

The Constant Theme of Scientific Research for Universities : Knowledge Innovation

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Universities are cradles of talent cultivation and important bases of the production and transmission of new knowledge and new ideas. Universities have two central tasks. One is to cultivate talent; the other is to produce new knowledge. The former can be achieved by teaching while the latter can be fulfilled by scientific research. They are the basis of high-quality talent cultivation. From the perspective of the basic elements of knowledge innovation, universities are the main force of knowledge innovation. Abundant human resources, a wide range of disciplines, a lively academic atmosphere of active, a fast stream of knowledge and talents are their advantages in knowledge innovation that academic institutes and enterprises can never have. These advantages allow universities to enjoy their important status in the national knowledge innovation system and in national economic development.

Statistics shows that two-thirds of the original high-level papers published in Nature and Science belong to universities, and three-quarters of the Nobel Prizes have been awarded to universities. Additionally, Laurence's H-bomb fusion technology research at the University of California, Von Neumann's stored program assumption and research on computer theory in Princeton University, the research on electronic countermeasure at Harvard University, the synthesis of penicillin at the Massachusetts Institute of Technology, and the electronic publishing system using precision laser phototypesetting developed by Wangxuan of our country are of epoch-making significance for the development of human society and the progress of science and technology. Obviously, universities are the main force of national fundamental research, the main source of original innovation and of high and new technology development, and the place where great scientific and technological achievements originate. Therefore, knowledge innovation should be the constant theme of scientific research in universities.

The main campus of our university is situated in Qingdao, Shandong Province. Its

name "Science & Technology" says it all. It clearly says that we should attach ever more importance to the foremost task of scientific research and so continue to achieve knowledge and technology innovation through that scientific research. With years of endeavor, our university has become the cradle of high and new technology talent and the base for the production of new knowledge and new technology in Shandong Province.

The achievements in scientific research of our university can be seen from the National Ranking of University Scientific and Technological Activities in 2002, publicized by the Ministry of Education, which involved 1071 universities. According to the Ranking, the number of appraised achievements of our university ranked 35 among the 1071 universities; the number of awards for scientific achievements ranked 39; the amount of scientific research funds ranked 82; the income from technology transfer in that year ranked 52 and the number of scientific papers published both domestically and abroad ranked 35. Overall, our university is ranked among the nation's top 100 universities.

Research comprises both scientific research and technological research. Scientific research refers to fundamental theoretical research and technological research refers to applied research, which produce original creative achievements and technological innovation achievements respectively. Scientific research and technological research are equally important with the former being the inexhaustible motive and source for the latter. When our country carried out the two great projects of Knowledge Innovation and Technology Innovation, it had specific aims. Knowledge Innovation involved establishing some world-famous knowledge innovation bases (such as research institutions, research centers and research-oriented universities) while Technology Innovation involved setting up large-scale enterprises with independent R&D abilities. As former Vice Premier Li Lanqing pointed out in 2000 during the National Conference of University Technology Innovation, universities should realize that technology innovation and High & New technology industrialization are the result of an urgent demand from developments in the current domestic and international situation, and universities should shoulder their heavy historical responsibility with a high sense of crisis, urgency and responsibility. He added that universities should take concrete and effective measures and strive to innovate in technology, transfer scientific and technological achievements and industrialize High & New technology, while intensifying strategic and fundamental researches. Therefore, it is of primary importance for universities to do well in both strategic and in fundamental research.

As for how to practice knowledge innovation, I have several thoughts, set out in the

following six aspects, which are based on the current situation of our university and my years of scientific research.

Firstly, scientific research in universities should take discipline as its support. Three requirements must be fulfilled to do scientific research well. They are full-time scientific research teams, stable research directions and established experimental facilities, which are three cores of discipline construction. Experience has proved that full-time scientific research teams are the fundamental requirement that ensures the standard of research and the quality of outcomes; that stable research directions are the necessary requirement for making key research achievements which may involve ten years or more of successive research; and that established experimental facilities are basic requirements for research. Thus, discipline construction is regarded as the central task of all universities, and discipline development and planning as the most important among all development plans in universities. During discipline development and construction, great achievements will be made. Discipline intersection will be accompanied by the establishment of specialized labs, research institutes, research academies and engineering technology centers etc., and the mode of Industry - University - Research will be formed step by step. It is these various institutes mentioned above that take on the key research projects and are able to make great scientific achievements because they are composed of high-level scientific researchers from universities. In order to arouse the enthusiasm of the teaching staff and scientific researchers, gather collective strengths, promote discipline intersection and integration, upgrade the level of scientific research and innovation comprehensively, universities should encourage the establishment of various and dynamic horizontally linked scientific research institutions, such as scientific research centers, research institutes, project groups etc., based on the vertical academic organizations of university, school and department, and set about organizing and integrating the scientific resources within the disciplinary group and creating linkage advantages to reinforce the original innovative abilities.

Secondly, as for discipline construction, key disciplines should play the leading role in promoting surrounding development of other disciplines. Key discipline construction can be divided into specially supported disciplines (promising and emerging disciplines) and key constructed disciplines (characteristic disciplines and superior disciplines). To be the latter is the aim of the former and the springboard to keep universities vigorous in their development. As an engineering-focused and multi-disciplinary comprehensive university, through years of discipline construction and development, our university now has 8 provincial and ministerial key disciplines and labs, two specially supported

disciplines, 4 key intensified disciplines and labs under the provincial 10th Five-year Plan period, and 6 engineering technology research centers at the provincial level.

Thirdly, key discipline construction should be guided by stable research directions, and make research team construction its core and lab construction its basis. The aim is to create a favorable environment in which excellent researchers can rise to prominence and great achievements can blossom. In research directions, our university emphasizes emerging science and has been engaged in the National High Technology Research and Development Program (863 Program) and the National Foundation Research and Development Program (973 Program) in the following strategic and high-tech fields of: information technology, robotics, advanced manufacturing and automation, ocean, super-conducting etc. In addition, our university has also involved itself in many programs of the National Natural Science Foundation and the National Key Research Project of Science and Technology. Our efforts have been rewarded with great achievements: more than 100 prizes on the national, ministerial and provincial level and many national patents, including the National Invention Prize and the National Prize for Progress in Science and Technology. In lab construction, we should strengthen the ties between the construction of infrastructure, the technology and the researchers. Early in 1999, our university broke away from traditional concepts and ideas of education and initiated the Project of Strengthening the Construction of Key Disciplines and Labs with a fund of 38 000 000 RMB, which has greatly accelerated the development of the construction of key disciplines and labs of our university. Further funding and high-level intensified construction in some research directions have laid a solid foundation for upgrading the standards and ranking of our scientific research.

Fourthly, scientific research needs a full time research team, which is necessary to ensure the level of research and the quality of achievements. Scientific research and innovation is a long, complex and laborious task. It requires both mental and physical work and the achievements may be unforeseeable as often as they are foreseeable. We should organize our professional R&D staff and continue to adjust our policies on the basis of obeying the laws of scientific innovation and respecting the hard work of scientific researchers. Only in this way can potential and outstanding researchers concentrate on a stable research direction for long time study, accumulate the abundant knowledge that leads to success and finally make original scientific discoveries and achievements of great importance.

Fifthly, fundamental theories should be given great attention and support in the current situation. Scientific achievements and discoveries are not castles in the air. Each depends on a well-integrated scientific system. Research effort on fundamental

theories, to some degree, reflects a nation's scientific and technological level, which should not be neglected, but on the contrary, should be reinforced. Our university has correspondingly made it our policy to support and develop the study of fundamental theory. In addition, we value extensive academic exchange and cooperation with other universities, research institutes and scholars, both domestic and abroad, because this proves to be very effective in improving fundamental theoretical research.

Sixthly, scientific research should not allow market forces to be its only guiding ideology. Similarly, technological study should not allow the finished product to be the only requirement. The transfer of scientific achievement urgently needs the establishment of scientific intermediaries to bridge the gap between universities and enterprises and to familiarize the entrepreneurs with the professors' achievements and realize the transfer of scientific achievements through these entrepreneurs' operations. The government has a part to play to make laws and policies to protect the intellectual property rights attached to these achievements and the rights of the universities in the process of scientific achievement transfer through enterprises. The reasoning behind this is the generally acknowledged fact that any scientific achievement transfer will involve risks and even excellent achievements may not necessarily result in complete success. In view of this fact, the risk should be taken jointly by the enterprises and the researchers. Only in this way can scientific researchers' concerns be minimized in the transfer process. Consequently, the integration of Industry - University - Research will be speeded up. On the whole, achievement transfer should not be listed as one of the main tasks of scientific research in universities due to the external factors that circumscribe it in many ways. To be practical and realistic, this does not conform to the current situation and the prime tasks of universities at present.

In the new century, scientific technology is developing rapidly across the globe. As the core of the national innovation system and the most important base of knowledge innovation, universities should not only strengthen their scientific research, but also value the development of discipline intersection. Universities should also strive to promote discipline integration through discipline intersection to make great scientific achievements. Consequently, talent with an innovative spirit and practical ability can be cultivated and independent R & D abilities can be intensified, which will contribute to the knowledge innovation, scientific achievement transfer and the enhancement of comprehensive national strength.