

# **New Structure in High School Curriculum in China: Case of Physics**

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## Background

In order to better respond to the socioeconomic changes, China has carried out a series of education reforms, among which curriculum innovations draw great attention worldwide and plays a significant role in educating 230 million primary and secondary school students.

From 2000, on the basis of experiment in some regions, China has made a lot of endeavors for curriculum reform preparation and implementation. China studied curriculum/learning standards in over 30 countries including those in the USA. Renewing the educational notions and ideas including personal growth, improving the design and implementation of teaching and curriculum with the personal growth and the spirit of new era, China's Ministry of Education (MOE) developed and issued the Guidelines for the Curriculum Reform of Basic Education in 2001. Learners' needs as well as the expectations of parents and community were taken care of. After consulting 1200 education, psychology, subject experts and teachers, MOE organized a new circle of design and development of curricula for K-12 education. The new curricula consist national curricula, provincial curricula and school curricula.

The MOE developed national curriculum standards, including all core curricular areas, namely Chinese, math, foreign languages (English as well as Russian, Japanese, French), moral education for grade 1-12, primary science (grade 3-6), integral science (grade 7-9), physics(grade 8-12), chemistry(grade 9-12), biology(grade9-12), history (grade 7-11),geography (7-11). The MOE sets guidance for provincial level curricula designing, yet does not interfere in its autonomy. Likely, each school may set its own school based curriculum. According to teaching hours, national curricula consist of 80%, provincial curricula consists 15% and school curriculum consists 5%.

With permission from MOE, one can edit textbooks according to national curricula. Before selling to school district, the textbooks have to be sent to MOE and got approved by the National School Textbook Examination Commission. So far, there are about 10 sets of textbooks being used in the country. Besides, some publishing houses may just produce two or three kinds of textbooks and are of less influence. Similarly, each province may organize and examine textbooks according to provincial curriculum. But if the textbooks go beyond the province boundary, they have to apply for approval from MOE. A school curriculum is not encouraged to have textbook, instead, various activities could be conducted along with it.

In 2001, over 550 counties started to pilot the new curricula during their

compulsory education period, usually beginning from grade 1 and grade 7. By the year 2005, all primary and middle schools in all counties in the whole country's 33 provinces, municipalities and autonomous regions have carried out the new curricula. In 2004, 4 provinces began to pilot the new curricula at their high schools. In 2006 altogether 10 provinces carried out the new high school curricula. Before the year 2008, most of provinces are advised to conduct the new high school curricula.

In primary school period, science standard consist simple or basic daily scientific phenomena, hands-on ability training, observation of natural environment and life skills. There is integral science subject at primary school period.

In middle school period, there are integral science and independent subjects. At the same time there is another track, which offers science related subjects. If a middle school offers integral science, it does not need to offer physics, chemistry, biology, vice versa.

At high school level, there is no subject called science. Rather, physics, chemistry and biology are taught respectively nationwide.

This paper introduces the new structure employing in the new curriculum in the new round Curriculum Reform. The table in this paper shows the learning areas, subject matter and modules in the new structure. And the illustrations aim at explicating Physics course structure and the integration of the different modules to educate students.

In the new round curriculum reform for the basic education, the documentation, Standards for the Subject of Physics in High schools, has been issued in April 2004 and it has been piloted as test documentation in the practice. We have to get knowledge on the physics course structure for the high schools followed by the cognition on the new structure for the new curriculum.

## **1 Learning Area: New Structure for the New Curriculum**

The reform of the New Curriculum for the high schools integrates on learning areas, the subject matter and modules, making an attempt to have the feature of varieties and selectivity, aiming at constructing the basic and flexible structures for each course. Table 1 shows the learning areas for Language and Literature, Math, Humanities and Society, Sciences, Technology, Art, Physical Education and Health and Comprehensive Practice Activities in the non-key senior middle schools. The Learning area contains the several subject matters, and each subject matter contains several modules, thus, the modules are the most basic units for the contents of the subject matter.

The establishment of the Learning Area can reflect the integration of the modern sciences, and takes advantages on setting up the subject matter, designing the standard for each subject matter, and tutoring the teachers' teaching; makes the benefit on designing the course contents wholly, improving students' quality, and making the requirements on students' development roundly. Meanwhile, the establishment of the Learning Area can make students get the credits in all contents of the Learning Area in

each semester, prevent students only good at certain subjects, and it reduce the overlap of the subjects' contents.

The Learning Area is constructed by some curriculums which have the similar value. The Learning Area covers some subjects: Chinese, math, foreign language, (including English, Japanese, Russia and so on), the moral education, history, geography, physics, chemistry, biology, arts (either music or fine art), PE and health, the information technology and applied technology. The standard of each subject covered by the Learning Area and the credits have been required in the national level intended to guarantee students' standing on the same basis.

Each subject is consisted of several modules. Each module has its own separate structure which constructs the learning unit, the modules are related in logic. Each module has its own educational goals and centers around the certain contents.<sup>1</sup>

**Table 1 Course Structure for High school**

Learning Area	Subjects (required credits)	Modules
Language and Literature	Chinese (10)	required: Chinese1, Chinese2, Chinese3, Chinese4, Chinese5, (Reading and perception, expression and communication) optional: poetry and essays, novels and plays, news and biography, application of language, Literature Readings
	Foreign Language (10)	required: English1, English2, English3, English4, English5 optional: courses in sequence (6 modules), optional (3 modules: language knowledge and skills, application of language, appreciative courses)
Math	Math (10)	required: math1, math2, math3, math4, math5 optional: series1 (2 modules), series2 (3 modules), series3 (6 modules), series 4 (10 modules)
Humanities and the society	Politics (8)	
	History (6)	required: history 1, history 2, history 3 optional: Reforms in history, Democracy and its practice in modern society, war and peace in 20 century, Big guys in history, Exploring the mystery in history, World Legacies
	Geography (6)	required: geography1, geography2, geography3 optional: space and earth, ocean geography, traveling geography, city-town planning, national calamity and its prevention, environmental protection, geographic information technology

<sup>1</sup> Department of Basic Education & Department of Normal Schools, Ministry of Education, Research Manual for the New Curriculum for High schools: Curriculum Schemes-formation and Guidance for Students' Selection, High Education Press, 2004.

Science	physics (6)	required: physics 1,physics 2 optional: Series1 (2 modules), Series 2 (3 modules), Series 3 (5 modules)
	Chemistry (6)	required: chemistry 1, chemistry 2 optional: chemistry and the daily life, chemistry and technology, material structure and nature, principles of chemical reactions, organic chemistry, experimental chemistry
	Biology (6)	required: biology 1 (molecule and cell) , biology 2 (genetics and evolution)、biology 3 (stable state and environment) optional: optional 1 (the application of biological technology), optional 2 (biological science and the society), optional 3 (biological technologies in contemporary times)
Technology	Commonly-used technologies (4)	required: technology and design 1, technology and design2 optional : electronic control , robot-making , the modern technologies for agriculture, domestic science and technology, car-drivers and maintenance, architecture and design, clothes and design
	Information technology (4)	required: foundations to information technology optional: algorithm and programming, the applications of multi-media, the applications of web-based technology, data management system, artificial intelligence
PE and health	PE and health (11)	Series 1: balls, Series 2: gymnastics, Series 3: tracks, Series 4: sports of water and ice, Series 5: folk's sports, Series 6: newly-developing sports, Series 7: health education
art	Fine art (3)	Appreciation of fine art, drawing & sculpture, design & craft, calligraphy & carve, arts of modern media
	music (3)	Appreciation of music, sing, play, composition, music and dance, music and drama
	or art (6)	Art and the daily life, art and the emotions, art and cultures, art and sciences
Comprehensive Practice Activities	Investigative study (15), community services (2), social practices (6)	

## 2 Sample: New Structure for Physics in High schools

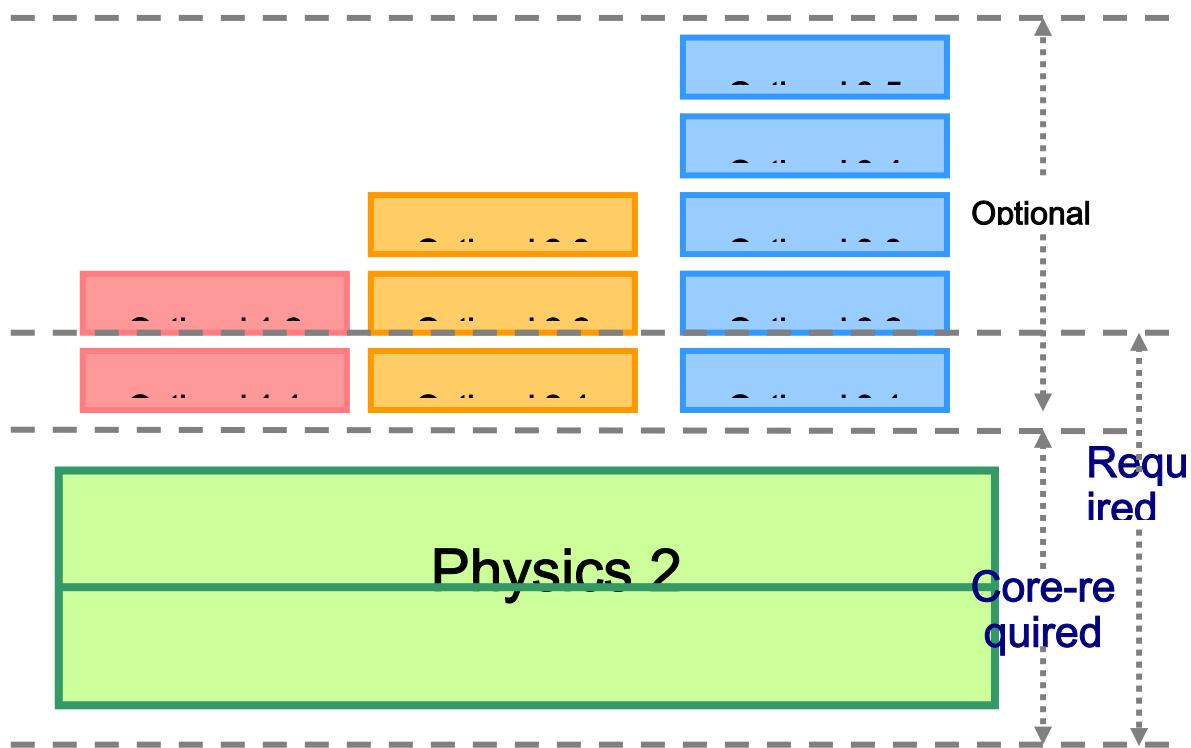
From above, we have knowledge on the new structure for the New Curriculum in the high schools, and each subject matter has the different structure constituted by different modules. We take Physics as example to elaborate the structure of the subject.

Physics in the New Curriculum composes two parts: required courses and optional courses in the attempt to emphasize the foundation and selection in the course design, which includes 12 modules, such as Physics 1, Physics2; Optional 1-1, Optional 1-2;

Optional 2-1, Optional 2-2, Optional 2-3; Optional 3-1, Optional 3-2, Optional 3-3, Optional 3-4, Optional 3-5, among them, Physics 1 and Physics 2 are core-required, and others are optional. Each module has two credits. Students get 4 credits after they finish the required modules, then, to get 6 required credits, students must take one module related to Physics 1 and Physics 2, therefore, students can only choose among Optional 1-1, Optional 2-1 and Optional 3-1, because these three modules are related with electromagnetics.

After students get 6 credits, they may take several optional modules to finish the required credits in the Learning Area of Sciences according to their interests, their potential development and careers in the future. These optional modules make the path for students to study further.

Figure 1 shows the structure of Physics in the high schools (1) <sup>2</sup>:



**Figure 1 Structure of Physics in the high schools**

Some further comments on Physics in the New Curriculum.

(1) Core- required Physics 1 and Physics 2 are designed for all the senior high

<sup>2</sup> Ministry of Education: Standards for the Subject of Physics in High schools (Experimental version), People's Education Publishing House, 2003.

students. Students have experience on the characteristics and methods employed in Physics through studying on the core contents and experiments such as principles of the object locomotion, inter-effect, power and so on, at the same time, students make the acknowledge on their interests and their potential development, and make their preparations for the further study.

(2) The selectivity of Physics not only has been reflected by the credits of the optional courses, but also by the required credits. Students get 4 credits after finishing the core-required course, then, students may get 2 more credits by taking either Optional 1-1, Optional 2-1 or Optional 3-1.

(3) After the completion of the required credits, students may choose the related contents as the further study in accordance with their interests, their potential development and the demands for the careers in the future. Teachers may guide students to choose the follow-up courses sequentially in the reference with figure of “the structure of Physics in the high schools”. It is acceptable if students make the leap in the choice of the optional courses based on their own situations.

(4) Physics, like the others’ subjects in the New Curriculum, is designed for most senior high students in the national level, so it concludes that Physics in the local level or the school-based Physics, e.g., “Experiments in Physics”, “Special Topics in Physics”, may be developed in the concrete situations in the intention for all students may develop soundly. Students may improve their experimental abilities, form their creativity, develop their abilities of self-study and self-research by taking courses in the different levels.

### **3 Samples for modules integration**

The integration of modules may guarantee the individual’s developments. In the New Curriculum, the module is the smallest unit when constructing the course structure, but each module has the comprehensive educational function, and the series in each module emphasize the different sides of the educational function. We take the module samples in Physics to deliberate the educational function by the integration of modules.

In the Course Structure of Physics, all each module has the conceptions, principles, experiments, physical thoughts, physical methods, Physics and the social development, Physics and the application of technology, Physics and the daily life, and

so on.

Physics 1 and Physics 2 are the core-required modules for all students, totally 4 credits. In these two core-required modules, students will learn the contents such as “describing motion”, “force and motion laws”, “mechanic energy and energy source”, “projectile motion and circular motion”, “achievement and limits of classical mechanisms”. By studying these contents, students experience the certain scientific exploration, and have the elementary knowledge on the characteristics of Physics and its methods, and experience the effects of Physics on the daily life and industrial production and society. Students may make the preparations for the follow-up studies. These two core-required modules make the stress on the scientific exploration and the physical experiments, highlight the physical methods and thoughts, emphasize the inter-effect between Physics and society, and pay attention to the integration of classical physics and modern physics.

Optional 1-1 and Optional 1-2 are called as Optional Series 1, totally 4 credits. The modules in this Series mainly focus on the key concepts of electromagnetics and calorifics, emphasize the relationship and the inter-effect between Physics and the society, highlight on the aspect of humanities in Physics, pay attention to the integration of Physics and the daily life, the social science and the humanities, stress the influence of Physics on the civilization. Students will learn “phenomena and principles of electromagnetics”, “technique of electromagnetics and the social development”, “the daily electronic utilities and the daily life” in the Optional 1-1; students will learn “phenomena and principles of calorifics”, “calorifics and the daily life”, “energy source and the social development” in the Optional 1-2.

Optional 2-1, Optional 2-2 and Optional 2-3 are called as Optional Series 2, totally 6 credits. The modules in this series reveal Physics from the perspective of the application, put the emphasis on the collaboration of Physics and technology, mainly focus on the application and practical use of Physics. Students will learn “electrocircuit and technicians”, “electromagnetic wave and the information technology” in Optional 2-1; students will learn “force and machine”, “heat and energetic machines” in Optional 2-2; in Optional 2-3, “light and optical instrument”, “atom structure and nuclear technology ”will be learned.

Optional Series 3 contains Optional 3-1, Optional 3-2, Optional 3-3, Optional 3-4 and Optional 3-5, totally 10 credits. The modules in this series stress the

fundamental knowledge in Physics, make the cognition on physical thoughts and methodology, let students be aware of the application of Physics and its influence on the economy and the society. Students will learn "electric field", "electric circuit", "magnetic field" in Optional 3-1 ; in Optional 3 – 2 , "electromagnetic induction", " Alternating current", "sensors" are mainly contained; in Optional 3–3, "theory of molecule motion and thought of statistics", "solid, liquid and gas", "thermodynamics laws and conversation of energy", "energy sources and sustainable development" will be learned ; in Optional 3 – 4 , "mechanical vibration", "electromagnetic shake and electromagnetic wave", "light", "the relativity" will be put forward to ; in Optional 3 – 5 , students will learn "collision and momentum conservation", "atomic structure", "nucleus", "the dual nature of both wave and particles".

The New Curriculum emphasizes on ideas of the improvement of the national quality, fundamental education for all and the foundation to students' lifelong study in nine year compulsory education. Based on these ideas and the principle of the student-based development, the New Curriculum underscores the fundamental contents for students' lifelong study, construct the relations of the social development, science advancement and students experiences, thus, the New Curriculum constructs the fundamental, diversified, leveled and comprehensive course structure aiming at meeting the demands of the society and students' all-round an individualistic development.