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FOREWORD

China's physics education reform in the new century:

Opportunities and challenges

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Executive Summary

The education theory, curriculum and practice around the world have undergone several waves of change. In China, the most recent curriculum reform of basic education began with the National Congress of Education held by the Chinese Central Government at the beginning of this century after a long period of preparation and review. It offers tremendous opportunities for physics education reform in response to the new economic context of China, and also faces new challenges.

Starting from 1980s up to the 21st century, there are many new ideas and methods emerging in the physics education field and the quality and effectiveness of the classroom instruction have improved so much because of the advancement in the modern information and experimental technology.

This change inevitably called for a relevant rectification of the old physics educational system which is facing various challenges. Hence, it is crucially important to know about the responses to the challenges, problems in practice, and commitment for taking up the responsibility in the future.

In some sense, the next stage of China's curriculum reform in physics education will largely depend on the theoretical base founded by the empirical research and it will take into practice gradually. Therefore, the current state of physics education and of its processes of development and practices are outlined together with the main future trends and challenges.

To depict the developmental process in China's physics education, it is necessary to go back to the "discipline pedagogy" in the early 1920s in normal schools, and which has then been retitled as a curriculum for "discipline teaching methods". Up to now, it has evolved through several developmental periods: Firstly, the text book and instruction period, i.e. "textbook and instruction methods", "discipline instruction methods" or "discipline teaching methods" in 1950's. Secondly, the discipline instruction period since 1980, under the guidance of instructional theory, established disciplinary instructional theory, called "physics instruction theory" which was a great leap in the theoretical basis. Thirdly, many research workers explored the direction of physics education since 1990. They established basic theoretical framework on physics education which includes the aims and objectives of discipline education, personal ability standards, subject curriculum, teaching and learning, modern technology in discipline education, subject-specific assessment.

Focusing on China's physics education as pilotted in practice, the reform in the recent years is being carried out on the side of ideas and paradigm for curriculum and instruction design which influence most of the physics education models in practice. The traditional linear, closed curriculum and instructional framework is being queried, and it is being replaced by some new multi-perspective and multi-dimensional curriculum and instructional design which focuses on students' autonomous learning.

Some concrete ideas of the new physics curriculum are given as follows (with examples taken from Shanghai):

- Enhancement of students' basic scientific literacy in general with reference to the students' development, ;

- Emphasis on the process of scientific investigation and the training on the spirit of creativity and practical ability;
- Stressing on the interrelationship of Science-Technology-Society for promoting the integration of science and humanity;
- Increasing the choice of education, so that the students' learning will be, to a greater extent, based on individual needs and diversity of learning ability;
- Allowing multivariate approaches on learning, training and assessment for strengthening students' autonomous learning ability.

In general, the challenges of migration and transformation of educational practice and theory in physics education, redevelopment of the mechanisms of physics education research, emphasise on teacher professional development, and so on are taken into account throughout this paper. Furthermore, several aspects of physics education in China have been discussed, to wit, (i) the fundamental questions of physics education research, (ii) how to establish a sustainable development mechanism for physics education research, (iii) the current problems in physics teaching and science education, (iv) how to carry out the frontier study on physics education. Some of those questions still remain to be properly addressed.

Finally, it is noteworthy to mention that there are more and more research groups on physics education research being formed from the graduates and research students of master degree or doctorate degree programs in physics education as offered by some key universities in China and this is expected to become the major thrust for the continuing development of physics education research.