Practices and Explorations on Introducing New Scientific Research Achievements into Electromagnetics Teaching for Undergraduates

Jing Liu, Jun Zhang, and Hanwu Yang
College of Optoelectronic Science and Engineering
National University of Defense Technology, Changsha 410073, China

Abstract — In accordance with the “Outline of China’s National Plan for Medium and Long-term Education Reform and Development (2010–2020)”, the raising of education quality is appointed at the heart of task for the present Chinese higher education reform and development. Furthermore, the fostering of young talents or professionals shall command a central position in college work, and no effect shall be spared to produce high-caliber professionals and top-notch innovators with steadfast faith, more integrity, rich knowledge, and superb abilities. Consequently, course teaching, as the most important activity in university, has become the top concerned and hot discussed subject. Actually, since from the beginning of the 20th century, many educational experts and scholars has suggested to introduce the latest scientific research achievement into undergraduate teaching, and then putted it into practice. This paper analyses and sums up these practices coming from some famous Chinese universities, and integrates with our own in the National University of Defense and Technology, during the past nearly 10 years. Based on these, several good ideas and reliable approaches are discussed and concluded, which we think are useful to effectively improve student’s research ability and creative thinking in the courses such as electromagnetic, electromagnetic field and wave, and electrodynamics for undergraduates. At last, some special impediments and outstanding problems are addressed with the expectation to have a deeper discussion with international colleagues.
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Liu Jing
College of Opto-electric Science and Engineering
National University of Defense Technology

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Outlines

- Background
- Practices and Explorations
- Difficulties
- Strategies
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The raising of education quality is appointed at the heart of task for the present Chinese higher education reform and development.

The fostering of young talents or professionals shall command a central position in college work.

- high-caliber professionals
- top-notch innovators
  - steadfast faith
  - more integrity
  - rich knowledge
  - superb abilities

Universities involved in the educational reform
Bilingual education

Computer-aided instruction

Introducing the latest scientific research achievements

Elementary physics curriculums have always been considered the first choice of pilot courses
The basic status of physics and electromagnetic phenomena is one of important subjects and concepts.

There are so much abstract knowledge and experimental content that it is very difficult for students to learn.

Promote students' learning effect through the teaching reform!
Outlines

✓ Background

◆ Practices and Explorations

◆ Difficulties

◆ Strategies
The close connection between the electromagnetic theory to these technologies

- Microwave engineering
- Antenna engineering
- Wave propagation and scattering
- Electromagnetic exploration
- Microwave remote sensing
- Micro-nano electronics
- Vacuum electronics
- Microwave electronics and optics

New scientific results easily put important influence on teaching!
1. textbook revision

Sun yat-sen university that was chosen as the first domestic electrodynamics national fine course, rewritten the electromagnetic properties of superconductors in the new third edition teaching material of electrodynamics
Domestic electrodynamics national fine course

Electrodynamics by Sun Yat-sen university
Tsinghua university: Modern physics and the physical basis of new and high technology

Focuses on the foundation and as far as possible to show the frontier work

- Atomic molecular nuclear
- Particle physics
- The general relativity and chaos
- State physics and new materials
- Modern optics and information processing
- New energy
2. redesign the experiments and practice programs

- Let the students near to the real and present scientific researches.

The undergraduate students' academic achievements in quality and quantity are demonstrated by the students' published academic papers.
3. establish a course online learning platform

http://jpkc.nudt.edu.cn/
Outlines

✓ Background
✓ Practices and Explorations
✧ Difficulties
✧ Strategies
1. How to solve the contradiction between the increased new content and limited hours

- The textbook, website content and the practice in the experimental, all need students to occupy their spare time to carry out

- It failed to solve the existing difficulty that integrating the lessons with scientific research in class
1. How to solve the contradiction between the increased **new content** and limited hours

2. How to solve the contradiction between the **new materials** and the textbook exiting knowledge

- relativity
- variability
- exploratory
- maturity
- logicality
- systematicness

- Students’ scientific discernment
- more difficult to ensure that students are able to correctly understand the new problem
Outlines

✓ Background
✓ Practices and Explorations
✓ Difficulties
◆ Strategies
the innovation of teaching method

- to cultivate the scientific literacy and scientific spirit of students and to stimulate the interest in scientific exploration of students
- during the class and within the limited hours

1. discussion-based teaching

- transfer the new thoughts, new ideas, new methods and novel application coming with new scientific research achievements to the learning materials
- unify the process of learning knowledge and applying knowledge with the process of thinking the research behavior coming out with new achievements repeatedly
2. redesign the classroom examples and exercises after class

- pay attention on the raise of ability to analyzing the problem and solving the problem in the real scientific research
- add some open questions for thinking, which focus on the capability of digesting the knowledge and the build of scientific thinking as well as the scientific values

3. course knowledge and concept map summary be worked out by the students

- provide a rich learning feedback to teachers
- the threshold concepts from the point of students
Thanks for your attention

Email: ljofnudt@163.com