is hidden in each university as a knowledge creation, transfer and dissemination institution.

3. Conclusion

It can be concluded that enhancing scientific research activities in general and scientific research in universities as well as building research university models in particular are absolutely essential. Developing scientific research activities in universities as well as developing the research university in contemporary society is the

model that many countries and universities around the world want to have. However, to realize this desire depends upon many different factors: philosophy of national educational and scientific development; investment resources; socio-economic institutional environment; etc. Especially, the institutional environment reaches a certain level of development for the university to properly express and promote its own characteristics (academic freedom, academic autonomy, openness and highly critical spirit, etc.).

On the basis of existing resources, including those of the university itself as well as the national resources, the current institutional environment, policy makers for national scientific and educational development as well as the university itself wishing to develop scientific research in the university (towards research university and world-class university), really needs appropriate policies and steps to ensure the successful development as well as a practical contribution to the development of the nation in particular and the mankind in general.

References

- [1] Etzkowitz H. (2002). *The Transformation of University-Industry-Government Networks*. Electronic Journal of Sociology.
- [2] Gibbons M., Limoges C., Nowotny H., Schwartzman S., Scott P. and Trow M. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London, U.K.: Sage.
- [3] Reddy R (2011). "The Evolving of Universities in Economic Development: the Case of University-Industry linkages", in Göransson B. & Brundenius C. (eds.), *Universities in Transition: The Changing Role and Challenges for Academic Institutions*. Springer.
- [4] Hoang Van Tuyen & Nguyen Thi Minh Nga (2015). *Research University: some basic characteristics*. Journal of science and technology policy and management (JSTPM). Vol. 4 (2), pp. 1-12.
- [5] Kazakova N. (2001). *Innovation, universities and changing environment in modern Russia*, paper at Conference "The Future of Innovation Studies", Eindhoven University of Technology, the Netherlands, 20-23 September.
- [6] Mohrman K., Ma W. and Baker D. (2008). *The research university in transition: the emerging global model*. Higher education policy, 2008, 21, pp.5-27.
- [7] Mongkhonvanit J. (2008). *The relationship between university and industry in the knowledge economy: A case study of Thailand's automotive cluster*, PhD. Dissertation (University of Bath, School of Management).
- [8] Mowery D. & Sampat B. (2004). "Universities in National Innovation Systems," in Fagerberg J., Mowery D.C. and Nelson R.R. (eds.), *Oxford Handbook of Innovation*. Oxford, UK: Oxford University Press.
- [9] Nguyen Xuan Xanh (2014). *University: history of an idea*. Humboldt University Proceedings (in Vietnamese), pp. 33-143.
- [10] Wolfe D. (2003). "Commentary on Part I: The Evolving Research Environment," in Aldo Geuna, Ammon J. Salter and W. Edward Steinmuller (eds.), *Science and Innovation: Rethinking the Rationales for Funding and Governance*. Edward Elgar, Cheltenham, U.K.