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Talent Training of Information and Communication Engineering Postgraduates by Innovative Achievements

Zhendong Yin [1], Zhilu Wu[1,*], Dasen Li[1] and Chengyu Hou[1]

[1]School of Electronics and Information Engineering, Harbin Institute of Technology, Harbin 150006, China
[*]Corresponding author. Email: wuzhilu@hit.edu.cn

ABSTRACT
The discipline of information and communication engineering has the characteristics of rapid updating of knowledge system, wide range of scientific research directions, the rapid development of cutting-edge topics and high requirements for innovation ability. It is the forefront of competition in the field of science and technology of major countries in the contemporary world, as well as the strategic, basic and leading discipline supporting economic and social development and ensuring national security. It is also the most impacted discipline and more "neck sticking" technologies as our country changes in the international situation. In this paper, in order to meet the needs of cultivating innovative talents for postgraduates of information and communication engineering, we construct a teaching system including educational concept, curriculum system, teaching mode and teaching materials which are guided by high-level innovation. In recent years, practice has proved that the teaching system can effectively improve the quality of innovative talent training, as well as the innovation ability and achievement level of postgraduates.
Keywords: *Innovative achievements, Information and Communication Engineering, innovative personnel training, teaching system, teaching practice*

1. INTRODUCTION

At present, the competition between countries is more reflected in the competition of talent training quality. As we know, the quality of talents training is fundamental for universities and the information age provokes an urgent need for a large number of high-level innovative talents [1]. The core set of indicators index of talent training quality is innovation ability. People who lack innovation ability cannot be regarded as high-quality talents. The cultivation of scientific research innovation ability is the core task of innovative talents training in Colleges and universities. Aim at this reason, universities devote to cultivating innovative talents and several evaluation methods are proposed [2], such as fuzzy algorithm and Sum-product method [3]. Many advanced design methods over the single subject are applied to traditional teaching, such as project teaching method [4], network teaching method [5], instead of textbooks knowledge.

Compared with other traditional disciplines, the discipline of information and communication engineering has the characteristics of difficult to learn and understand basic theory, rapid updating of knowledge system, wide range of scientific research directions, rapid development of frontier subjects and high requirements for innovation ability. It not only contains a lot of basic subject knowledge, but also covers many advanced technologies, such as IOT, FPGA, PLC, and students are required to master some software tools such as MATLAB [6] and Python.

In conclusion, despite some difficulties, it is important to cultivate innovative talents for Postgraduates of information and Communication Engineering. In order to provide talents to the country, we put forward the educational concept of "To cultivate people with moral integrity and student-centred as the purpose, innovative achievements as the guidance, consolidate the theoretical foundation, cultivate innovation ability, and strengthen scientific research practice". We take the cultivation of systematic thinking, creative thinking, practical ability, team cooperation ability and knowledge accumulation required by discipline innovative talents as the goal, and use high-level innovative achievements leading it. Then we construct the teaching system of innovative talents training on the discipline of information and communication engineering.

2. PROBLEMS AND METHODOLOGY

2.1. Problems in Innovative Talents Training

The teaching system includes educational concept, curriculum system, teaching mode, scientific and technological innovation activities, teaching materials and teaching quality assurance system. The training system has been widely practiced in the discipline of information and communication engineering in Harbin Institute of

technology. So far, it has benefited more than 2000 undergraduate students in five sessions. Compared with the past, students have made great progress in obtaining high-level papers, discipline competitions, invention patents and other innovative achievements. Students have gained rich and solid theoretical knowledge accumulation, enhanced their interest in autonomous learning, and cultivated innovative thinking, innovative consciousness, scientific research and innovation ability, engineering practice ability and team cooperation ability. The main teaching problems solved by this innovative talent training system:

- The traditional teaching system cannot meet the positioning and needs of innovative talents training. It is clear that the education of innovative talents in information and communication engineering should pay attention to five aspects of quality: systematic thinking, creative thinking, practical ability, team cooperation ability and knowledge accumulation.
- In the traditional teaching system of information and communication engineering, the education of innovative theory and method is insufficient, the students' systematic thinking and creative thinking ability are not strong, the innovation consciousness is not active, and the ability to find valuable scientific and technological innovation clues is weak, which cannot adapt to the characteristics of wide cross scientific research direction, rapid development of frontier topics and high requirements for innovation ability.
- The basic theory course of information and communication engineering is difficult to learn and understand, the knowledge system is updated rapidly, and the students' learning effect is poor, which leads to the weak theoretical foundation and the lack of solid knowledge accumulation to obtain high-level innovative achievements.
- The traditional teaching activities and research platform have no obvious contribution to the cultivation of students' innovative achievements, lack of open and flexible self-learning, team cooperation technology innovation environment, atmosphere and practice platform, students' scientific research innovation practice and team cooperation ability are not strong, lack of high-level innovation achievements of concise ability and construction experience.

2.2. Solutions to the Problems

The method is to optimize the training program, curriculum system and knowledge content. Leading by the cultivation of innovative achievements, the research institute has constructed a multi-level, multi-objective and whole process innovation ability training curriculum system and training scheme, optimized the teaching content of theoretical curriculum system, and constructed a series of multi-level innovative practice courses: 30 undergraduate project learning, innovative research and innovation practice courses, 14 master's innovative practice courses, so as to make the teaching system meet the disciplines The orientation and demand of innovative talents training; the introduction of innovative methodology teaching and academic moral education in curriculum teaching has improved students' systematic thinking, creative thinking and the ability to find valuable scientific and technological innovation clues.

2.2.1. New Teaching Mode

we put forward the mode "network-based interactive research efficient classroom integration theory course learning mode". In the classroom teaching, heuristic interactive discussion is fully introduced, passive learning is changed into active thinking, and interactive discussion among students on the network platform based on Feynman learning method are carried out, which significantly improves the learning effect, solves the problem of difficult to learn and understand the basic theory of the discipline, at last consolidates the knowledge accumulation that students should have to obtain innovative achievements.

2.2.2. Practice

Reform the practice learning mode, abandon the old and fixed practice content, and put forward the "independent topic selection, interactive research, teamwork based on STIPBL (Science & Technology Innovation Problem based Learning) and practical learning mode, including six learning steps as "innovative methodology and academic moral education → independent topic selection → topic demonstration → team cooperation → interactive discussion → condensation of innovation achievements". Through the innovation achievements such as the cultivation of high-level academic papers, patents, competitions, and the mechanism of achievements condensation, students can complete the construction of innovative achievements according to the instruction, and effectively improve the students' scientific research practice, team cooperation ability and experience in the condensation and construction of innovative achievements. In the six levels of teaching steps, each step introduces different teaching methods according to its own characteristics and needs. The details are as follows:

- In the stage of classroom theory teaching, innovative methodology education is introduced to inspire students' systematic thinking, creative thinking and innovative consciousness through case teaching method and TRIZ innovation method analysis.
- In the stage of independent topic selection, students actively think and find valuable scientific and technological innovation problems through literature

research and scientific and technological novelty retrieval.

- In the stage of project demonstration, brainstorming teaching method is used to demonstrate the innovation value, innovation points, research scheme, technical route and expected results of the project. All teachers and students equally express their opinions through brainstorming, and finally determine reasonable research plans and valuable scientific issues for research.
- In the research stage of team cooperation, the members of each research team work on the key problems through close cooperation according to the PBL mode. When the research encounters difficulties and the course group cannot solve them, the expert consultation is started to assist in tackling key problems, and experts and professors or senior doctoral students in related research fields are invited to consult the subject to help solve the problems encountered in the research.
- The course group will hold regular interactive discussions in the stage of scientific research practice and achievement cultivation, analyse and demonstrate the research and innovation achievements of the project in the form of academic meeting or brainstorming.
- After the project research is completed, leading the students to complete the final construction of scientific research and innovation achievements through the guidance of the high-level scientific research paper, the high-level patent, the science and technology competition guidance.

2.2.3. Teaching Platform

Relying on the achievements of discipline construction, we should build a multi-level innovative practice teaching platform. Relying on the achievements of discipline construction and school enterprise cooperation projects, we have built more than 10 innovation practice teaching platforms, developed 3 student science and technology innovation societies, established 4 IEEE academic sub associations, hosted and hosted 10 important international conferences, created a high-level innovation practice environment and platform, improved students' scientific research practice and team cooperation ability, adapted to the interdisciplinary scientific research direction, and developed rapidly in frontier subjects The characteristics of high demand for innovation ability.

2.2.4. Textbook Updated

According to the needs of teaching content reform, the construction of teaching materials should be updated. The teaching concept, scientific research achievements and innovative methods are written into the teaching materials, which provides knowledge carrier for the implementation of innovative and research-oriented teaching, makes the teaching materials and teaching contents not only pay attention to the discipline foundation, but also takes into account the frontier development, so as to enhance the students' knowledge accumulation and adapt to the rapid development of the subject knowledge system.

2.2.5. Teaching Quality Assurance System

Establish and improve the teaching quality guarantee mechanism. We will implement the project of improving teachers' teaching ability, training young teachers and cultivating teaching achievements, the incentive mechanism for students' innovative achievements. It will fully mobilize the enthusiasm of both teachers and students to provide high-quality teachers for the implementation of innovative talent training.

2.3. Our Contributions

- A new top-level framework of the teaching system is created, which is oriented to all the undergraduate students of information and communication engineering discipline and strengthens the cultivation of innovation ability through the whole teaching process. It is revealed that the education of innovative talents in this discipline should pay attention to five qualities: systematic thinking, creative thinking, practical ability, team cooperation ability and knowledge accumulation. A multi-level, multi-objective and whole process innovation ability training curriculum system and training scheme from freshman entrance education to graduate thesis guidance was constructed. The theoretical course of teaching content and teaching material construction were optimized. A series of multi-level innovative practice courses for all grades of undergraduate students were constructed. The cultivation of innovation ability was integrated into classroom teaching, practical teaching and scientific and technological innovation Objective learning and other teaching links, multi link interactive parallel, forming a joint force, teaching effect is remarkable.
- We put forward the "independent topic interactive research team cooperation type STIPBL practice learning mode" for innovation practice courses and scientific and technological innovation projects. It takes the cultivation of innovation achievements as the goal, takes the independent topic selection team cooperation research as the main contents. The content of study and research is set as engineering practice or cutting-edge scientific and technological issues. The introduction of innovative methodology and academic moral education in the teaching of innovative practice courses and guidance of scientific and technological innovation has improved students' innovative thinking and awareness, then cultivated innovative practical ability, team spirit, dedication spirit and academic morality.

- We propose the mode of "network-based interactive research efficient classroom integration theory course learning mode" for the discipline basic theory course. It introduces the heuristic interactive discussion teaching method in the classroom teaching, changes the passive learning into active thinking, and carries out the self-directed interactive discussion and question answering among students based on Feynman learning method, and realizes the whole staff of difficult problems Thinking and benefiting the whole staff greatly improves the learning effect, cultivates the excellent moral character of helping each other, consolidates the theoretical foundation, enriches the knowledge accumulation, and lays a good foundation for the achievement of innovative achievements.
- In the process of innovation practice course teaching and students' scientific and technological innovation guidance, innovation achievements condensation mechanism is constructed. In view of different innovative achievements such as high-level discipline competitions, academic papers and invention patents, we adopt appropriate cultivation methods to refine and construct them, continuously obtain innovative achievements and cultivate innovative talents. Students' scientific research and innovation ability, practical ability and experience in condensing and constructing innovative achievements have been greatly improved, and a large number of high-level innovative achievements have been cultivated.

3. RESULT AND EFFECT

3.1. Students Cultivate

The effect of talent training is remarkable, and the innovation ability of students is enhanced. Over the past four years, students' innovation ability and innovation achievements have been greatly improved in all aspects of innovation courses and science and technology innovation project learning. The participation rate of students in scientific and technological innovation projects and innovative practice courses was 100%. In the domestic and international high-level discipline competition and Innovation Experiment Program projects, our discipline students have won 166 awards, including 45 national and international awards and 104 provincial and ministerial level awards. As chief engineer and core members, undergraduates of our college are responsible for the development of the first micro nanosatellite "lilac-2" independently developed and successfully launched by the student team; in the National University biological network design competition sponsored by the Ministry of education, our student team won the only grand prize (Ti Cup) in 2014 and 2017. He directed students to publish more than 400 SCI retrieval papers, including 5 highly cited papers on ESI, and authorized to accept more than 400 invention patents. Undergraduate and postgraduates have been widely praised by employers.

3.2. Social Reputation

The social reputation has been significantly improved, and the influence of disciplines has been significantly enhanced. To response policy the "one belt, one road" initiative, we have held three sessions of China Uzbekistan science and Technology Forum, as well as high-level international conferences for 10 times. We have formed 4 famous international academic organizations IEEE sub Association. The assessment result of the fourth round of the discipline assessment by the Ministry of education was excellent (tied for the seventh place).

3.3. Research Achievement

The research achievement is well received and the practical experience is promoted. The results have been highly praised by peer experts, and 39 teaching research papers have been published. Among them, the CSSCI source journal papers have been cited for 19 times, including the citation and positive evaluation of teaching papers by scholars from seven "Double-First Class (discipline)" construction universities, such as Renmin University of China and Jilin University. We made a special report at the important teaching conferences such as the National Graduate School Engineering Graduate Education Seminar, and the paper achievements won three national and provincial excellent thesis achievement awards. Eight universities such as Beijing University of Posts and Telecommunications, Dalian University of Technology, gave high evaluation on the achievements and considered that the educational concept and teaching system of the achievements are of great significance to the teaching and talent cultivation of this discipline and other related disciplines The teaching method and experience of this achievement are introduced into its teaching system.

3.4. Construction of Teaching Staff

The construction of teaching staff has achieved remarkable results and teaching resources have been expanded rapidly. Around the implementation of innovative talent training, the team teachers undertook 33 teaching reform projects above the provincial and ministerial level, and published 16 textbooks, including 13 national key books (7 provincial and ministerial planning textbooks). The teachers in the team have got more than 40 teaching and research awards and honorary titles at or above the provincial and ministerial level, such as the national excellent online open course, the Innovation Education Award of China Association of higher education, the winner of the National Outstanding Youth Science Fund, and the Baogang excellent teacher award. 15 well-known

overseas experts and scholars such as Alexander Denisov, academician of the Ukrainian Academy of Sciences, have been introduced. We build 12 international high-level courses, and more than 10 teaching platforms and practice bases, such as national engineering practice education centre and collaborative innovation centre.

4. CONCLUSION

To sum up, the teaching system of innovative talents training on information and communication engineering is closely related to the teaching objectives of cultivating innovative talents and innovative achievements. It is innovated from the aspects of teaching philosophy, teaching methods, teaching process, teaching links, teaching contents, and so on. Guided by high-level innovative achievements, the innovative methodology education, scientific research innovation topic selection and innovation are carried out the introduction of new achievements and other links into the teaching system can comprehensively cultivate students' scientific research and innovation literacy in five aspects: systematic thinking, creative thinking, practical ability, team cooperation ability and knowledge accumulation. The teaching practice has proved that: this teaching system can greatly improve the innovation ability of graduate students in information and communication engineering discipline, guide them to obtain scientific research and innovation achievements through research, at last become the innovative talents. It solves the problem of insufficient construction of teaching staff caused by the serious disconnection between traditional teaching and scientific research, which is worth promoting at the same time.

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