Promoting scientific research, technological development and innovation in Vietnam's universities in the context of the Industrial Revolution 4.0

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Abstract: *Universities are among the three components of the national innovation system, serving as venues for scientific research and technological development as well as "incubators" to create human resources for scientific and technological innovation. Under the impact of the Industrial Revolution 4.0, it is an urgent task to promote science/technology and innovation activities in universities. The article presents the requirements of scientific research, technological development, and innovation for universities as well as analyzes the current situation and solutions to promote scientific and technological activities in Vietnam's universities in the context of the Industrial Revolution 4.0.*

Keywords: universities; scientific research; technological development and innovation; Industrial Revolution 4.0.

The Industrial Revolution 4.0 emerged in the 2000s with the concept of everything being connected in virtual reality. Compared to the three industrial revolutions that have taken place in human history, Industrial Revolution 4.0 narrows the gap between generating ideas and realizing social products. The Industrial Revolution 4.0 has had a strong and comprehensive impact on all aspects of social life. As a product of science and technology development, the Industrial Revolution 4.0, in turn, sets higher and more urgent requirements for the development of science and technology. In Vietnam, promoting research, the application of scientific advances, technology transfers, and innovation has become an objective requirement for the development of the country. The 13th National Congress has determined: "Promoting the research, transfer, and application of scientific and technological advances and innovation, especially the achievements of the Industrial Revolution 4.0 to enhance the role of science and technology as a key driving force of economic growth."(1)

Serving the two basic functions of training and scientific research, universities in Vietnam play a critical role in the development of science, technology, and national innovation in the current context, particularly in the two directions which will be discussed as follows. *First*, training and developing high-quality human resources including a team of scientists and technology developers in applying scientific

achievements and implementing innovation. *Second*, performing the functions of scientific research, development, and technology transfer. In particular, the quality of scientific research, technological development, and transfer, as well as innovation, determines the quality of training, which is also a decisive factor in the development of each university.

Scientific research is a creative activity to explore and discover the nature and principles of the world as well as to apply it to social processes to create material and spiritual products that satisfy the human's needs. "Technological development refers to the application of findings from fundamental research and applied research via experimental development and trial production to complete existing technology and create new technology"[2]. "Technological transfer is a process of effectively bringing technologies from a place where there is a need to transfer technology to a place where there is a need to receive technology, from a place with a higher level of technology to a place with a lower level of technology, meeting the requirements of all parties"[3]. Innovation is the activity of applying existing knowledge, on the basis of new ideas, to create new products and services to meet human and social needs. In a university, scientific research, technological development, and transfer are innovation activities (both innovation in thinking and creation of effective practices). Innovation is truly effective when it is based on the results of scientific research, technology development and transfer.

The role of scientific research, technological development, transfer, and innovation activities of a university in the context of the Industrial Revolution 4.0 is shown in various aspects.

First, there is an organic relationship between teaching and scientific research, technological development, and innovation. The Industrial Revolution 4.0 accelerates the amount of scientific knowledge. Researching science and technology helps lecturers and researchers to update new research results, as well as to supplement and develop teaching content. Besides, the Industrial Revolution 4.0 also poses a requirement to establish new approaches and research directions as well as new methods in scientific fields and areas. With the priority of basic research, the results of scientific and technological research and innovation in universities, especially research universities, will be directly applied and deployed in the training activity of the universities and enrich the scientific theoretical system of mankind.

Second, teaching activities will be carried out through different forms and methods. In particular, teaching through scientific research is one of the effective teaching methods mentioned in university teaching theory. In the context of the Industrial Revolution 4.0, teaching by the participation of students in scientific research, technological development and innovation is an inevitable trend. The philosophy of lifelong learning requires teachers and learners to constantly

improve their knowledge. The process of acquiring knowledge does not take place only at school or in a specific period. Promoting initiative, activity, and creativity in both lecturers and students is considered a determining factor of the quality of teachers and learners' activities. Scientific research activities of students and teaching through scientific research activities with the participation of students are evidence of the right direction in the development of research universities. The lecturers are acting as scientific guides, instead of one-way knowledge facilitators, associating theory with practice. ; tThey are also learning, cultivating, and developing expertise from scientific research practice, professional and technological development, and innovation. The quality of teaching and learning as well as the quality of the university's training activity can only be enhanced by promoting the capability of lecturers and students in scientific research, technological development, and innovation.

Third, the Industrial Revolution 4.0 not only creates a change in reality but also poses a requirement for innovation in thinking. The rapid alteration and fierce competition in all aspects of a country's development process require teachers and learners to have new and breakthrough thinking in creative work. The human factor in the process of national construction and development is now considered a crucial role for the success of the revolutionary cause. The new context also requires the emergence of new personality models. Those are the people who dare to think, dare to do, and aspire to change reality in a positive direction. Teachers and learners participate in scientific research, technological development, and innovation, forming and developing a scientific and effective working style. Moreover, promoting scientific research, technological development and innovation in each university also contributes to the creation of a scientific-democratic environment. This is an important condition for the development of our country at the moment.

Fourth, as a scientific agency – conducting research and experiments, applying achievements, transferring technology and implementing innovation – the results of each university's scientific activities would contribute to national scientific and technological development. The publication of research works in specialized journals, and the invention and transfer of new technologies, are meant to create sustainable development in all fields of social life. The Industrial Revolution 4.0 is gradually re-establishing the position and relationship of countries in the development process. With the function of training scientific human resources along with technological development and innovation, it is urgent to promote the role of universities in promoting scientific and technological research and innovation activities.

Aware of the new context and objective requirements of promoting research and application of scientific achievements, technology transfers and innovation

in universities in Vietnam, we have made remarkable achievements. Scientific and technological research activities at universities have been focused and promoted in recent years. The number of scientific research works in universities increases steadily every year. A number of scientific research and technological development products are published in prestigious journals. Universities have paid attention to building an open and highly connected science and technology operating environment. The process of internationalization, including the internationalization of scientific and technological activities and innovation, has been accelerated.

However, in the context of the Industrial Revolution 4.0 and its new requirements, the scientific and technological activities and innovation of universities are still limited. Despite the increase in research works, the number of high-quality research is not much enhanced. The content of the research mainly focuses on supplementing and perfecting the teaching curriculum. The results of scientific research in universities have not yet met the practical requirements. The research works have not followed and started from real life or from the nature of each field. There is a high number of scientists in universities, but the number of research works recognized at regional and international levels is inadequate. The names of Vietnamese scientists are also absent in major international research programs as well as science and technology research awards. The achievements in science, technology, and innovation that a single university has achieved are still modest compared to the scientific potential of the universities. In recent years, scientific and technological research and innovation activities have been paid more attention by university leaders and lecturers, but that attention is still insufficient to make this change substantive and effective. Training is still a priority activity, while other activities – including scientific research and technology development – revolve around the training axis of universities. The extent of promoting research, scientific application, technology transfer and innovation efficiency in universities in Vietnam has not ottenmet the level of development requirements in the context of the rapid and strong impact of the Industrial Revolution 4.0.

To promote scientific research, application, technology transfer and innovation at universities in Vietnam, it is necessary to have a full, multi-dimensional view and a new and reasonable rationale to solve problems.

First of all, it is necessary to realize that scientific research, technological development, and innovation are activities that maintain the existence of a university in the current fierce competition. Scientific and technological research and innovation ensure the quality of training, creating the university's brand. Instead of considering science and technology research as supportive for training activities, the current context requires science and technology

innovation in the university to be considered pioneering activities. Leaders and administrators of universities need to amend the position and role of scientific and technological research and innovation in the context of the Industrial Revolution 4.0, thereby building a suitable science and technology strategy in universities. The Industrial Revolution 4.0 and the integration process are creating great opportunities for the development of universities, promoting scientific research, technology and innovation. Therefore, it is necessary to make the most of the scientific and technological achievements of other countries for the development of both Vietnam's science and technology activities in general as well as promoting scientific and technological research and innovation in universities specifically.

Second, it is necessary to renovate and perfect scientific and technological management methods as well asnd enhance the operating efficiency is necessary. The role of consultation in formulating strategies for scientific and technological development and innovation and developing action plans in each period in line with the university's mission must also be implemented well. Each university needs to closely evaluate, revise, perfect and issue regulations on management of scientific research, technological development, and innovation to match the actual situation. In the current conditions, the regulations on science, technology and innovation need to be stricter. Issues on ensuring intellectual property rights for scientific and technological products and innovations need to be clearer and more transparent. It is also needed to renovate activities to evaluate the results of scientific research and technological development and innovation in a substantive direction, on the basis of scientific values and the practical significance of research works.

Third, we need to develop scientific human capital in each university. This is a decisive factor that directly determines the level of promotion of scientific and technological research and innovation activities.

It is important to build a team of professional science and technology managers to well perform the function of advising and consulting on policies, promulgating regulations and developing plans for scientific and technological activities for the university in each period.

Also, we should focus on enhancing the quantity and quality of staff who carry scientific research, technology development and innovation activities. the capacity of scientific research, technology development and innovation for research staff should be improved. The universities need to pay attention to the research capacity of lecturers right from the time of recruitment. It is also important to create conditions to promote the research capacity of the lecturers, allocating time, assigning tasks, and balancing research and teaching norms in a reasonable manner. There should be policies to attract talent and adequate remuneration for

researchers who have made great contributions to the development of science, technology, and innovation activities in the university.

Fourth, under the strong impact of the Industrial Revolution 4.0, the development of a digital technology platform is a requirement and also a condition for the process of promoting scientific and technological research and innovation. To do so, it is necessary to supplement and replace infrastructure network, computer equipment, etc., to ensure a smooth connection and to be ready to transform and upgrade the information technology infrastructure system to meet requirements. Beside investing in digital technology equipment infrastructure, it is necessary to quickly digitize data and develop a national information database to operate the network in each industry and field. It is also imperative to ensure consistency, efficiency and safety when mobilizing data to provide, look up, and exploit data. At the same time, it is required to develop and issue plans to ensure information and data security during the operation of scientific research and technological development. We also need to review and invest in laboratory systems, research facilities, and material and technical facilities for scientific research and technological development. It is needed to focus on investing in facilities and means of scientific research, developing technology with a key focus; prioritize research in the key fields and core strengths of each university.

Fifth, it is necessary to focus financial resources on promoting scientific research, technological development, and innovation in the direction of identifying core and key investments in fundamental and long-term strategy, ensuring development in a highly competitive global environment. We have to transform the mechanism of allocation, use, and financial management for science and technology activities; thoroughly overcome the current situation of "unreasonable dissemination" and "make it equal" investment funds. There should be an effective mechanism for investment cooperation to mobilize financial resources from domestic and foreign organizations and enterprises for scientific research, technological development and innovation. The grant, payment and settlement of funds must ensure financial principles and minimize unnecessary intermediaries, as well as creating maximum convenience for researchers, especially the scientific payment and settlement mechanism.

Sixth, it is essential to build and implement democratic regulations and culture in scientific and technological research and innovation activities. Democratic culture is expressed firstly in the consciousness, attitude, and responsibility of the researcher towards social and human issues. Democratic culture in science is also reflected in the spirit of freedom in creativity, positivity, initiative, and independence in thought when proposing ideas and implementing creative ideas. Moreover, the democratic culture is displayed in the relationship between the

individual with the collective and management. To do so, it is necessary to develop and promulgate democratic cultural regulations for universities' activities such as debate, scientific criticism, social criticism, etc.

Seventh, it is needed to promote cooperation and association in scientific and technological research and innovation and international integration in science, technology and innovation.

Cooperation and exchange in scientific activities is an objective requirement in the context of globalization and integration. In the process of scientific and technological development and innovation, each country inherits the scientific heritage of its own as well as absorbs the scientific and technological achievements of all mankind. This development contributes to individual development as well as to the overall development of advanced humanity.

Under the impact of the Industrial Revolution 4.0, there are scientific problems that do not belong to a sole country. Many research projects need to coordinate and mobilize countries to participate. Cooperation, linkage, and exchange in scientific research, technology and innovation among countries not only increases scientific resources for each university and country but also shares results on a large scale of beneficiaries, and thus enhances social value. To escalate international exchange and cooperation in scientific research and technology transfer, it is necessary to improve the quality of research activities. The university should take advantage of all opportunities to attract international experts to support training in the fields in which we still have limitations. At the same time, we need to promote participation in the international scientific human resource training activities. In the current context, each university needs to renovate its thinking on international integration in scientific and technological research and innovation, along with enhancing its initiative in the integration process. The process of research cooperation and international integration in the fields of science, technology and innovation of universities must take efficiency as a measure, avoiding ostentatiousness and formality./.

(1) Communist Party of Vietnam (2021), *Document of the 13th National Congress*, National Political Publishing House, p.46.

(2) Phan Xuân Dũng (2017), *Technology and technology transfer*, Science and Technology Publishing House, p.16.

(3) Đỗ Công Tuấn (1999), *General Science*, National Political Publishing House, p.172.