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ICPE Chair's Corner

Women in Physics are a special interest group in any country. All of us at the commission have been concerned about the global need for enhancing women's participation in Physics. To flag the issue, the IUPAP Working Group on Women in Physics, organized the *First International Conference on Women in Physics* in Paris in March 2002 and subsequently a second in Rio de Janeiro in May 2005. The deliberations and the recommendations of these conferences have catalyzed several countries to initiate policy-level changes aimed at promoting the recruitment, retention and advancement of women in physics. The proceedings can be accessed from the IUPAP web site:

<http://www.iupap.org/wg/wip/index.html>

Irrespective of gender, physics is viewed by many students as daunting. The problem is more severe for women and begins early. It is important to catch them young, while still at school. It is essential to overcome stereotypes and create experiences that communicate the joys of discovery and inculcate a sense of achievement. Students can be led to recognize that one does not have to be a genius to build a successful career and contribute creatively to the domain.

All this is easier said than realized. Evidence shows there is a distinct attenuation in the confidence and motivation of women in physics at each level. The underpinning reasons are culturally determined and vary from region to region, but it is a global constant that special intervention programs are needed at all levels. As physics educators, we need to develop pedagogies, research-based curricula and extramural experiences that aim at building gender and race equity in physics at all levels.

We need to launch, both large-scale outreach programs and sharply focused, small group programs which nurture talent and build capacity. Mentoring and networking has to begin early and continue at all levels. As women move up the ladder, they require greater institutional support, a laboratory or research group of their own, leadership training and of course, greater visibility. The world can only gain from the women's ways of knowing and looking at science.

It is not just path breaking research at the frontiers that matters. Invariably, it is the work of many that makes for a discovery. The world is full of problems awaiting

innovative solutions and application of what is well known. The upcoming conference *ICPE 2007* at Marrakech, titled *Building Careers with Physics*, will provide us an opportunity to take a panoramic view on the diverse areas of human enterprise where training in physics is crucial. We seek presentations that highlight how the physicists' way of looking at things can enrich a wide spectrum of domains and change their landscape. The conference will also provide a forum to review the research on physics education, share examples of how best to attract students and stop the flight of talent from physics, of men and women at all levels. This indeed is the over-whelming problem most countries face today. It is the discerning classroom that will shape the future.

Pratibha Jolly

Pratibha Jolly, ICPE Chair, Delhi

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ICPE 2007, Marrakech

International Conference on Physics Education

Building Careers with Physics

November 11-16, 2007, Marrakech, Morocco

As first announced in the ICPE Newsletter 52, the *International Conference on Physics Education* (ICPE2007) will be hosted by the Cadi Ayyad University in Marrakech, Morocco from November 11 to 16, 2007. ICPE2007 is organized in collaboration with the Tunisian Society of Optics and the Moroccan Society of Applied Physics which has been recently created.

The conference will focus particularly on Building Careers with Physics with the following main topics highlighted:

- A – New Job Opportunities
- B – Effective Teaching Strategies
- C – Learning with Technology
- D – Physics for Sustainable Development
- E – Bridging the Gaps
- F – Women and Girls in Physics

The scientific program aims at presenting these issues in plenary lectures, workshops, contributed papers, posters and panel discussions.

Given the significant role of the International Commission on Physics Education through the world, ICPE2007 will provide the driving force needed to introduce new job-oriented curricula in physics which are highly solicited.

June 30, 2007 is the extended deadline for papers and abstracts submissions. You are cordially invited to submit your works before this deadline. The preliminary list of invited speakers is now available. More details regarding ICPE2007 and online registration can be found in the new conference web site at:

<http://www.icpe2007.org>

The support of the conference is largely provided by the International Union of Pure and Applied Physics

(IUPAP). Participants from developing countries are invited to contact the organizing committee for an eventual support that will be provided by other national and international organizations (e.g., UNESCO, EPS, ICTP, CNRST, AUF). These grants are destined to promote participation from these countries. An application form for requesting financial support can be downloaded from the conference web site.

The conference will be held in the charming city of Marrakech which is located in the south central part of Morocco (40km from the majestic and picturesque High Atlas Mountains). It is the second largest city of Morocco with 1.5 million inhabitants and the tourist pearl of the country. Marrakech offers a rich historical and cultural heritage. Jamaa El Fna square, the heart of the old city is a melting pot of centuries-old cultural heritage and open-air gastronomy. At night the square offers various spectacles and shows (snake charmers, story tellers, acrobats, musicians, etc.) as well as delicious and diversified

Moroccan food. Numerous monuments (Koutobia minaret, Badii Palas, Saadienne tombs, Bahia Palace, Benyoussef Medersa, Menara gardens etc.) still testify of the glorious days that this imperial city.

We look forward to welcoming you in Marrakech.

For any questions regarding papers, posters, and

symposia, please contact the Organizing Secretariat.

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Global Concerns and Local Initiatives in Selected Physics Teacher Education Programs

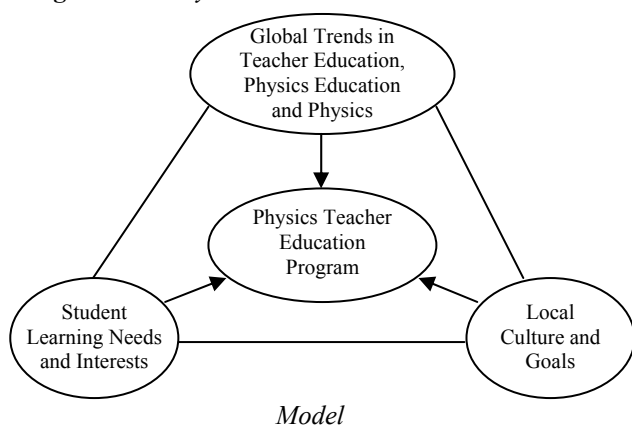
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Introduction

Academic program review or curriculum revision is a continuing, multi-faceted, multi-variable undertaking [1,2]. Figure 1 shows a curriculum model for physics teacher education. It involves the interactions and synergy of key variables — global trends in teacher education, physics education, and physics; student learning needs and interests; and local culture and goals — to produce a physics teacher education program.

Figure 1. A Physics Teacher Education Curriculum



This paper focuses on global trends in teacher education and physics education. The study was a project of the International Commission on Physics Education (ICPE), and it presents the results of a survey on physics undergraduate teacher education programs in selected institutions in six countries. Four research questions were posed to the participating universities.

1. What is the institutional profile in terms of the population of physics education students, faculty size, and student-faculty ratio?

2. What are common and distinctive program characteristics and courses?
3. What global concerns are indicated in the program characteristics and courses?
4. What are some local initiatives in terms of distinctive program characteristics and courses?

Methodology

The study used descriptive survey design, purposive sampling, and questionnaire as a common instrument. The six participating universities in six countries are: Instituto de Fisica, Universidade de São Paulo, Brazil; Guangxi Normal University, Guilin, China; Faculty of Mathematics, Physics, Science, University of Napoli, Federico II, Italy; Faculty of Education and Human Sciences, Niigata University, Japan; The Stockholm Institute of Education, Sweden; and College of Education, University of the Philippines, Philippines.

Data were collected in the academic year 2005–2006. Qualitative data analysis procedures were used: content analysis of the teacher education programs and cluster evaluation involving multiple program models in multiple sites [3].

Results and discussion

Institutional Profile

The university with the largest education student population was Guangxi Normal University with 13,526 students (Table 1), while Universidade de São Paulo had the fewest education students (264). Table 2 shows a small percentage of education students who majored in physics education, from 0.3% in the Stockholm Institute of Education to 10% in University of Napoli. The ratio, however, of physics education faculty to physics education students appears manageable, ranging from 1:11 in University of the Philippines to 1:20 in Universidade de São Paulo (Table 2).

Table 1. Education Student Population and Faculty Size

University and Country	Number of Education Students	Number of Education Faculty Members
Universidade de São Paulo, Brazil	264	2
Guangxi Normal University, China	13,526	1,051
University of Napoli, Italy	2,000	0*
Niigata University, Japan	1,610	120
Stockholm Institute of Education, Sweden	7,000	20
University of the Philippines, Philippines	2,171	49

*300 science faculty

Table 2. Physics Education Student Population and Faculty Size*

University	Number of Physics Education Students	% Physics Education Students	Physics Education Faculty Size	Physics Education Faculty/Student Ratio
Universidade de São Paulo	14	5	1	1:14
University of Napoli	200	10	17	1:12
Stockholm Institute of Education	20	0.3	1	1:20
University of the Philippines	22	1	2	1:11

* no data from other participating universities

Program Characteristics

All the programs are intended for secondary school physics teaching. Each program has education courses, content courses, (physics and mathematics), and physics education courses. At least one physics education course integrates physics content and teaching methods. Practice teaching in schools is required in all the programs.

Distinctive program characteristics include the four year evening program of the Universidade de São Paulo. University of Napoli offers a two year post-university program. The programs at Universidade de São Paulo and University of the Philippines involve other colleges. For example, Filipino students take physics courses at the National Institute of Physics and take their general education courses from different units of the university.

Program Philosophy and Objectives

A distinct institutional philosophy is that of the College of Education, University of the Philippines, to wit: Education is the uncompromising commitment to the notions and values of intellectual liberation, independence, responsibility and challenge to attain what is true and noble. The philosophy of the Faculty of Education, University of Tokyo, underscores constant human growth through social experience and cultural

interactions [4]. The University of Napoli, has the following distinctive program objectives:

1. to require teachers to participate in construction of knowledge; and
2. to take into account, whenever possible, common sense knowledge.

Guangxi Normal University stresses educational technology and teacher’s professional morality in the following program objectives:

1. to master modern educational technology, especially multimedia and internet educational technology, and have the abilities of using them; and
2. to be acquainted with educational laws, to grasp and use basic theories of pedagogy and psychology, have a good teacher’s professional morality, and basic ability of teaching physics.

In line with students’ mastering modern educational technology, one recent program innovation in Guangxi Normal University is a special laboratory to promote students’ involvement in developing educational resources.

Program Courses

Table 3 lists some local initiatives in terms of distinctive program courses in the participating universities.

Table 3. Distinctive Program Courses

University	Course
Stockholm Institute of Education	Pedagogical Content Knowledge in Physics Pedagogical Content Knowledge in another Subject Area (student’s choice)
University of Napoli	Pedagogical/Didactic Laboratories History and Epistemology of Science
Niigata University	Health and Sports Special Lecture in IT-Based Science Education
University of the Philippines	Pedestrian Physics Mathematics for Physics Teachers
Guangxi Normal University	Microteaching of Secondary School Physics Physics Education Research
Universidade de São Paulo	<i>Estrutura de Matéria, Estrutura e Funcionamento do Ensino Fundamental e Média</i>

Table 4. Number of Hours of Practice Teaching

Universidade de São Paulo	Niigata University	University of the Philippines	Stockholm Institute of Education	Guangxi National University	University of Napoli
600	560	420	400	320	300

Table 5. Distinctive Global Concerns of Programs

University	Distinctive Global Concerns of Program
University of Napoli	Multicultural education
Niigata University, University of the Philippines	Lifelong education
Niigata University	Interdisciplinary research
Universidade de São Paulo	Education for Working Students
Niigata University, University of Napoli, University of the Philippines, Guangxi Normal University	Information Technology Integration in Teaching
University of Napoli, University of the Philippines	Constructivist Teaching
Guangxi Normal University, University of the Philippines	Values Education for Teachers

Undergraduate student research is required in Guangxi Normal University and Niigata University but not in the University of the Philippines. On the other hand, a teacher’s licensure examination for graduates is required in the Philippines but not in China and Japan.

Global Concerns

Age-old, common global concerns in the six programs are development of competent secondary school teachers, creation of knowledge (research), critical inquiry, and integration of theory & practice. Indicated in Table 5 are distinctive global concerns of the programs.

The concern in Niigata University for lifelong education is shared by the physics teacher education program in University of Tokyo where a course is offered on Theory of Lifelong Learning and in University of South Africa which has a course on Educational Research and Lifelong Learning [4]. Information technology integration in teaching is a global concern indicated in four programs (Table 5), also practiced in Kagawa University, Seoul National University and University of South Africa [4].

Conclusion

Age-old and recent global concerns are reflected in program objectives and courses. Course description, course syllabi, and the teaching itself need to be examined to determine how global concerns are specifically addressed and to identify other global concerns, which include sustainable development, gender issues, peace education, integrative approaches, multiple intelligences, differentiated teaching, learning in context (other forms such as daily life, community and environmental), and functional physics literacy. Additional global concerns that were not indicated in the data are physics-related developments like robotics and nanotechnology.

Global concerns and local initiatives, as shown by distinctive program characteristics and courses, reflect

changes in student learning needs and interests. For example, technology integration in teaching is increasingly needed to keep up with students’ easy access to worldwide information national development goals are informed and changed by international trends like lifelong learning. Interactions among key variables of academic program review (Figure 1) make continuing benchmarking of programs with those of other universities and countries a necessity in the global village.

Acknowledgements

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ICPE 2006 Tokyo Conference

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The International Conference of Physics Education was held from the August 13 – 18, 2006 at the National Olympic Memorial Youth Center in Tokyo on the topic *Toward Development of Physics for All*. This conference was officially supported by IUPAP/ICPE, and was the second international conference on physics education held in Japan since 1986. The organizing committee was chaired by Professor Toshio Hyodo of the University of Tokyo. Professor Akira Akabane of Saitama Medical School was chair of program committee and Mr. Hiroshi Masuko of Azabu high school the general secretary.

The total number of participants was 415 from various countries. This number was far beyond expectations. Numbers of participants and their countries were as follows: Japan, 308; Korea, 20; China, 17; India, 11; Pakistan, 11; USA, 9; Brazil, 7; Philippines, 6; UK, 5; Italy, 3; Mexico, 3; Finland, 2; Malaysia, 2; Australia, Belgium, Czech Republic, Columbia, France, Germany, Iran, Kenya, South Africa, Sri Lanka, Thailand, 1 each.

The main program

The program consisted of one special lecture and eight plenary lectures, several oral sessions each with five to six presentations, poster sessions in three rooms, various workshops and two demonstrations of hands-on experiments.

The special lecture was given by Dr. Akira Tonomura from Hitachi Co. with a title *Electron Wave Unveil the Microcosmos – Reenactment of Friday Evening Discourse*. The titles of the plenary lectures were follows:

- *The New Direction of Research on Undergraduate Physics Education*, Edward J. Redish (USA);
- *Research-based Support to Teachers for Teaching of Inquiry-based Science in New National Curriculum in China*, Xingkai Luo (China);
- *Key Points of Physics Education for Everyone*, Hiroshi Kawakatsu (Japan);
- *Professional Development of Physics Teachers in Developing Countries*, Diane Grayson (South Africa);
- *Physics Curriculum Development in the UK: Context-led Physics for all?* Elizabeth Swinbank (UK);
- *Physics Teacher Education Program: Perspectives, Global Concerns and Local Initiatives*, Vivian Talisayon (Philippines);
- *Development of Conceptual Understanding in Physics*, Priscilla W. Laws (USA); and
- *Physics Education for Future*, Jon Ogborn (UK).

Three oral sessions of 90 minutes were held on the first and third days, with five parallel strands, i.e. Curriculum,

Teachers Training, Teaching Materials and Teaching Process, Popularization, and Other topics. The majority of presentations were in the strand Teaching Material and Teaching Process. A poster session of 110 minutes was held in the evening of the first day of the conference. Three rooms were provided for 139 presentations. One room was reserved for posters with demonstration and hands-on experiments.

Workshops of various subjects were held on the second and fourth days. The subjects of the workshops were the same as those of oral sessions. However, organization of each workshop was entrusted to workshop organizers; and held in various styles; e.g. symposium, discussion, etc.

Teachers' session

The teachers' session was the first workshop of this kind in the ICPE Conference. The participants of the workshop were school teachers from Japan, Brazil, and Korea. Exchange of their experiences in the physics education field was very fruitful. They discussed establishing an international network among school teachers.

Demonstrations of hands-on experiments were organized by Japanese participants. Stray Cats, a group from Kagawa University, and Lady Cats, composed of female teachers and researchers, demonstrated various experiments.

The presentation ceremony of the ICPE Medal to Professor Jon Ogborn of the Institute of Education, University of London was held before the conference banquet. The medal was presented from Professor Pratibha Jolly, Chair of ICPE. The photograph of the ceremony appeared in the preceding issue of ICPE Newsletter.

The Science Show for Youth was held in the last day as an attached program of the conference. The show was organized by Galileo Workshop headed by Professor Yoji Takikawa.

Many professors of Japanese universities and technical colleges participated in this conference. This is most important, and it was not the case in the former conference of 20 years ago. In 20 years the environment of physics education in Japanese universities and technical schools has changed drastically, and professors are becoming conscious of the importance of physics education. It is certain that this conference will have a tremendous influence on Japanese physics education research. Proceedings of the conference is planned to be published in this year. For further information see the web site:

<http://www.komed.c.u-tokyo.ac.jp/ICPE2006/>

GIREP Conference Modeling in Physics and Physics Education Amsterdam, August 20 – 25, 2006

Ed van den Berg en Ton Ellermeijer
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Some 260 physicists, physics educators, and teachers from over 40 countries attended the Amsterdam Conference to remodel their thoughts on *Modeling in Physics and Physics Education*. Together they presented 125 papers, 90 posters, 11 workshops, and 12 plenary lectures.

Models and modeling take on different meanings in physics education. The activity of practicing physicists is centered around the development, testing, and application of mathematical models for physical phenomena (Hestenes). Modeling in physics can also be seen as creating ‘artificial worlds’ to give insight into how real systems work, and to predict what they might do (Ogborn). Teaching models can be mainly conceptual and qualitative, or they can be mathematical. With the current state of ICT, even quite complex and realistic models can enter the classroom through *Excel* spreadsheets, or modeling programs like *Insight*, *Stella*, *Coach* and *Modellus*.

Over the past 20 years, there has been much R&D both in conceptual modeling and quantitative modeling. In his opening lecture David Hestenes took us at lightning speed through what we know now about how conceptual models develop in student brains and how to promote such development. He considers that mathematical modeling of the physical world should be the central theme of physics instruction and he has defined a small number of basic models, which can represent most of high school physics.

Hans Fuchs, who teaches physics to engineers, distinguishes a limited number of basic models differently:

First, we have to agree on which physical quantities we are going to use as the fundamental or primitive ones; on their basis other quantities are defined, and laws are expressed with their help. Second, there are the fundamental laws of balance of the quantities, which are exchanged in processes, such as momentum, charge, or amount of substance. Third, we need particular laws governing the behavior of, or distinguishing between, different bodies. Last but not least, we need a means of relating different types of physical phenomena. For this we use the energy principle, i.e., the law which expresses our belief that there is a conserved quantity which appears in all phenomena, and which has a particular relationship with each of the types of processes.

Teodoro takes issue with this ‘system dynamics’ modeling based on the ‘flux, flow, and stock metaphor’ which originated outside physics and becomes problematic when rates of change depend on other rates of change. Lijnse argued that progress with respect to modeling on the pedagogical front has been very limited.

He quoted a 2005 paper by Schwarz and White stating that:

There is ample evidence indicating that students may not understand the nature of models or the process of modeling even when they are engaged in creating and revising models. ...Furthermore, teaching students about the nature of models and the process of modeling has proven to be difficult. Direct efforts at improving modeling knowledge have met with limited success

This problem applies to both secondary and university students. Many speakers and poster presenters gave their own solutions to this problem. However, one can also consider modeling as a tool that students must get used to just like many of us have gotten used to the techniques of applying quantum mechanics before gaining any understanding. Furthermore, if modeling is integrated with experimental work, students may slowly develop a practical view of the possibilities and limitations of modeling. Rogers, Lawrence, and Mikelskis provided snapshots of how modeling is used in real classrooms starting at lower secondary. Modeling is there to stay, but it takes time and will require us to omit some topics from the curriculum!

In their summary, Zollman and Kuehnelt compared modeling in physics education with nuclear fusion research. Both have great promise, both have shown successes in lab experiments. However, realization of this potential on a larger scale is still problematic. Zollman also emphasized that teaching should point out where a model goes wrong and every model goes wrong somewhere. The analogy with models of the nucleus is interesting. The shell model, the liquid drop model, the optical model, and the many body model all have features that are clearly wrong, yet these models have been very useful in physics. In teaching modeling we should pay attention to:

- what has been omitted from the model;
- why the model may be useful anyway;
- what the model and its limitations tell us; and
- where the model fails/succeeds.

For further information regarding the 2006 GIREP conference, see www.girep2006.nl. There you can find the slides and papers of the plenary sessions. Before mid 2007 we will also add the edited proceedings.

If you would like to be kept informed about GIREP activities including the 2007 Seminar in Croatia and the 2008 Conference in Cyprus, please register at: www.girep2006.nl and we will put you on the email list. For general information about GIREP see:

<http://www.girep.org>



The role of ASPEN in promoting active learning methods in physics in Asia

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The Asian Physics Education Network (ASPEN), was established in 1981 on a recommendation by the UNSECO, in order to contribute towards the overall development of university Physics Education in the Asian region. During the first phase of ASPEN activities, this has been achieved largely by implementing projects with the support of UNESCO and other organizations, on development of equipment, curriculum and text books, audio visual material, and research and evaluation on a national, regional and international level.

However, over the past several years, the emphasis by the ASPEN has been towards organizing 'Active Learning Workshops (ALWs)' in different countries in the region aimed at familiarizing Asian Physics educators with the latest active learning methods. A main emphasis has been to train a group of local resource personnel, wherever possible, in order to promote and disseminate active learning ideas of teaching Physics to effectively improve Physics Education in the region.

The following activities have been organized by ASPEN during the last several years:

- Active Learning Workshop on Physics Education at Kagawa University, Takematsu, Japan, 9 – 12 August 2006.
- Active Learning Workshop on Physics Education in Karachchi, Pakistan, 24 – 29 November 2004.
- Fact finding mission to the Department of Physics at the Royal University of Phnom Penh, Cambodia by a three-member ASPEN team 22 – 26 April, 2003.
- ASPEN 4th GA and the Regional Workshop on *Active Learning Methods in Physics*, University of Peradeniya, Sri Lanka, 30 November – 5 December 2002.
- ASPEN Workshop on Physics Education at National University of Laos PDR, 30 October – 2 November 2001.

- ASPEN Trainers Workshop on *Interactive Physics Teaching*, Ateneo De Manila University, Quezon City, Manila, Philippines, February 2001.
- National Workshop on *Computer-based Interactive Methods of Physics Teaching* at University of Peradeniya, Sri Lanka, organized and run only with ASPEN resource persons and local staff, February 2001.
- Seminar-Workshop on *Multimedia Physics Education: Promoting Active Learning in Introductory Physics Course*, Chonbuk National University, Chonju, Korea, 9 – 15 July 2000.
- UNESCO-ASPEN Meeting on UUFCEP Asia 2000 Review and Strategic Planning Meeting for the UNESCO University Foundation Course in Physics (UUFCEP), Chulalongkorn University, Bangkok, Thailand, 17 – 22 November 1999.
- ASPEN Workshop on Physics Demonstrations and Classroom Innovations, National University of Hanoi, Hanoi, Vietnam, 11 – 14 November 1999.
- ASPEN Workshop on Physics Curriculum Design and Content, National University of Laos, Vientiane, Laos PDR, 23 – 26 February 1999.
- NSF *Chautauqua* Workshop on Promoting Active Learning in Physics Education, Swinburne University, Melbourne, Australia, 27 – 29 January 1999. 11 ASPEN participants were funded for this workshop.

ASPEN participation in other national, regional and international meetings:

- KPS Workshop on *IT based Physics Education*, Chonbuk National University, Chonju, Korea, 12 – 16 July 2001.
- International Conference on *Physics Education in Cultural Context*, KNUE, Cheongwon, S. Korea, August 2001
- National Seminar and Workshop on *Multimedia Approach in Learning Physics and Engineering*, SMILE 2001, Universiti Tenaga Nasional, Kajang, Selangor, Malaysia, June 2001.

- ASPEN Malaysia 2000: Seminar and Workshop on *Smart Approach in Physics Education*, University of Penang, Malaysia, 28 – 31 March 2000.

Other ASPEN Activities:

- *Virtual Physics* Lecture Demonstration Video Clips Vol. 1, PC/MAC CD-ROM, containing 25 high resolution video clips, 2002.
- Preparation and publication of UUFPC-based physics education material in electronic form on a WWW platform, 2000.
- Development and maintenance of ASPEN web page.

The above activities were supported to a large extent by UNESCO, Jakarta office. ASPEN has an important role to play in initiating and assessing the development of physics education reforms in the Asian region. A successful model has been developed around the concept of 'Local Active Learning Workshops' using ASPEN

trained resource personnel wherever possible. This model needs to be fine tuned via careful and quantitative assessment so that the work we do is efficient and effective in improving physics education in developed and developing countries in our region.

The ASPEN community has a proud history of cooperation in Physics education activities regardless of race, religion or culture. Hopefully, our continued work in ASPEN will help, if only in a small way, to show what can be achieved in our region with goodwill and respect.

Acknowledgements

We wish to thank to Dr. Minella Alarcon of UNESCO, for her support, assistance and continuing interest in promoting Physics Education activities in the Asian region.

UNESCO Workshops on Active Learning in Optics and Photonics (ALOP)

Within the framework of the UNESCO mandate in physics education promoting active learning in introductory university physics, the project *Active Learning in Optics and Photonics* (ALOP) provides a focus on an experimental area that is relevant and adaptable to educational conditions in many developing countries. Project ALOP aims to better equip university and high school teachers to teach optics in the introductory physics course. Teachers are trained through intensive workshops that illustrate the pedagogy of active learning through carefully crafted learning sequences that integrate concept questions and mentally engaging hands-on activities.

Project ALOP aims to better equip university and high school teachers to teach optics in the introductory physics course. Teachers are trained through intensive workshops that illustrate the pedagogy of active learning through carefully crafted learning sequences that integrate concept questions and mentally engaging hands-on activities. It is hoped that this exposure would foster better understanding and appreciation of optics, improve laboratory practice and promote the use of active learning and hands-on techniques in actual classrooms. Inasmuch as Optics and Photonics is also an area of interest to industry and critical for sustainable development, innovations in teaching of optics and photonics would enhance the quality of human capital and impact local research activities and development in the field.

UNESCO has organized a series of workshops to address the situation in university physics teaching in many countries, especially the developing world. The aims of these workshops are to bring together teacher participants

from the region and establish a consortium for furthering the use of innovative teaching-learning strategies in physics classrooms. Specifically, the workshops aim to:

- share and compare information about existing practices in teaching of optics in introductory physics courses in colleges and universities;
- provide hands-on experience in the use of the active learning method in optics and photonics, including the use of experiments, interactive lecture demonstrations, class and group discussions, and conceptual evaluation; and
- encourage the use innovative techniques in teaching of physics in general, and optics and photonics in particular.

The first three workshops were held at: University of Cape Coast, Ghana (November, 2004); IPEIM Monastir, Tunisia (March, 2005); and Cadi Ayyad University, Morocco (April, 2006). The latest workshop, and the next two, were/will be held at:

- University of Delhi, India, 6–11 November, 2006, <http://www.mirandahouse.ac.in/alopasia2006/>;
- University of Dar es Salaam, Tanzania, 5–10 July, 2007, <http://www.edu.udsm.ac.tz/physics/>; and
- University of São Paulo, Brazil, 22–27 July, 2007 <http://www.alop-sp-2007.fe.usp.br/>.

Preparations are underway for organizing the fifth workshop for physics teachers in Latin America.

Physics Education in Korea

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Introduction

Korea is located in the eastern section of the Asian continent. The total land area of South Korea is about 110,000 square kilometres and the population is 48 million. Thus the population density is approximately 476 persons per square kilometre, which is among the highest in the world. As of 2002 per capita GNI of Korea is \$10,013. Semi-conductors, iron and steel, ship building, automobiles and machinery are the main exports. Recently, the information technology industry has grown and the broad band internet is widely used.

Many people believe that education has, up to now, been the major source of trained manpower in various fields, especially science and engineering. But recently the decline in the numbers of science and engineering major students, and fall-off in their quality are considered to be big problems.

School Physics

Korea has a single track 6-3-3-4 system which maintains a single line of school level. To ensure the standard quality of education, the national curriculum

for each school level is prescribed by law, as are the criteria for development of textbooks and instructional materials. The national curriculum is revised on a periodic basis and the 7th curriculum was revised in 1997 following the principles of enriching elementary and basic education, increasing self-directed ability and increasing autonomy at the local school level.

The 7th curriculum introduces ten basic common subjects, autonomous activities, and special activities that cover the ten years from the first year of elementary school through the first year of high school. As a result, all students take science lessons three times a week up to grade ten. Elective subjects are introduced for the final two years of high school and physics I/II, chemistry I/II, biology I/II, and earth science I/II are provided as elective subjects. Science and engineering track students enroll in at least two of them. Physics is not the most popular science subject as shown by Table 1. In 2005, only 18 % of the all students took physics at the level of the *Mock College Scholastic Ability Test*.

Table 1. Physics I and II taking at *Mock College Scholastic Ability Test 2005* (unit: %)

subject level	Percentage of the total examinees (N=533,625)				Percentage of the examinees who take science subjects (N=179,057)			
	Physics	Chemistry	Biology	Earth science	Physics	Chemistry	Biology	Earth science
I	18	30	29	17	55	90	86	50
II	4	13	11	3	12	39	32	8

According to the Third International Mathematics and Science Study (TIMSS-R) and the Program for International Student Assessment (PISA) studies, the average achievement of Korea seems superficially to be good (Table 2). But internally, several problems, remain — such as low percentage and low score of upper 5 % group, the biggest gender difference, and low score of affective domains are found.

Recently, WISE (Women in Science and Engineering) was launched to promote the girls' taking the science

and engineering tracks. And large scale of promotions like modernizing laboratories, improving physics textbooks, and scientific cultural events are being organized. Also some encouraging results in international competitions, such as Physics Olympiad and the International Young Physicists' Tournament (IYPT), have been noted. But on the other hand, the industry is still complaining the fall-off of manpower quality, and it is regarded as serious for the next generation's economy.

Table 2. Rank of Korea in the TIMSS-R and PISA studies

International study	Year	Target	Number of countries	Rank of Korea for Average Achievement	Rank of Korea for the upper 5 %	Rank of Korea for gender difference
TIMSS-R	1999	Grade 8	38	5	9	1
PISA	2000	Grade 10	31	1	5	1

New trends in Physics Education

Among many approaches to boost the number of students who take science and engineering track and raise the quality of achievements in physics, two featured enterprises will be introduced — scientific exploration at cultural sites and Microcomputer-Based-Laboratories (MBL).

Physics Education in a cultural context

Scientific explorations at cultural sites, such as the old palace, the world cup stadium, the world cultural heritage, and museums have been developed and researched actively from the year of 1998, when the first APEC Youth Science Festival was held. At that time, scientific exploration programs at Changdukgyung palace, Celadon village, a Korean folk village and the old printing museum were developed and evaluated as unique programs during the first APEC Youth Science Festival.



Figure 1. High school students discuss sundials at King Sejong's tomb

After that, programs for various other sites have been developed and many researchers have suggested that scientific exploration at cultural sites would give students a chance to do a real science and explore how science originated in Western culture and in Korea.

An example is the scientific exploration at National Folk Museum, located in downtown Seoul, which exhibits more than 7,000 collections of highlights of cultural heritages, and artifacts for everyday life. Because of its large number of collections, students and

teachers can choose their own favourite exhibitions to work with. Thus students can explore the collections according to their own abilities and interests.

In particular, at the National Folk Museum, many models and miniatures are exhibited to show the process of making metal arts, celadon and handcrafts. Also, old instruments such as the tread mill, snow shoes, sun dials, pottery stills and so on, can show how the physical principles can be applied directly (as opposed to modern instruments which often look like black boxes). But most of the exhibitions may not be touched, so activities at the museum are restricted to estimation and observation. Also, new generations of students are often unacquainted with the collections, and they might not be interested and feel difficulties in following up their own inquiry problems.



Figure 2. Dr Yu explains the pitches of pipes of various lengths at the National Folk Museum



Figure 3. An exhibition at the National Folk Museum shows the process of making celadon

A group of physics educators, led by Emeritus Professor Sungjae Pak at Seoul National University, have been developing guidebooks for students and science teachers. As the result of discussions, and their own researches, a primitive teaching model has been developed which is regarded as a proper approach to the scientific exploration at cultural sites.



Figure 4. A treadmill demonstrates the physics of levers directly

Microcomputer-based laboratories



Figure 5. MBL at Chuncheon National University of Education

The Korean government and other opinion leaders are expressing concerns about the fall-off in science and engineering major students since 2001. Physicists especially are worried about the radical fall-off in physics major students. One way to boost the number of science and engineering major students is to improve school science education and modernize the school science and physics laboratories. MBL is one of the keywords and many pre-service and in-service teacher training courses are adapted MBL experiments. Especially, sound related experiments are getting popular with MBL.



Figure 6. Middle school students doing experiments using MBL equipment

Also the Korea Science Foundation has held a nation wide competition for middle school students and high school students, in which participants perform scientific inquiry experiments using computers.

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